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Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for the G-Area Oil Seepage Basin (GOSB) (U)

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SAVANNAH RIVER SITE • AIKEN, SOUTH CAROLINA

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Aiken, South Carolina

EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation Report (RI) with Baseline Risk Assessment (BRA) and Corrective Measures Study (CMS)/Feasibility Study (FS) has been prepared for the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU) located at Savannah River Site (SRS) in Aiken, South Carolina (Figure ES-1). This combined document incorporates elements of two typically stand-alone documents – the RFI/RI Report with BRA and the CMS/FS. A core team of representatives from the United States Department of Energy (USDOE), the U.S. Environmental Protection Agency (USEPA), and the South Carolina Department of Health and Environmental Control (SCDHEC) agreed to this combined and accelerated strategy for the GOSB OU.

This document presents a summary of data collected for development of the RFI/RI/BRA/CMS/FS, describes the nature and extent of contamination, provides an assessment of the potential risk to human health and ecological receptors, identifies remedial action objectives (RAOs), and evaluates potential remedial alternatives for the GOSB OU.

The GOSB was initially used for liquid waste disposal during SRS plant construction (1951-1956) and later for receipt of effluent from sanitary wastewater treatment plants in Central Shops. The basin may have received unknown liquid waste from the time of plant construction until the early 1960s. However, there are no records indicating that disposal of radioactive or hazardous materials at the GOSB occurred. The basin received effluent from the Central Shops sanitary wastewater treatment plant from 1983 until 1992. Prior to 1983, the basin received effluent from a smaller sanitary wastewater treatment facility. The designation of the basin as an oil seepage basin may be a misnomer, as there is no information available to support the specific use of the basin for management and disposal of waste oils. The basin has received no discharges since 1992 and is inactive. Sewer lines leading to the basin have been plugged, and rainwater is typically retained in the basin.

The GOSB OU is comprised of four subunits:

- GOSB Interior Subunit
- GOSB Berm Subunit
- Pipeline Subunit
- Effluent Discharge Subunit

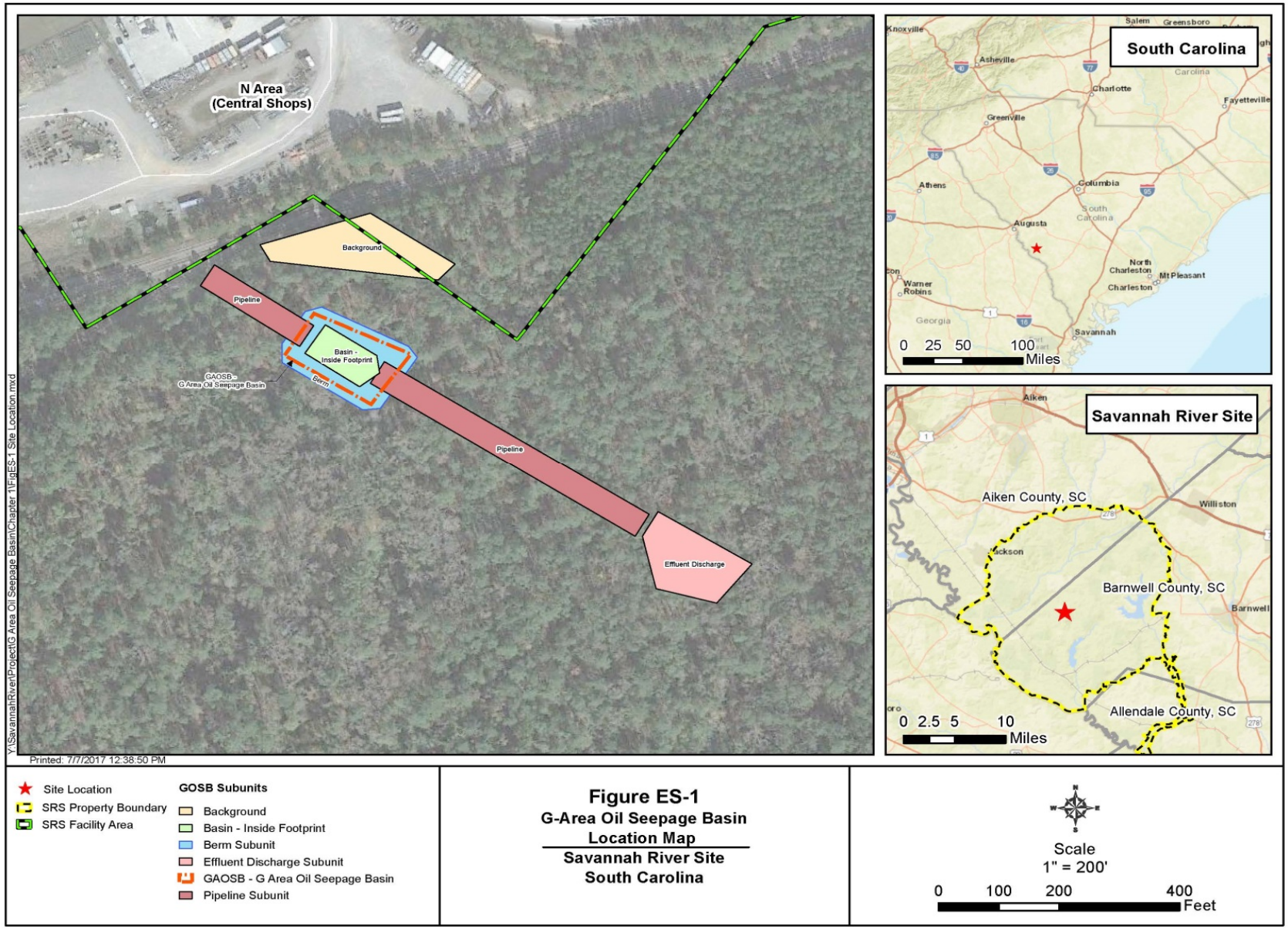
The remedial investigation is based on samples of water in the basin, sediment at the bottom of the basin, and soils associated with the berms, pipelines and effluent discharge area. Although groundwater is not a subunit of the GOSB OU and will be addressed as part of the Central Shops Groundwater OU, groundwater in the vicinity of the basin was evaluated to support the contaminant fate and transport analysis.

The GOSB Interior Subunit is the only subunit at the GOSB OU that presents unacceptable risks to human health and the environment. Pesticides are present in basin sediments at levels that have been determined to pose a risk to human health and the environment. In addition, pesticide levels in the water in the basin pose a risk to ecological receptors. There are no problems warranting action for the GOSB Berm, Pipeline, or Effluent Discharge Subunits.

The CMS/FS portion of the document includes the identification and screening of technologies, development and screening of alternatives, and a detailed analysis of remedial alternatives. Five remedial alternatives were evaluated for the GOSB Interior Subunit:

1. No Action
2. Land Use Controls (LUCs)
3. Place 0.6 meters (2 feet) of clean fill at the bottom of the basin and manage surface water (includes LUCs)
4. Backfill the basin and manage surface water
5. Excavate and dispose of contaminated sediment at the bottom of the basin, and manage surface water

~~Relative ranking of alternatives indicates that Alternative A-4 (Backfill Basin and Manage Surface Water) may be the most favorable.~~These alternatives were ranked relative to each other using the nine criteria established by USEPA. The preferred alternative will be determined in the development of the SB/PP based on information contained in this report and comments received from the USEPA, SCDHEC, and the public prior to finalization in the Record of Decision.



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LIST OF ABBREVIATIONS AND ACRONYMS

~	approximately
ac	acre
ARAR	applicable, relevant and appropriate requirement
ARF	Administrative Record File
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BRA	Baseline Risk Assessment
°C	degrees Celsius
~~CBCU~~	~~Crouch Branch Confining Unit~~
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CM	contaminant migration
cm	centimeter
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSM	Conceptual Site Model
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
ERA	Ecological Risk Assessment
ESV	ecological screening value
°F	degrees Fahrenheit
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
GA	Gordon Aquifer
GCU	Gordon Confining Unit
GOSB	G-Area Oil Seepage Basin (761-13G)
ha	hectare
HH	human health
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
in.	inch
km^2	square kilometers
L	liter
LUC	land use control
m	meter
m^3	square meters
MCL	maximum contaminant level
mg/kg	milligrams per kilogram

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

mi	mile
mi^2	square miles
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRIE	Natural Resource Injury Evaluation
NRMRL	National Risk Management Research Laboratory
O&M	operation and maintenance
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PP	Proposed Plan
PRG	Preliminary Remediation Goal
PTSM	Principal Threat Source Material
RAIP	Remedial Action Implementation Plan
RAO	remedial action objective
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RG	remedial goal
RGO	remedial goal option
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
RSV	refinement screening value
SB	Statement of Basis
SCDHEC	South Carolina Department of Health and Environmental Control
SRS	Savannah River Site
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBC	to be considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCR	total cumulative risk
TES	Threatened, Endangered and Sensitive (species)
TL	threshold level
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VOC	volatile organic compound
WSRC	Washington Savannah River Company
yd^3	cubic yards

1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation Report (RI) with Baseline Risk Assessment (BRA) and Corrective Measures Study (CMS)/Feasibility Study (FS) has been prepared for the G-Area Oil Seepage Basin (GOSB) (761-13G) Operable Unit (OU) located at Savannah River Site (SRS) in Aiken, South Carolina (Figure 1-1).

The primary goal of the GOSB OU RFI/RI/BRA/CMS/FS combined document is to provide sufficient information to support a Statement of Basis (SB)/Proposed Plan (PP) and a Record of Decision (ROD) for completion of remedial activities at the GOSB OU. The requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) constitute the applicable regulatory framework for this document. The format and content of this document have been developed to accommodate decisions made by Core Team representatives from the U.S. Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and the United States Department of Energy (USDOE) – Savannah River.

The GOSB OU RFI/RI/BRA/CMS/FS combined document describes the evaluations and decisions made during the scoping process, summarizes the characterization activities, discusses the results of the contaminant migration and risk evaluations, and proposes remedial alternatives for the GOSB OU subunits requiring cleanup. For evaluation purposes, the GOSB OU was segregated into the following four subunits: 1) GOSB Interior, 2) GOSB Berm, 3) Pipeline, and 4) Effluent Discharge. Groundwater is not a subunit of the GOSB OU and will be addressed as part of the Central Shops Groundwater OU.

1.1 Organization of Report

The contents of this document generally follow the guidelines established in the *Environmental Compliance and Area Completion Projects Regulatory Document Handbook* (SRNS 2012). However, several sections of the document were modified to accommodate the merging of the RFI/RI/BRA/CMS/FS information into a single combined document and improve readability.

Chapter 1, *Introduction*, broadly discusses the purpose and organization of the report, regulatory background, unit description, and land use. Chapter 2, *Site Description*, provides a review of the physical setting, geology and hydrogeology, and a generic conceptual site model (CSM) description. Chapter 3, *Remedial Investigation*, provides information on the characterization efforts, nature and extent of contamination, and results of the risk assessment and Principal Threat Source Material (PTSM) evaluations for each of the individual subunits. Chapter 4, *Remedial Action Objectives (RAOs) and Remedial Goal Options (RGOs)*, discusses the RAOs, RGOs, and applicable or relevant and appropriate requirements. Chapter 5 is the *Corrective Measures Study and Feasibility Study*. This chapter includes the identification, screening, and detailed analysis of remedial alternatives. Chapter 6, *RFI/RI//BRA/CMS/FS Summary/Conclusions*, provides a summary of the complete report including the OU strategy and implementation schedule. The list of document references is provided in Chapter 7, *References*.

Supporting information includes:

- Investigation Data (Appendix A)
- Contaminant Fate and Transport (Appendix B)
- Human Health Risk Assessment (Appendix C)
- Ecological Risk Assessment (Appendix D)
- Principal Threat Source Material Evaluation (Appendix E)
- Remedial Goal Option Calculations (Appendix F)
- Natural Resource Injury Evaluation (NRIE) Checklist (Appendix G)
- Detailed Cost Estimates (Appendix H)

Appendices A through H are pertinent to supporting the conclusions presented in the RFI/RI/ BRA/CMS/FS.

1.2 Regulatory Background

On December 21, 1989, SRS was included on the National Priorities List making the entire SRS subject to the provisions and requirements of CERCLA. In accordance with Section 120 of CERCLA, the USDOE negotiated a Federal Facility Agreement (FFA) (FFA 1993) with the USEPA and SCDHEC to coordinate cleanup activities at SRS as one comprehensive strategy. The GOSB OU is identified as a RCRA/CERCLA waste unit in Appendix C of the SRS FFA.

Characterization activities for soil, sediment, and surface water media were conducted at the GOSB OU in 2009, and a scoping meeting was held on May 5, 2010, with the Core Team to review the results of the 2009 characterization. The Core Team determined that additional sampling was needed but further characterization activities were placed on hold due to program funding realignment. A second scoping meeting was held on December 9, 2015, and the Core Team identified data gaps that needed to be addressed prior to the development of the RFI/RI/BRA/CMS/FS. A sampling and analysis plan (SRNS 2016) was developed to address these data gaps and characterization activities were implemented from November 2016 through January 2017. A post-characterization scoping meeting was held on March 8, 2017, and the Core Team determined that all data gaps had been addressed and the GOSB OU was fully characterized. Prior to development of this RFI/RI/BRA/CMS/FS combined document, a scoping meeting was held with the Core Team on July 19, 2017, to review the results of the risk assessment and contaminant migration evaluations to reach agreement on the problems warranting action and remedial alternatives.

The *Savannah River Site Federal Facility Agreement Community Involvement Plan* (SRNS 2011) facilitates public participation in the decision-making processes. Public participation requirements (Sections 113 and 117 of CERCLA) include the establishment of an Administrative Record File (ARF) that documents the selection of cleanup alternatives and provides for review and comments by the public on those alternatives. This RFI/RI/BRA/ CMS/FS combined document is part of the ARF and will be available to the public at USDOE's Public Reading Rooms at the University of South Carolina-Aiken, in Aiken, South Carolina, and the Thomas Cooper Library in Columbia, South Carolina. A notice will be published in local

newspapers when information is being compiled regarding the investigation and cleanup of the GOSB OU. Additional repositories may be added and/or locations changed to better meet the needs of the public.

1.3 Unit History

The GOSB OU is located southeast of N Area (Central Shops) in relatively flat terrain, approximately (~) 54-meters (m) (180-feet [ft]) south of the railroad tracks, which run adjacent to Central Shops (Figure 1-1). The area surrounding the GOSB OU is wooded with heavy underbrush and contains no stressed vegetation or other visual indications of contamination.

The basin is ~45 m (150 ft) long and ~28.5 m (95 ft) wide. The basin is ~3-m (10-ft) deep around the edges of the basin with berms on the northern and southern sides (0.9-m [3-ft] and 0.6-m [2-ft] high, respectively). The remaining two sides of the basin are roughly even with the surrounding grade. The deepest part of the basin, near the center, is ~4.8-m (16-ft) below ground surface (bgs) (Figure 1-2). Depth to groundwater is ~9- to 12-m (30- to 40-ft) bgs and ~6- to 7.5-m (20- to 25-ft) below the basin bottom. Approximately 57 m (190 ft) of buried 30-cm (12-in.) vitrified clay pipe (previously abandoned in place) runs to the inlet side of the basin. On the outlet side of the basin, ~153 m (510 ft) of buried 30 cm (12 in.) vitrified clay pipe discharges southeast of the basin into an intermittent stream. Both inlet and outlet pipes are buried to a depth of ~1.8- to 2.4-m (6- to 8-ft) bgs.

The GOSB was initially used for liquid waste disposal during SRS plant construction (1951-1956) and later for receipt of effluent from sanitary wastewater treatment plants in Central Shops. The basin may have received unknown liquid waste from the time of plant construction until the early 1960s. However, there are no records indicating that disposal of radioactive or hazardous materials at the GOSB occurred. The basin also received effluent from the Central Shops sanitary wastewater treatment plant from 1983 until 1992. The discharge of the effluent from the Central Shops wastewater treatment plant to the GOSB OU was regulated under a National Pollutant Discharge Elimination System (NPDES) permit. An analysis of sanitary wastewater effluent discharged to the basin was included in the NPDES permit application on June 30, 1988. Detected concentrations of metals (i.e., aluminum, barium, copper, magnesium, and iron) were reported in

the effluent. Chromium, lead, and silver were reported as not detected. Bromoform and chloroform were the only volatile organic compounds (VOCs) detected in the effluent sample, and no pesticides or semivolatile organic compounds (SVOCs) were detected (WSRC 1991). Two surface water samples and one sediment sample were collected from the basin in February 1989. Barium, chromium, lead, silver, and chlordane were detected in the sediment sample at higher concentrations than other inorganics. Bromoform, 1,3-dichlorobenzene, and 1,2-dichlorobenzene were detected in the surface water samples (WSRC 1991).

Prior to 1983, the basin received effluent from a smaller sanitary wastewater treatment facility. The designation of the basin as an oil seepage basin may be a misnomer, as there is no information available to support the specific use of the basin for management and disposal of waste oils. The GOSB OU was also known as the N-Area Oil Seepage Basin (761-13N) on early SRS engineering drawings. The basin has received no discharges since 1992 and is inactive. Sewer lines leading to the basin have been plugged, and rainwater is typically retained in the basin. Currently, sediment in the basin is covered with ~20 cm (8 in.) of leaf debris and decayed organic material. The amount of rainwater in the basin varies with an estimated maximum of 1,567,160.48 liters (L [414,000 gallons {gal}]). Sandy clay underlies the decayed organic material.

1.4 Land Use

The GOSB OU is located ~300-m (1,000-ft) southeast of N Area (Central Shops) in an area currently designated for industrial use. No current or projected future development or use of the GOSB OU is planned. In order to support risk management decision making, both the residential (unrestricted) and industrial land use scenarios were evaluated in the risk evaluation. Groundwater is not part of the GOSB OU and will be addressed as part of the Central Shops Groundwater OU.

1.5 Natural Resource Trustees Injury Evaluation

The potential for natural resource injuries is documented by completing the NRIE Checklist (Appendix G). The purpose of the NRIE Checklist is to identify potential natural resource injuries associated with CERCLA remedial activities. If potential injuries are identified, consideration is given as to whether trustee involvement is needed. The checklist is a starting point in potential

injury identification and is not intended to be all-inclusive. The checklist has been designed as a series of questions to help identify the potential for natural resource injuries and what resources may be affected. It is based on the pre-assessment screen in 43 CFR 11.13.

The USDOE, as a trustee of its land, is responsible for identifying resources of concern. SRS integrates the Natural Resource Damage Assessment and RI/FS processes to assess threats to natural resources during the remedial process. The intent is to prevent potential injuries to natural resources that can occur as the result of remediation activities and to mitigate, to the extent practical, any injuries that have already occurred. The list of trustees for the SRS is included in Table 1-1.

Refined constituents of concern (RCOCs) have been identified in the GOSB Interior Subunit. Based on the NRIE Checklist (Appendix G), natural resources have not been adversely affected by hazardous substances from the GOSB OU. Remedial alternatives may or may not address injuries to the natural resources and could cause additional injury based on the scope of the action. No irreversible or irretrievable resource losses are known to exist. The impact to natural resources will be considered during the remedial alternative evaluation for the GOSB Interior Subunit.

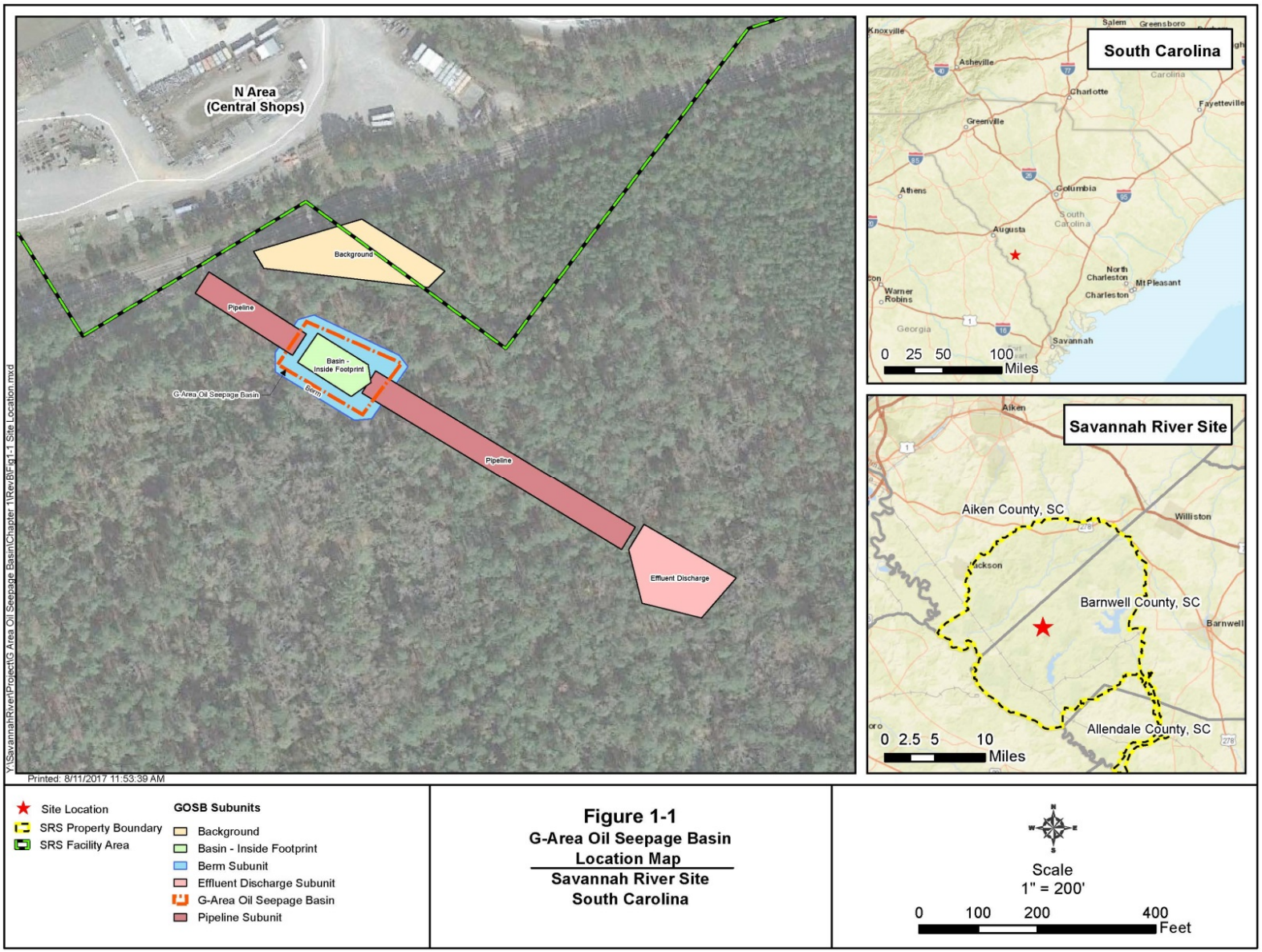

Figure 1-1. GOSB Location Map

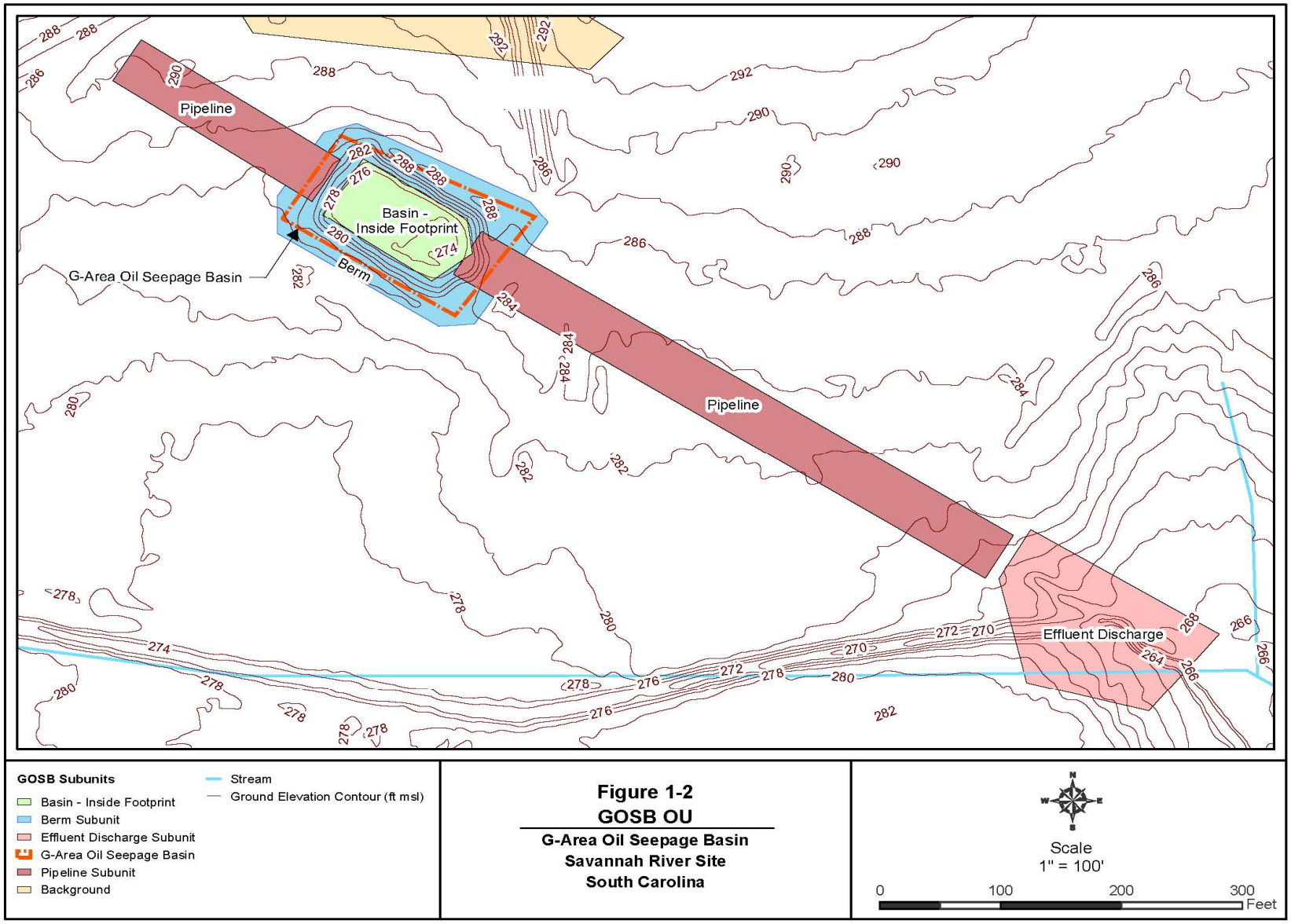

Figure 1-2. GOSB OU

Table 1-1. Savannah River Site Natural Resource Trustees and Their Responsibilities

Governing Power	Responsibilities
USDOE, Savannah River Operations Office	All natural resources located on, over, or under land administered by USDOE
South Carolina Office of the Governor	All natural resources of the State of South Carolina
SCDHEC, Bureau of Land and Waste Management	Geologic resources including soil, groundwater resources (including drinking water sources), air resources, and surface water resources
U.S. Department of the Interior	Threatened and endangered species (includes Red-Cockaded Woodpecker, Bald Eagle, Wood Stork, Shortnose Sturgeon, and Smooth Coneflower), migratory birds, anadromous species, National Park Service land (Fort Pulaski National Monument), Fish and Wildlife Service land (Savannah River National Wildlife Refuge), Tybee Island National Wildlife Refuge, and Orangeburg National Fish Hatchery
South Carolina Department of Natural Resources	Commercial species, game and non-game species, and state sensitive species
Georgia Department of Natural Resources	Savannah River resources, groundwater resources, air resources, and surface water resources
U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)	Living and non-living natural resources in coastal and marine areas including the following: • All life stages, wherever they occur, of fishery resources on the Exclusive Economic Zone and continental shelf • Anadromous and catadromous species throughout their ranges, rivers, and tributaries to rivers, which historically or presently support the above species • Federally endangered and threatened species, including designated critical habitat and marine mammals for which NOAA has assigned responsibility • Tidal wetlands, salt marshes, estuaries, and all other habitats supporting all fishery and marine resources listed above • Living and non-living resources of National Marine Sanctuaries and National Estuarine Reserves
U.S. Army Corps of Engineers, Charleston, South Carolina District, Savannah, GA District	Savannah River resources, navigable waters resources, and waters of the United States resources

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2.0 SITE DESCRIPTION

A discussion of the physical attributes of the G-Area Oil Seepage Basin (GOSB) (761-13G) Operable Unit (OU) is provided in the following sections. The GOSB OU physical setting, habitats, ecological setting, surface features, meteorology, unit-specific geology and hydrogeology, surface water hydrology, and sediment/soils are described below and depicted in Figure 2-1.

2.1 Physical Setting

The GOSB OU is located at the Savannah River Site (SRS) ~304.8-m (1,000-ft) southeast of N Area (Central Shops) and ~54.9-m (180-ft) south of the railroad tracks that run adjacent to Central Shops (Figure 2-1). The terrain is relatively flat and the area surrounding the GOSB OU is wooded with heavy underbrush. The area is currently designated for industrial use.

2.1.1 Habitats and Ecological Setting

The diverse habitats of SRS support a wide range of aquatic, semi-aquatic, and terrestrial species (Table 2-1). There is extensive ecological data available for SRS, as well as more area-specific data for the N Area, including the GOSB OU. Based upon site investigations, the GOSB OU is characterized by pine/hardwood forest and aquatic habitats. There are no Threatened, Endangered, or Sensitive (TES) species present at the GOSB OU. One TES survey was conducted at the Central Shops Burning Rubble Pit (631-6G) that included portions of the GOSB OU (Bumpus and Garner 1994). No TES species were identified during the survey.

2.1.2 Surface Features

The GOSB OU is located in a wooded area that is relatively flat and gently sloping to the southwest (Figure 2-2). There are no remarkable surface features other than an unpaved access road, a nearby railroad track, and drainage ditches.

2.1.3 Meteorology

The climate of the central Savannah River area is humid and subtropical. It is characterized by hot summers and mild winters. Outbreaks of severe thunderstorms occur more frequently during the spring; rainfall is evenly distributed throughout the year. Except for the Savannah River valley, there are no topographic features that would significantly influence the general climate.

Meteorological monitoring has been conducted at the SRS since the 1950s. Monthly averages of temperature and precipitation based on a 50-year historical record of observations are presented in the Table 2-2. During the summer months, temperatures at SRS typically exceed 32.2 degrees Celsius (°C) (90 degrees Fahrenheit [°F]) in daytime, dropping to near 21.1°C (70°F) at night. On average, fall and spring temperatures vary between 21.1°C (70°F) and 29.4°C (85°F) during the daytime and 7.2°C (45°F) and 18.3°C (65°F) in the night. Winter daytime temperatures are generally near 15.6°C (60°F) with nighttime temperature near 4.4°C (40°F). Average precipitation is relatively consistent throughout the year, with slightly higher rainfall occurring during the summer months when the humidity levels are higher.

2.2 Geology and Hydrogeology

This section describes the geology, hydrogeology, surface water hydrology, and soil types for the GOSB OU.

2.2.1 Surface Water Hydrology

The five major streams that drain from the SRS to the Savannah River are the Upper Three Runs, Fourmile Branch, Pen Branch, ~~Upper Three Runs~~Steel Creek, and Lower Three Runs (Figure 2-3). The GOSB OU is an area of relatively flat topographic relief gently sloping to the southwest with poorly drained surface depressions in both directions (Figure 2-2). Drainage ditches, located on either side of the GOSB, lead to an unnamed tributary of Pen Branch located ~914.4 m (3,000 ft) to the southeast.

2.2.2 Unit Soils

The soils within the GOSB OU are classified as Ultisols and Entisols. Ultisols are soils that are rich in clay, some mineral nutrients and metal oxides, and typically have a humus-rich surface horizon. These soils are generally well-formed and associated with areas of older geological settings. The Dothan series is the only Ultisol soil series located within the GOSB OU; however, it covers the majority of the GOSB OU and surrounding area to the east and west (Figure 2-4).

There are two Entisol soil series located within the GOSB OU: Udorthents and Ochlockonee. Entisols are associated with areas of relatively recent geologic formation. These soils are typically associated with areas of land development and areas where disturbance of the land occurs either naturally or by man (i.e., erosion, deposition, excavation or construction activities). The Udorthents series is present at the northwestern tip of the GOSB OU where the Pipeline Subunit begins. The Ochlockonee series is located at the southeastern end of the GOSB OU in the Effluent Discharge Subunit and surrounds the unnamed tributaries into which the GOSB OU drains (Figure 2-4).

2.2.3 Geology

SRS is situated on the Atlantic Coastal Plain, a wedge of unconsolidated and semi-consolidated sediments that thickens toward the southeast. Investigations into regional and SRS geology are summarized in the *Hydrogeologic Framework of West-Central South Carolina* and other reports (Aadland et al. 1995; Fallaw and Price 1995; Stieve and Stephenson 1995).

As shown on Figure 2-5, the shallow geologic units associated with the GOSB OU include the middle to late Tertiary Age Dry Branch Formation, Tobacco Road Formation, and "Upland Unit" (correlative to the Altamaha Formation). The Dry Branch Formation in the area of the GOSB OU is ~18.3-m (60-ft) thick. Locally, this formation consists of coarse to medium grained, poorly to moderately sorted sand and silt with minor amounts of clay matrix. Interbedded sandy and silty clay layers (0.3- to 3.0-m [1- to 10-ft] thick) are abundant, and pebble layers occur locally. The Dry Branch Formation includes a semi-continuous clay horizon referred to in many SRS reports as the "tan clay." The "tan clay" is ~7-m (23-ft) thick at the GOSB OU. The sediments of the Dry

Branch Formation appear to have been deposited in a lower delta plain or shallow shelf environment (Aadland et al. 1995). The top of the Dry Branch Formation contains a relatively well-sorted medium sand known as the Irwinton Sand. The uppermost Dry Branch Formation is highly channelized and the contact with the overlying "Upland Unit" is irregular.

Overlying the Dry Branch Formation, the Tobacco Road Formation is ~12.2-m (40-ft) thick and consists of moderately to poorly sorted, red, brown, tan, purple, and orange, fine to coarse, clayey quartz sand. Pebble layers are common, as are clay laminae and beds. Trace fossils, possibly *Ophiomorpha sp.* burrows, are abundant in parts of the formation. Sediments have the characteristics of a shallow marine deposit.

The informally named "Upland Unit" consists of poorly sorted, silty, clayey sand, pebbly sand, and conglomerate. This unit caps hills in higher elevations over much of SRS and throughout all of the GOSB OU, where the average thickness is 12.2 m (40 ft). The color is variable, and facies changes are abrupt; weathered feldspar is abundant in places. Due to the highly eroded and channelized nature of the underlying Tobacco Road Formation, the thickness of the "Upland Unit" changes abruptly. The "Upland Unit" appears to have been deposited in a fluvial environment.

2.2.4 Groundwater Hydrogeology

The unconsolidated marine and fluvial sediments of the Atlantic coastal plain underlying the GOSB OU and all of SRS are a variably stratified, heterogeneous sequence of sand, clay, limestone, and gravel layers. In terms of hydrostratigraphy, the uppermost sediments make up the Floridan Aquifer System. In the GOSB OU, the Floridan Aquifer System consists of, in ascending order, the Gordon Aquifer (GA), the Gordon Confining Unit (GCU), and the Upper Three Runs Aquifer (UTRA) (Figure 2-6). The Floridan Aquifer System is separated from lower aquifer units by the Crouch Branch Confining Unit ~~(CBCU)~~, which is a competent aquitard.

2.2.4.1 Unit-Specific Hydrogeology

Based on the eight temporary piezometer wells installed in 2016 and 2017, depth to water ranges from 9.6 m (31.6 ft) in wells GOSB-61 and GOSB-69 to 11.2 m (37 ft) in well GOSB-62. Based on these data, the groundwater flow at the GOSB OU is in an east-southeastern direction (Figure 2-7).

2.3 Conceptual Site Model

The conceptual site model (CSM) is an objective framework for assessing data pertinent to the investigation. The preliminary CSMs for the four subunits of the GOSB OU (Figures 2-8 through 2-11) identify and evaluate suspected sources of contamination, contaminant release mechanisms, potentially affected media (secondary sources of contamination), potential exposure pathways, and potential human and ecological receptors.

Exposure pathways describe the course a chemical or physical agent takes from the source to the exposed receptor. The following seven components constitute an exposure pathway:

1. Primary Sources
2. Primary Sources Environmental Release Mechanisms
3. Secondary Sources
4. Secondary Sources Environmental Release Mechanisms
5. Exposure media (sediment, soil, surface water, etc.)
6. Exposure route (external radiation, ingestion, dermal contact, inhalation, etc.)
7. Receptor (resident, worker, wildlife, etc.)

If any of these elements are missing, the pathway is incomplete and is not considered further in the quantitative risk assessment. A pathway is complete when all five components are present to permit potential exposure of a receptor to a source of contamination. Exposure analysis is important in terms of identifying all potentially complete exposure routes, understanding the nature and extent (as well as fate and transport) of contamination, and developing preliminary remedial alternatives. In a complete pathway, exposure occurs at exposure points that may represent only

a small portion of the entire exposure route. If there is no exposure point, then there is no exposure, and the pathway is considered incomplete.

2.3.1 Primary Sources of Contamination

The GOSB was initially used for liquid waste disposal during SRS plant construction (1951-1956) and later for receipt of effluent from sanitary wastewater treatment plants in Central Shops from 1983 until 1992. Prior to 1983, the basin received effluent from a smaller sanitary wastewater treatment facility. The basin also may have received unknown liquid waste from the time of plant construction until the early 1960s. However, there are no records indicating that disposal of radioactive or hazardous materials at the GOSB occurred. All of these sources, whether identified or potential, comprise the primary sources of contamination for the GOSB OU. The basin is inactive and sewer lines leading to the basin have been plugged. However, rainwater is typically retained in the basin.

2.3.2 Primary Sources Environmental Release Mechanisms

Environmental release mechanisms evaluated as primary sources of contamination to the GOSB OU were liquid wastes disposed of in the basin during SRS plant construction activities in the 1950s, and more recently, effluent was received from the Central Shops sanitary wastewater treatment plant from 1983 until 1992, and effluent received from a smaller wastewater treatment plant prior to 1983. All environmental release mechanisms for primary sources of contamination have been inactive since 1992.

2.3.3 Secondary Sources of Contamination

As a primary source contacts other media, secondary sources of contamination can potentially be created. At the GOSB OU, receipt of liquid wastes during the construction of the SRS plant and the retention and effluent from the Central Shops sanitary wastewater treatment facility had the potential to create secondary sources including surface water, groundwater, sediment, and soil.

2.3.4 Secondary Sources Environmental Release Mechanisms

At the GOSB OU, potential secondary release mechanisms included volatilization, biotic uptake, fugitive dust by wind or other soil surface disturbances, and exposure to on-site workers during soil excavation.

2.3.5 Exposure Media

GOSB OU exposure media include air vapor, biota, surface water, surface sediment, surface soil, and soil to a depth of 3.0-m (10-ft) bgs.

2.3.6 Exposure Routes

GOSB OU exposure routes include inhalation, external radiation, ingestion, and dermal contact.

2.3.7 Receptors (Human and Ecological)

The industrial worker is the most appropriate receptor scenario for potential risks associated with the surface water, sediment, and soil of the GOSB OU. The resident scenario is protective of the industrial worker, since the resident is a more conservative scenario to assess potential risk to human receptors. A comparison of exposure assumptions to potential human exposure scenarios at SRS is provided below:

Potential Receptor	Years	Days/Year	Hours/Day	Exposure Hours
OU Resident	26	350	24	218,400
OU Industrial Worker	25	250	8	50,000

Potential ecological receptors for GOSB OU include terrestrial and aquatic/semi-aquatic wildlife.

Complete exposure pathways to potential human receptors and ecological receptors for evaluation in this document are included in the preliminary CSMs (Figures 2-8 through 2-11). The refined CSMs, which include the refined constituents of concern, are discussed and included in Chapter 3.

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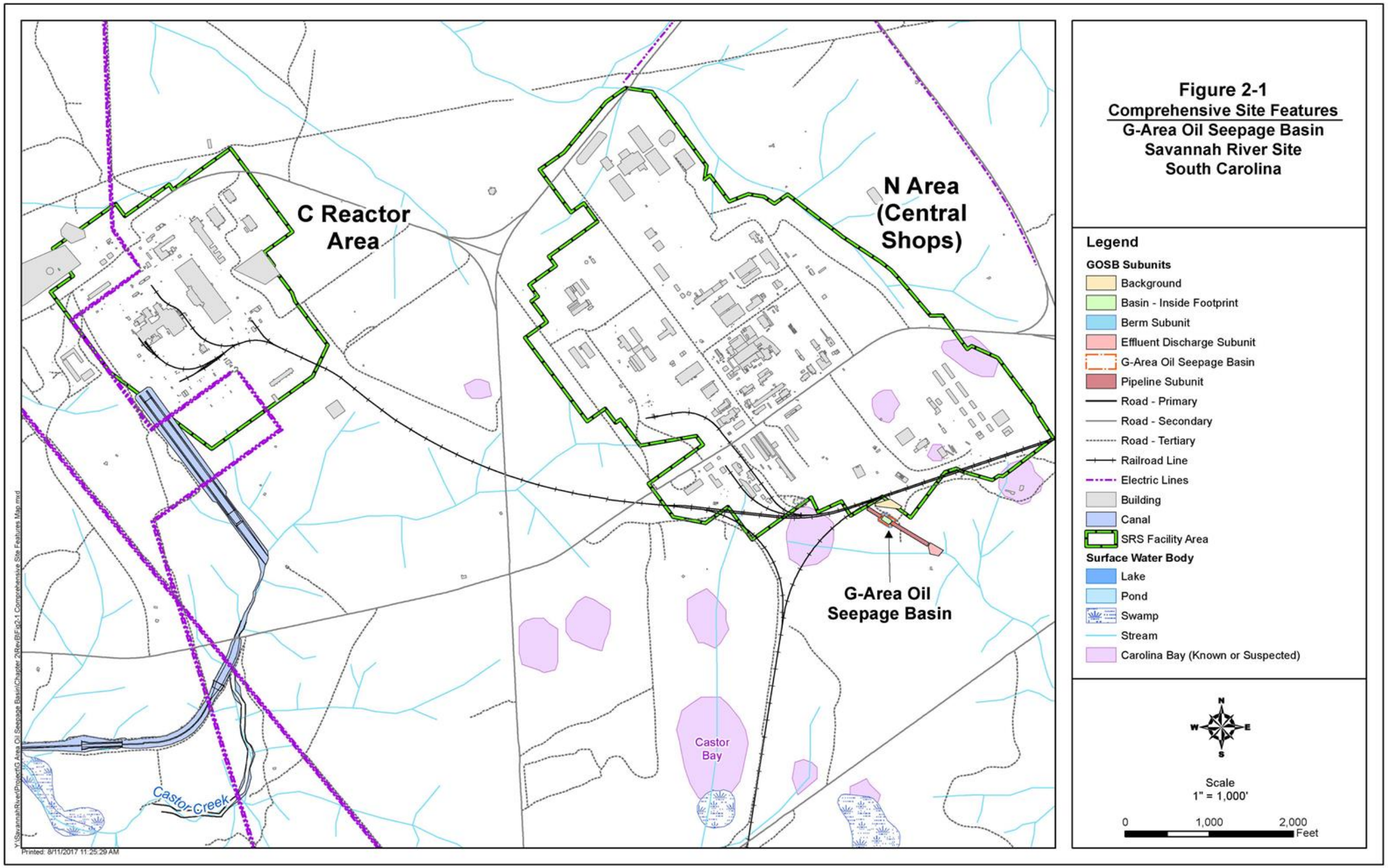

Figure 2-1. Comprehensive Site Features

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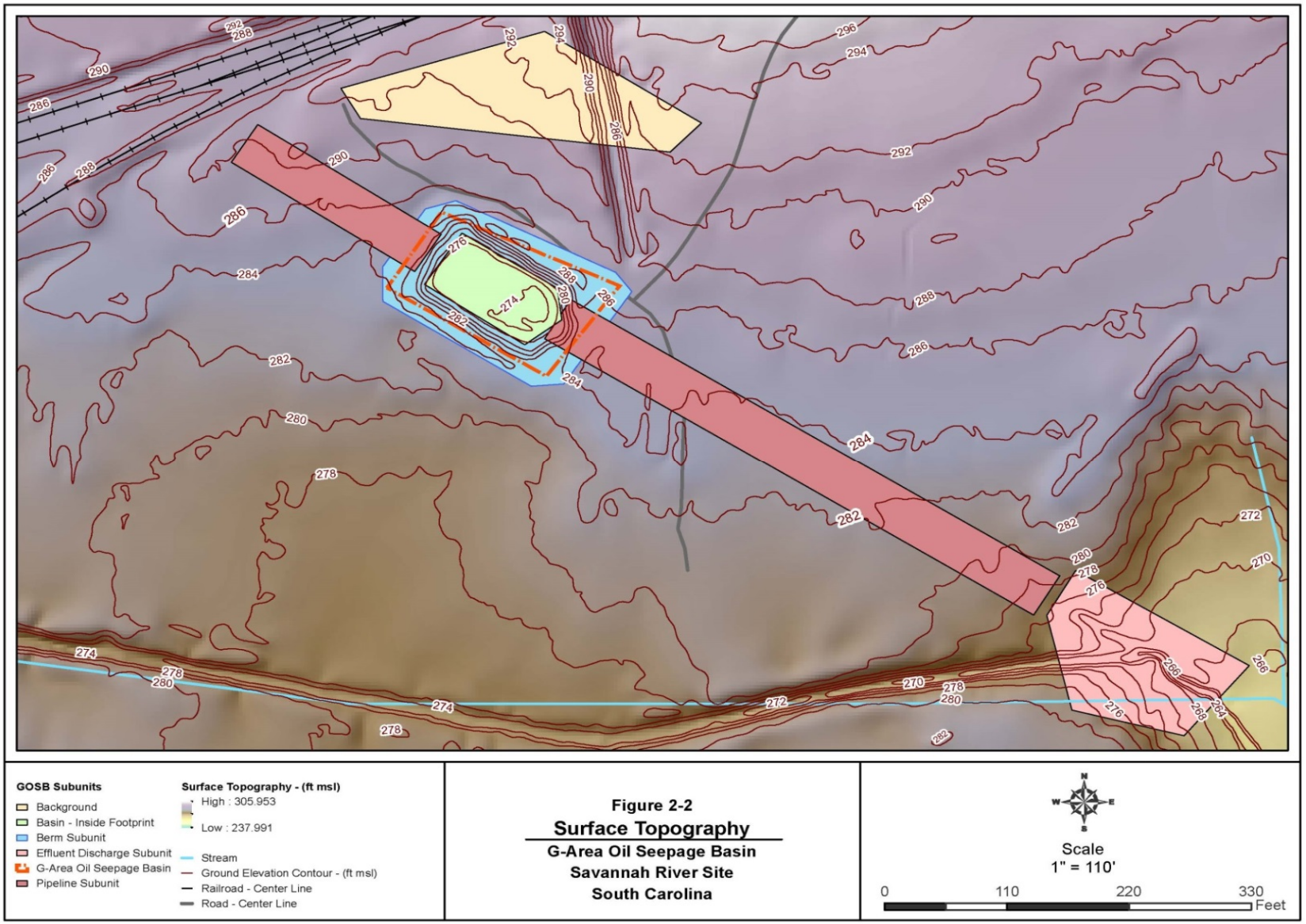

Figure 2-2. Surface Topography

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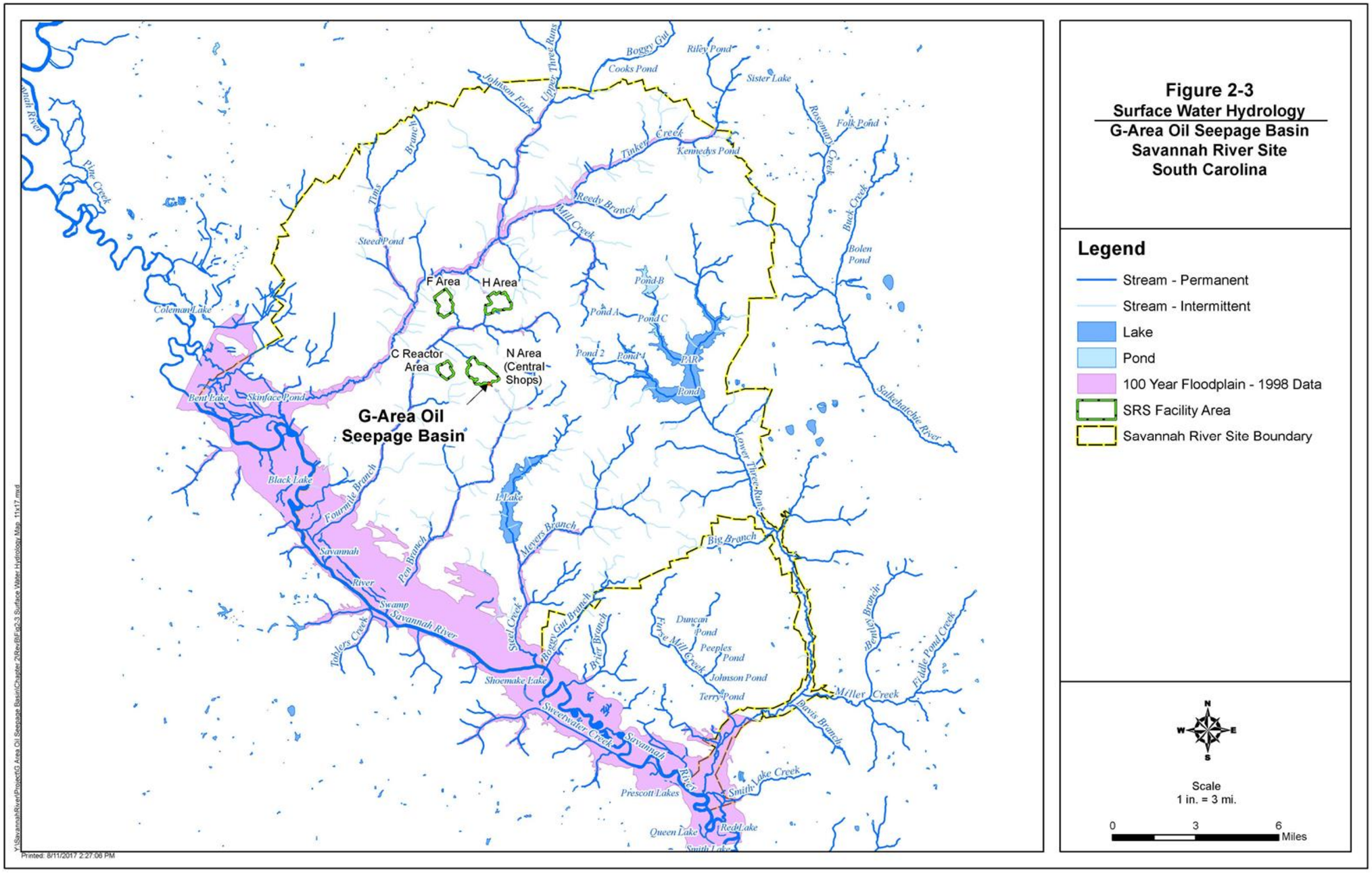

Figure 2-3. Surface Water Hydrology

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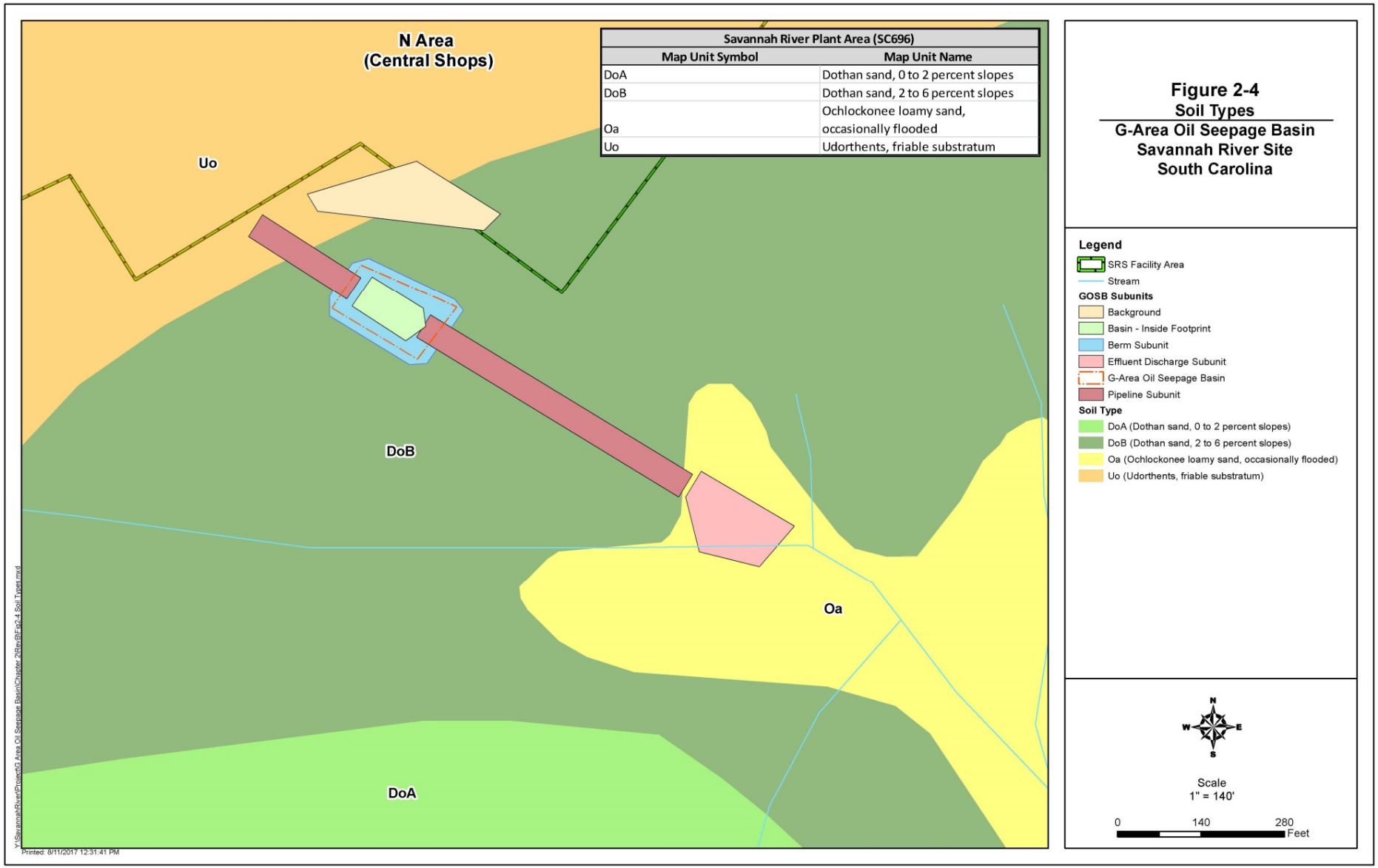

Figure 2-4. Soil Types

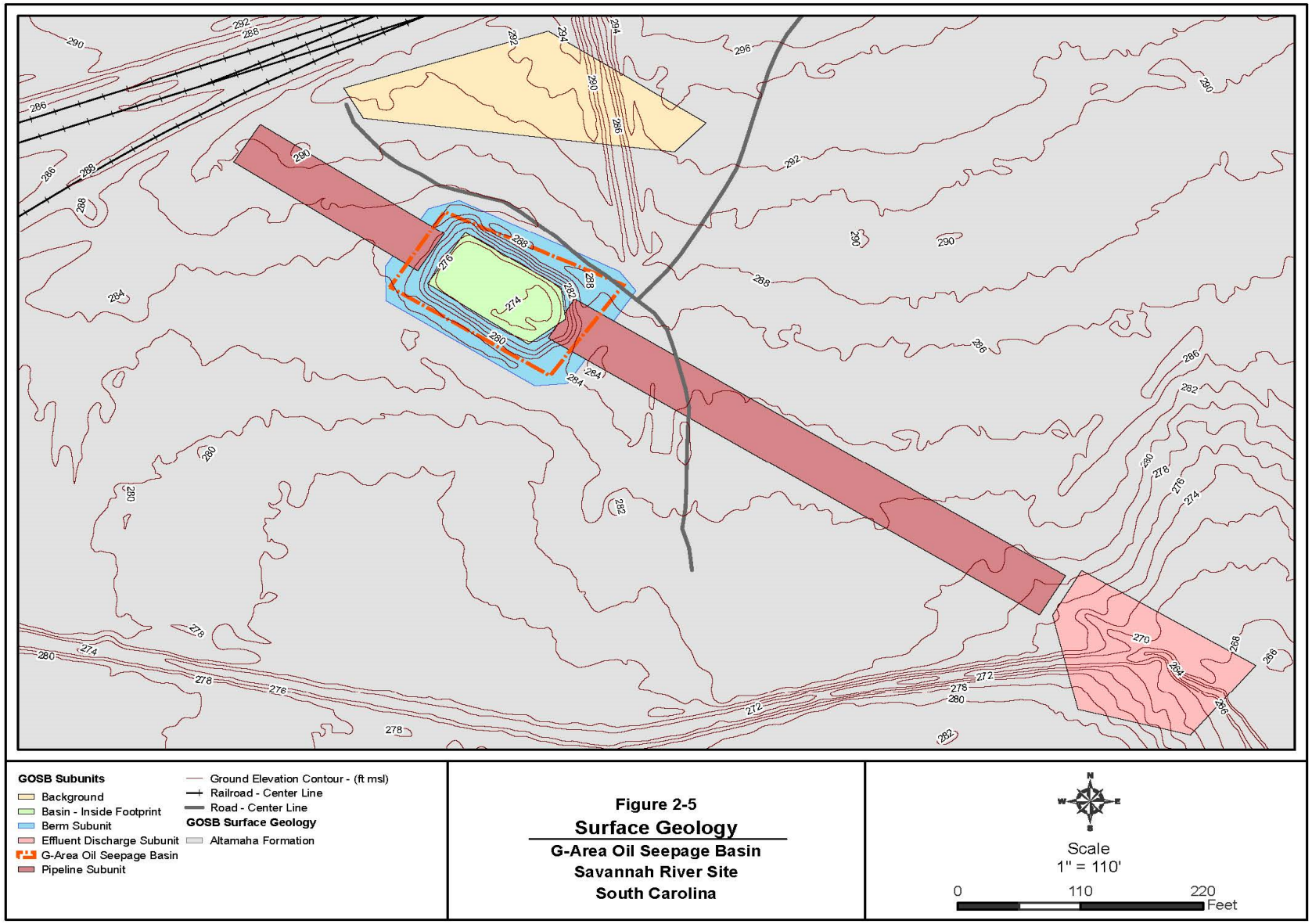

Figure 2-5. Surface Geology

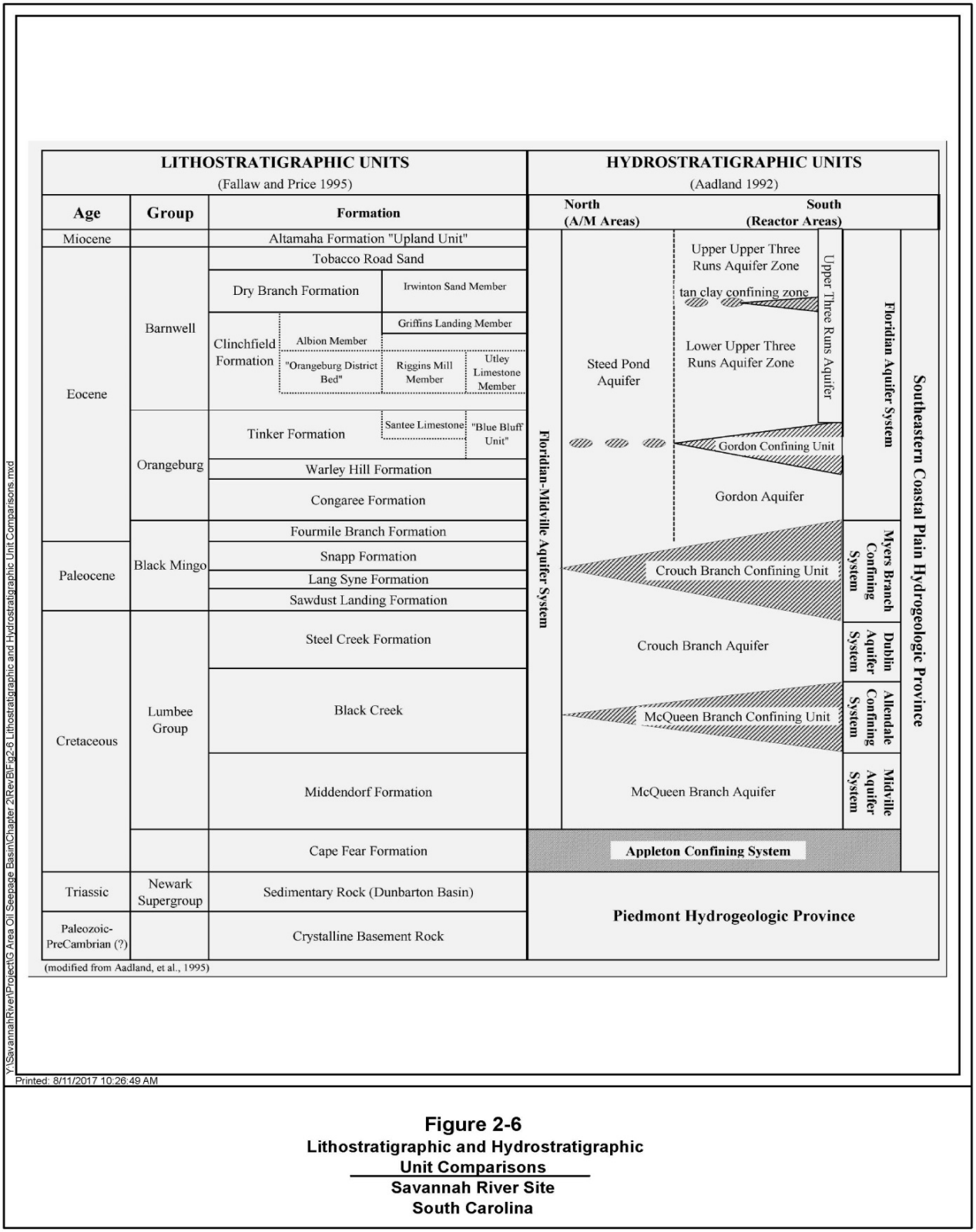

Figure 2-6
Lithostratigraphic and Hydrostratigraphic Unit Comparisons
Savannah River Site
South Carolina

Figure 2-6. Lithostratigraphic and Hydrostratigraphic Unit Comparisons

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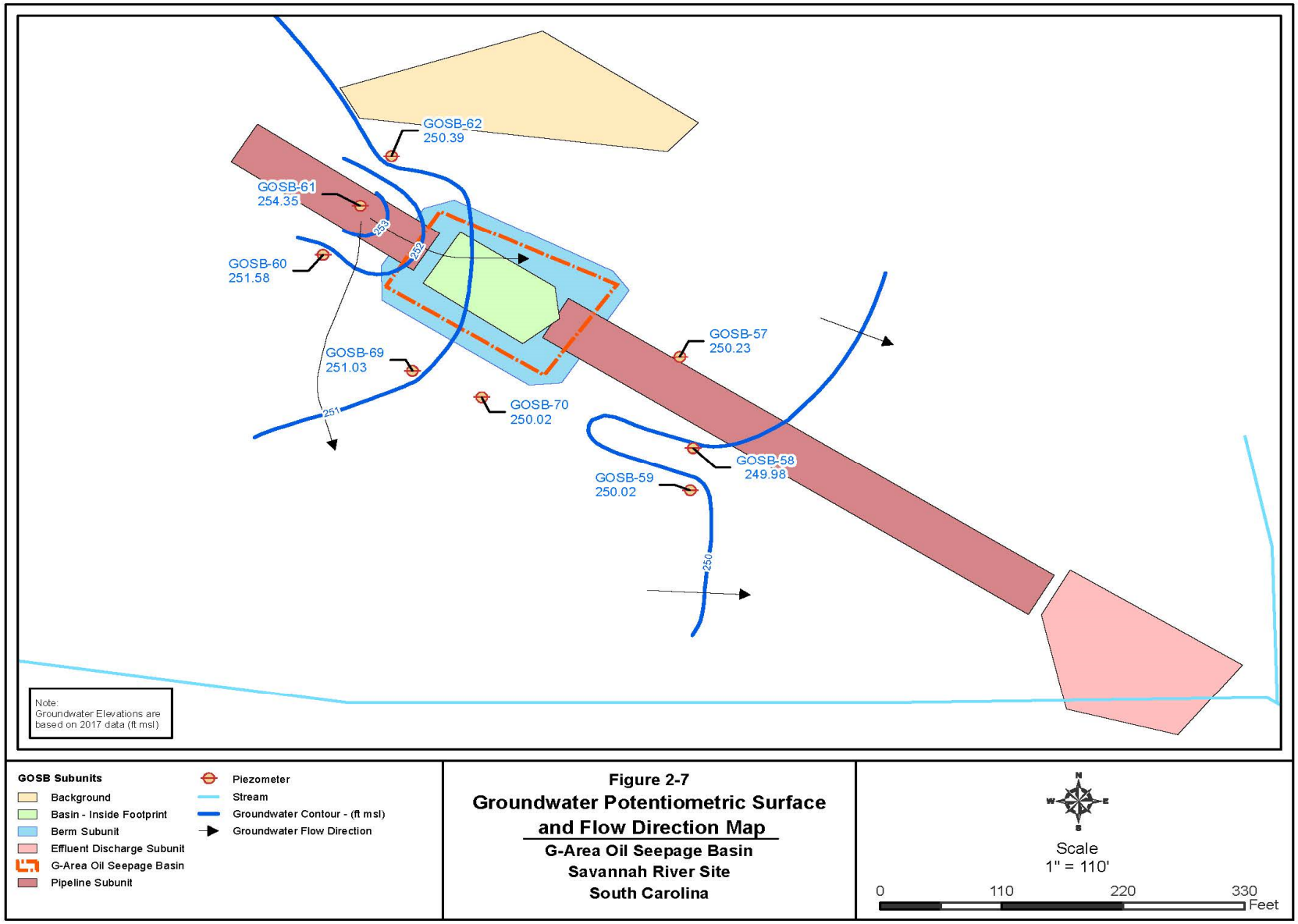

Figure 2-7. Groundwater Potentiometric Surface and Flow Direction Map

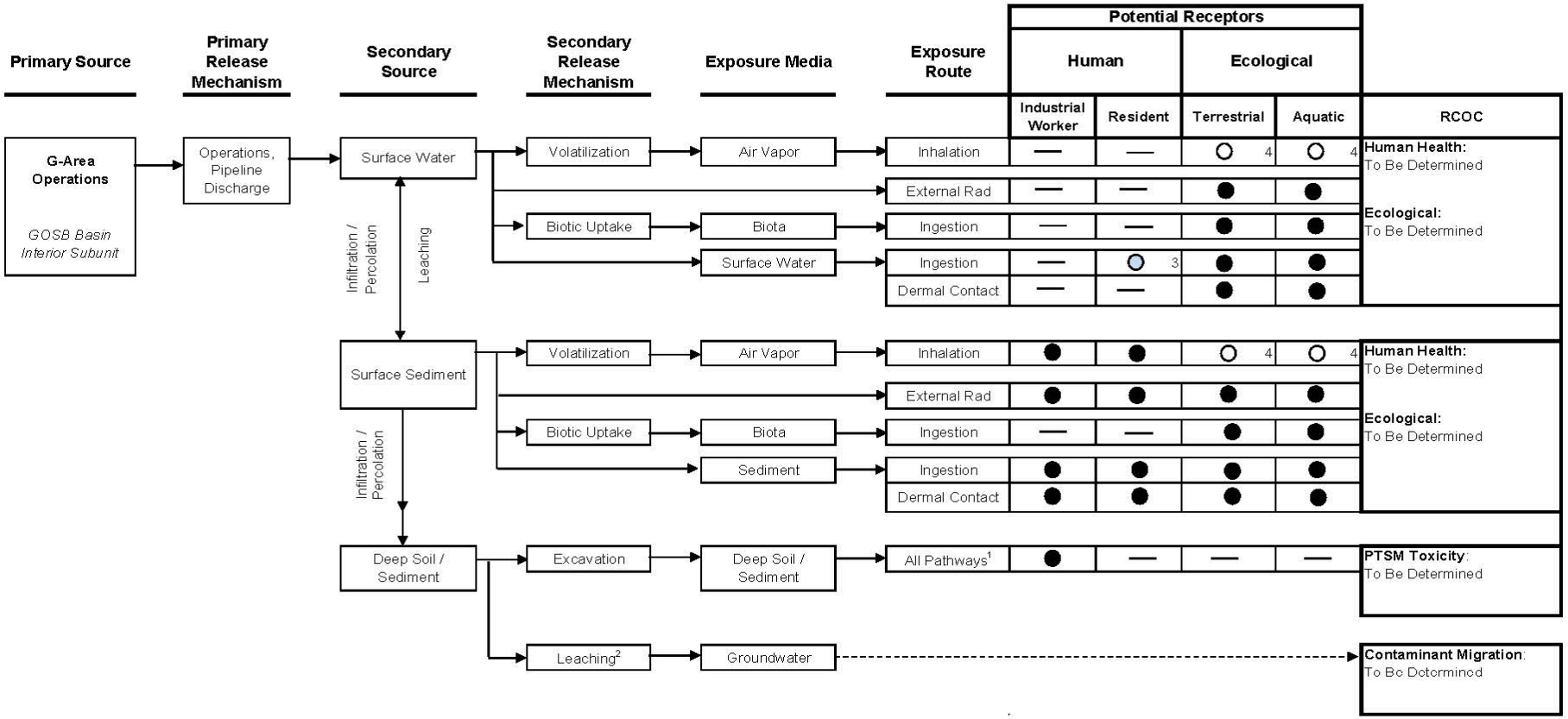

Figure 2-8. Preliminary Conceptual Site Model for the GOSB Interior Subunit

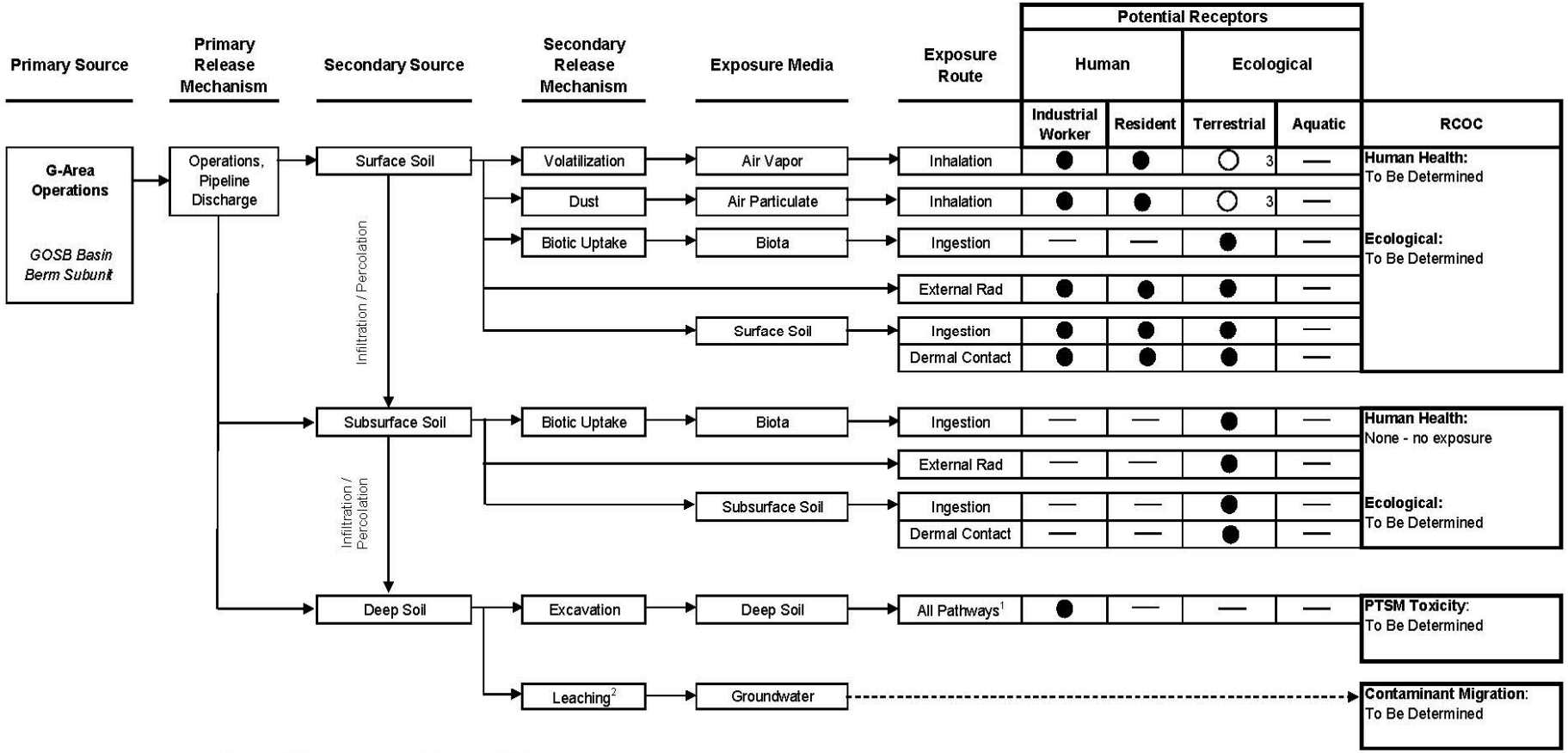

Figure 2-9. Preliminary Conceptual Site Model for the GOSB Berm Subunit

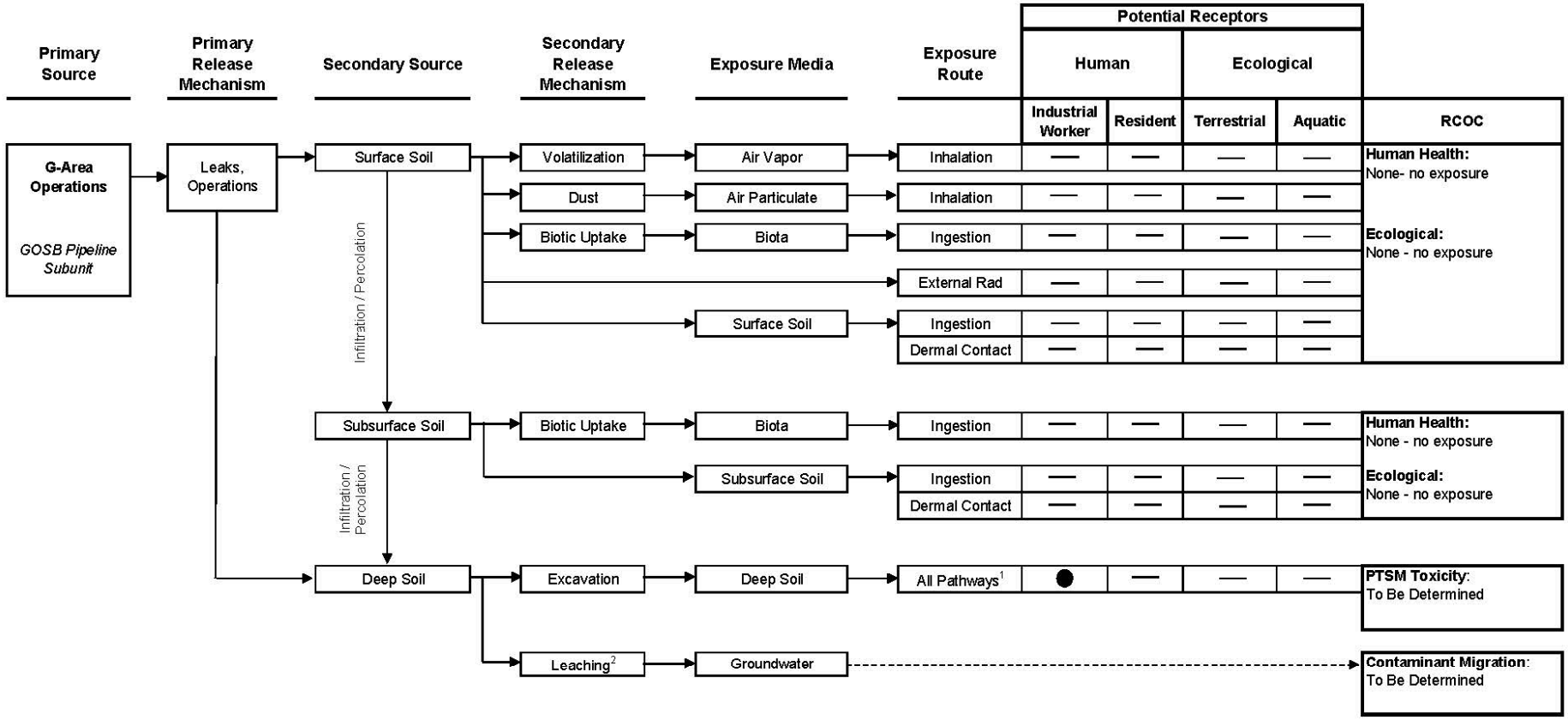

Figure 2-10. Preliminary Conceptual Site Model for the Pipeline Subunit

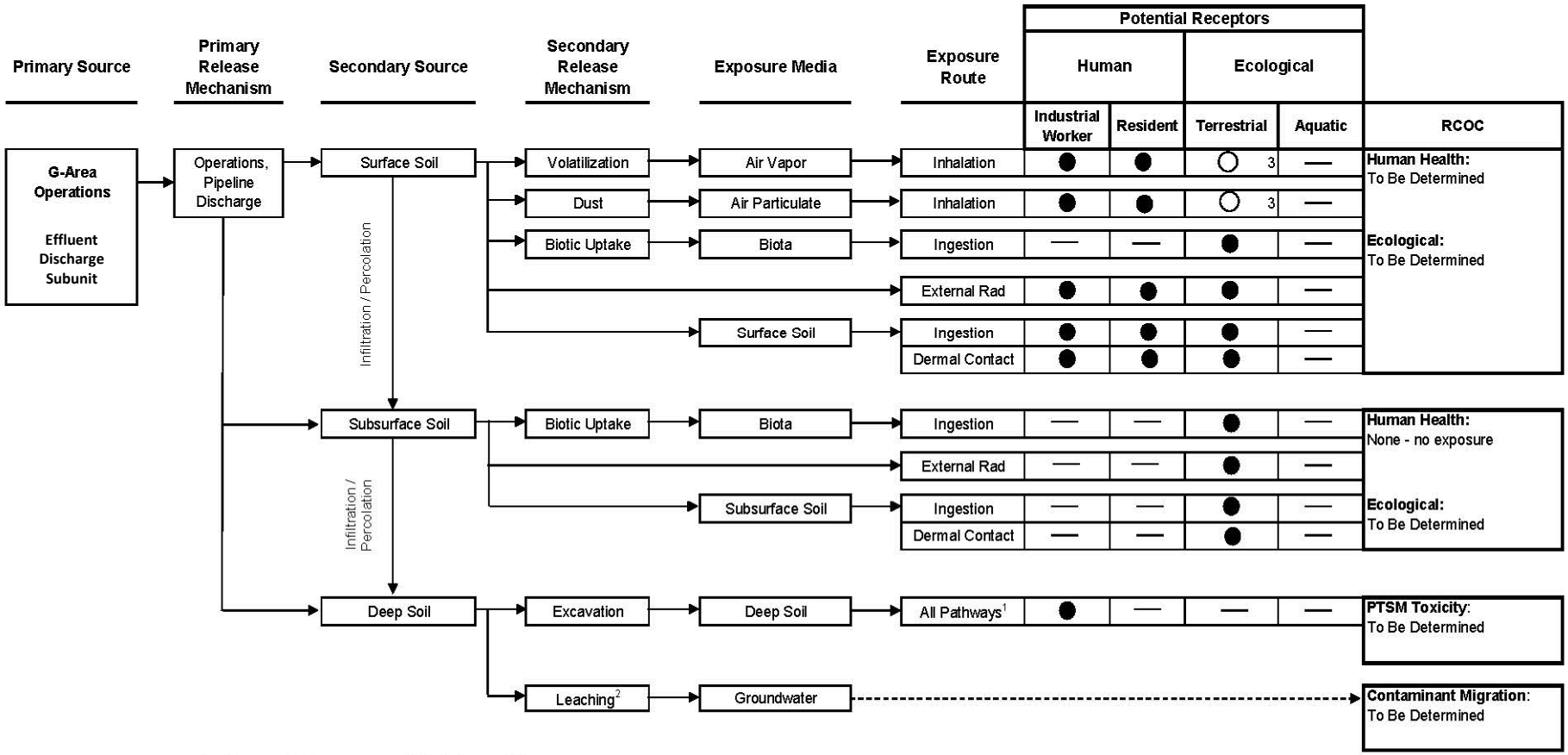

Figure 2-11. Preliminary Conceptual Site Model for the Effluent Discharge Subunit

Table 2-1. TES Plant Species Known to Occur on SRS

Species	Habitat
Striped garlic (*Allium cuthbertii*)	Sandhills, granite domes, flatrocks.
Gerardia (*Agalinus decemloba*)	Dry clayey or sandy woods
Incised groovebur (*Agrimonia incisa*)	Pinelands
Dutchman's pipe (*Aristolochia macrophylla*)	Cove forests
Great Indian plantain (*Arnoglossum muehlenbergii*)	Cove forests, other mesic forests
Hairy milkpea (*Astragalus villosus*)	Sandhills and other dry, sandy places
Sandhills milkpea (*Astragalus michauxii*)	Sandhills
Lanceleaf wild indigo (*Baptisia lanceolata*)	Sandhills
Chapman's sedge (*Carex chapmanii*)	Edges of calcareous pine savannas, calcareous slopes and bottomlands, mesic hammocks, stream terraces
Collins sedge (*Carex collinsii*)	Bogs and Carolina bays
Cypress-knee sedge (*Carex decomposita*)	Blackwater swamp forests, river sloughs
Long sedge (*Carex folliculata*)	Bogs, boggy forests
Eastern few-fruit sedge (*Carex oligocarpa*)	Rich forests, over calcareous or mafic rocks
Nutmeg hickory (*Carya myristiciformis*)	Calcareous nonriverine swamps, oak flatwoods
Rose coreopsis (*Coreopsis rosea*)	Upland depression ponds
Elliott's croton (*Croton elliottii*)	Shores of clay-based Carolina bays
Carolina larkspur (*Delphinium carolinianum*)	Limestone glades
Smooth purple coneflower (*Echinacea laevigata*)	Open woodlands and glades over mafic or calcareous rocks
Little bur-head (*Echinodorus tenellum* var. *parvulus*)	Drawdown zones of coastal plain ponds, pineland ponds, blackwater riverbanks
Southern swamp privet (*Forestiera acuminata*)	Swamp forests
Green-fringe orchid (*Platanthera lacera*)	Swamps, bogs, seepages
Two-wing silverbell (*Halesia diptera*)	Bottomland forests, forested edges of brackish marshes
Little silverbell (*Halesia parviflora*)	Moist slopes, coves, creek-banks, bottomlands

Table 2-1. TES Plant Species Known to Occur on SRS *(Continued/End)*

Species	Habitat
Pondberry (*Lindera melissifolia*)	Wet flats and depressions, generally with pocosin shrubs
Bog spicebush (*Lindera subcoriacea*)	Peaty seepage bogs in headwaters of blackwater streams, with pocosin shrubs
Boykin's lobelia (*Lobelia boykinii*)	Cypress ponds and depression meadows
Spatulate seedbox (*Ludwigia spathulata*)	Sinkhole ponds, cypress-gum ponds, depression meadows, boggy shores
Carolina birds-in-a-nest (*Macbridea caroliniana*)	Swamp forests
Canada moonseed (*Menispermum canadense*)	Moist nutrient-rich forests, especially on floodplains or lower slopes
Indian olive (*Nestronia umbellula*)	Relatively mesic sites in sandhills
Sandhill lily (*Nolina georgiana*)	Sandhills
American nailwort (*Paronychia americana*)	Sandhills
Durand oak (*Quercus durandii*)	Alluvial and slope forests
Three-awned meadow-beauty (*Rhexia aristosa*)	Clay-based Carolina bays, depression meadows, and limesink ponds
West Indies meadow-beauty (*Rhexia cubensis*)	Limesink ponds
Oconee azalea (*Rhododendron flammeum*)	Sandhills, upland forests on slopes, ridges, stream bluffs
Drowned horned rush (*Rhynchospora inundata*)	Limesink depression ponds, intermittently flooded depression meadows
Slender arrowhead (*Sagittaria isoetiformis*)	Pineland ponds, clay-based Carolina bays, other seasonally flooded depressions
Sweet pitcher plant (*Sarracenia rubra*)	Seepage bogs and savannas
Canby's bulrush (*Scirpus etuberculatus*)	Beaver ponds, on peat in small depression ponds, in flowing blackwater streams
Baldwin's nut rush (*Scleria baldwinii*)	Wet savannas, under pines or pond cypress
Least trillium (*Trillium pusillum*)	Dry to dry-mesic forests and woodlands
Florida bladderwort (*Utricularia floridana*)	In deep water of natural Carolina bay lakes, other natural lakes, and limesink ponds
Dwarf bladderwort (*Utricularia olivacea*)	In floating mats (often algal) in water of limesink ponds, artificial lakes, or beaver ponds

Table 2-2. Average Temperature and Precipitation for SRS

Month	Temperature (°F)					Sweltering Days (>90°F)	Freezing Days (<32°F)	Rain (inches)
	Highest Maximum	Mean Maximum	Lowest Minimum	Mean Minimum	Average			
Jan	86	57	-3	36	46	0	10.1	4.1
Feb	86	60	12	39	49	0	6.9	4.2
Mar	90	69	11	46	57	0	2.2	4.7
Apr	99	77	29	53	65	0.9	0.1	3.1
May	99	84	38	61	73	5.3	0	3.6
Jun	108	90	48	69	79	14.5	0	5.0
Jul	107	92	58	72	82	20.1	0	5.3
Aug	107	91	56	71	81	16.8	0	5.1
Sep	104	86	41	66	76	7.2	0	4.0
Oct	96	77	28	55	66	0.5	0.1	3.0
Nov	89	68	18	45	56	0	2.2	2.8
Dec	82	60	7	39	50	0	7.2	3.7
Annual	108	76	-3	54	65	65.3	28.8	48.6

Notes:
1. Period of record 1964-2016.
2. Source: *Trends in Atmospheric Climate Parameters Measured at SRS 1964-2013* (SRNL 2016).
3. Records from 2014-2016 provided by SRS.

3.0 REMEDIAL INVESTIGATION

This chapter describes the data collected and evaluated at the four subunits that were investigated during the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU) characterization events. The four subunits include 1) the GOSB Interior, 2) GOSB Berm, 3) Pipeline, and 4) Effluent Discharge.

3.1 G-Area Oil Seepage Basin Operable Unit Investigation Overview

A comprehensive approach was implemented to address potential impact to the environment, human health, and ecological receptors at the GOSB OU. Soil, sediment, and surface water samples were collected from within the basin and surrounding area in 2009. GOSB Interior Subunit surface water samples, groundwater samples, and Effluent Discharge soil samples were collected during an additional sampling event in 2016-2017. Figure 3-1 shows the sampling locations for the 2009 and 2016-2017 campaigns.

3.2 Site Characterization and Data Usability

In 2009, a sampling campaign was conducted to determine the nature and extent of any hazardous substances in the basin and surrounding environment, and to collect sufficient data to support the human health and ecological risk assessment, contaminant migration evaluation, and principal threat source material (PTSM) analysis. Ninety-five soil, sediment, and surface water samples from fifty-three locations were collected from within the basin and the surrounding area for characterization of GOSB OU. The 2009 field investigation was conducted in compliance with procedures and methods applicable at the time of sampling. The 2009 sampling campaign consisted of:

- Soil samples collected from the GOSB Interior Subunit included ten composite basin floor/wall sediment samples. The data objective was to characterize the area of the basin exposed most consistently to the potential source term. At each location, one composite sediment sample was collected from 0- to 0.3-m (0- to 1-ft) below ground surface (bgs) and one composite sediment sample was collected from the 0.3- to 1.2-m (1- to 4-ft) bgs. Sediment samples from

the basin floor were collected below the leaf debris and decayed organic material. Paired surface water samples were collected at each of the sediment sample locations for a total of five basin surface water samples. Sediment and surface water samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) inorganics, and radiological indicators/gamma spectroscopy.

- Soil samples collected from the GOSB Berm Subunit included thirty-nine soil samples from thirteen locations along the basin perimeter at 15 m (50 ft) intervals. The data objective was to characterize the perimeter of the basin to evaluate extent of contamination from the potential source term (within the basin). At each sampling location, soil samples were collected from the 0- to 0.3-m (0- to 1-ft), 0.3- to 1.2-m (1- to 4-ft), and 2.4- to 3-m (8- to 10-ft) bgs intervals and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy.

- Soil samples collected from the Pipeline Subunit included twenty-nine locations spaced ~15-m (50-ft) apart along both sections of the buried pipeline. The data objective was to characterize the impact of any leaks. All pipeline samples were collected from the 2.4- to 3-m (8- to 10-ft) bgs along the buried clay pipe and analyzed for TCL VOCs, SVOCs, PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy.

- Soil samples collected from the Effluent Discharge Subunit included three locations at depth intervals of 0- to 0.3-m (0- to 1-ft) and 0.3- to 1.2-m (1- to 4-ft) bgs. The data objective was to characterize the impact of GOSB pipeline effluent on the shallow soil. Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy.

- In addition to samples collected from the subunits listed above, six soil samples were collected from three locations upgradient of the basin. Upgradient samples were collected from the 0- to 0.3--m (0- to 1-ft) and 0.3- to 1.2-m (1- to 4-ft) bgs intervals and analyzed for TCL VOCs, SVOCs, and pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. These upgradient samples served as local soils unimpacted by the GOSB OU.

A scoping meeting was held on May 5, 2010, with the Core Team, consisting of members of the U.S. Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and United States Department of Energy (USDOE), to review the results of the 2009 characterization for soil, sediment, and surface water media (SRNS 2010). The Core Team determined that additional sampling was needed; however, further characterization activities were placed on hold due to program funding realignment.

At a second scoping meeting held on December 9, 2015, the Core Team identified data gaps that needed to be addressed prior to the development of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI)/Baseline Risk Assessment (BRA)/Corrective Measures Study (CMS)/Feasibility Study (FS). As result of this scoping meeting, additional sampling for the GOSB OU occurred during 2016-2017. The purpose of this supplemental sampling was to address the data gaps that were identified in the previous scoping meetings, including additional surface water samples from the GOSB Interior Subunit and additional soil samples at the Effluent Discharge Subunit to further refine the nature and extent of contamination. Groundwater samples in the vicinity of the basin were also collected and evaluated to confirm whether or not a past release to the shallow aquifer had occurred (Appendix B). The 2016-2017 field investigation was conducted in compliance with Savannah River Site (SRS) 3Q1 Manual, Section 9006, *Soil Boring Investigations* (SRNS 2015a), and Section 9015, *Sampling Groundwater Monitoring Wells, Tanks/Vessels (Sample Ports or Spigots), and Surface Water* (SRNS 2015b). The 2016-2017 sampling campaign included the following soil, groundwater, and surface water samples collected from seventeen locations (SRNS 2016).

- Six surface water samples were collected at the GOSB Interior Subunit and analyzed for inorganics (metals), VOCs, SVOCs, and radiological indicators.

- Eight deep soil borings (GOSB-57 through GOSB-62, GOSB-69 and GOSB-70) were drilled by direct push to 14.4- or 21-m (48-or 70-ft) bgs for lithologic descriptions and subsequently converted to temporary 5-cm (2-in.) diameter piezometers for groundwater sampling. These temporary wells were sampled (filtered and unfiltered) and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy.

- Six soil samples were collected at the Effluent Discharge Subunit from three locations at intervals of 0- to 0.3-m (0- to 1-ft) and 0.3- to 1.2-m (1- to 4-ft) directly following the end of the pipeline subunit and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators.

Unit-Specific Constituent Screening

A data evaluation to determine the nature and extent of contamination at the GOSB OU was conducted by comparing soil and sediment data for all depth intervals to SRS background data presented in Appendix B-2 (all depths) of the approved *2006 Background Soils Statistical Summary Report for the SRS Study* (WSRC 2006). A constituent for which the maximum concentration is greater than twice the SRS background mean concentration is more likely to be present from unit-related activities and is identified as a unit-specific constituent (USC).

The USCs identified for the GOSB OU are provided in Appendix A in Tables A.2.1 through A.2.4. Constituents for which the maximum concentrations are greater than twice the SRS background mean concentrations are identified as USCs. Constituents for which no background concentrations are available are identified as USCs if detected at one or more location and depth interval. The nature and extent of unit-related contaminants is discussed in more detail in sections 3.7.3, 3.8.3, 3.9.3, and 3.10.3.

The GOSB OU data are of sufficient quality to support final remedial decisions, including the baseline human health and ecological risk assessment (SRNS 2017).

3.3 Contaminant Fate and Transport Analysis

Simulations of contaminant transport through the vadose zone were completed for each specific GOSB OU Subunit using VZCOMML©, a multi-layer vadose zone contaminant migration (CM) modeling program developed by SRS (Appendix B). For the Tier I screening, each subunit was modeled under the most conservative assumptions including maximum constituent concentrations at the maximum sample depth (i.e., shortest travel time distance in the vadose zone to water table). Constituents predicted by the model to impact groundwater at concentrations exceeding action

levels were retained as Tier I CM constituents of potential concern (COPCs). A less conservative set of assumptions was used for the Tier II analysis to impact groundwater at concentrations exceeding action levels within the evaluation time of 1,000 years (Appendix B).

3.4 Human Health Risk Assessment Methodology

The purpose of the human health risk assessment (HHRA) is to assess the potential for adverse effects to various human receptors associated with exposure to contaminants present at the GOSB OU (Appendix C). The evaluation for each subunit estimates the risk potential in the absence of remedial actions and provides a basis for determining whether or not remedial action is necessary. Statistical data summaries for each media of concern by subunit are used in the process (Appendix A). The HHRA includes the following steps:

- Identification of potential human receptors
- Identification of COPCs
- Identification of constituents of concern (COCs)
- Identification of refined constituents of concern (RCOCs)

Risk-based threshold levels (TLs) used in this assessment are obtained from the USEPA Regional Screening Levels (RSLs) website (USEPA 2016) for chemicals and from the USEPA Preliminary Remediation Goals (PRGs) website (USEPA 2017) for radiological constituents. The TLs are applied to both sediment and soil media.

For sediment and surface soil COPC screening, maximum detected concentrations from the 0- to 0.3-m (0- to 1-ft) sampling interval are compared to residential risk-based TLs, as well as two times the average background concentration for each constituent. Those constituents that exceed both the TLs for sediment/surface soil and the background values are identified as COPCs and are carried forward into risk or hazard calculations for resident and industrial worker receptors, consistent with the subunit-specific conceptual site models (CSMs) presented in Chapter 2. As discussed in Chapter 2, the most likely human receptor for risks associated with the GOSB OU subunits is the industrial worker. For comparative purposes, a risk evaluation was also conducted for a hypothetical, future resident.

Exposure point concentrations, which are concentrations in an exposure medium to which a receptor may be exposed, consist of the lower of either the 95% upper confidence limit on the mean concentrations for constituents or the maximum detected concentration used in the formal risk/hazard calculations. Results of the risk and hazard calculations identify human health COCs for either sediment or soil where both the hazard index (HI) and individual constituent hazard quotients (HQs) exceed 1 for noncarcinogens and constituent-specific risk exceeds 1E-06. Constituents identified as COCs are carried forward for further evaluation.

For surface water, maximum detected concentrations are compared to TLs only. For surface water, maximum contaminant levels (MCLs) or tap water PRGs/RSLs/ambient water quality criterion in the absence of a MCL are identified as the TLs. Constituents with a maximum detected concentration greater than the TL were identified as COCs and are carried forward for further evaluation.

Individual constituents that are identified as a COC are further evaluated in a refinement step. The refinement step is an uncertainty evaluation that includes an interpretive discussion of the applicable uncertainty factors (lines of evidence) and a recommendation whether the constituent should or should not be identified as a RCOC and carried forward for further remedial evaluation. The major categories of uncertainty used in the evaluation include the following:

- Unit related uncertainty related to the nature and extent of contamination, consistency with history of use, and presence in background
- Data quality and risk assessment uncertainties related to data quality and physical characteristics
- Risk assessment uncertainty related to toxicity data and changes in constituent concentrations, or lack thereof, due to natural decay or transformation

The results of this process determine which remedial actions need to be evaluated in order to protect human health receptors. Remedial action objectives (RAOs) for protection of human health are developed for constituents identified as RCOCs and are discussed in more detail in Chapter 4.

3.5 Ecological Risk Assessment Methodology

The purpose of the ecological risk assessment (ERA) is to assess the potential for adverse effects to terrestrial and aquatic/semi-aquatic ecological receptors (wildlife, benthic organisms, and aquatic organisms) associated with potential exposure to contaminants present at the GOSB OU (Appendix D). The evaluation for each subunit estimates the risk potential to ecological receptors in the absence of remedial actions and provides a basis for determining whether or not remedial action is necessary. The process follows the latest available USEPA guidance (USEPA 2003, USEPA 2015), as well as input from the staff of USEPA Region 4 and the SCDHEC. Statistical data summaries for each media of concern by subunit are used in the process (Appendix A). The ERA includes the following:

- Identification of risk assessment exposure groups and exposure pathways,
- Identification of potential ecological (wildlife) receptors and assessment endpoints, including terrestrial and aquatic,
- Identification of constituents of potential ecological concern (COPECs),
- Identification of COPCs,
- Identification of RCOCs.

Risk-based TLs used in the ERA are no observed adverse effects level and lowest observed adverse effects level values obtained from the USEPA Region 4 ERA Supplemental Guidance Interim Draft (USEPA 2015) and the Los Alamos National Laboratory EcoRisk Database (LANL 2015).

The ERA is conducted by comparing constituent concentrations in environmental media within each subunit, including sediment, soil, and surface water with regulatory or technically defensible screening values called ecological screening values (ESVs), as well as two times the mean concentration in SRS soil background. Constituents that are less than an ESV are eliminated from further consideration in the ERA, while those that both exceed an ESV and background are identified as COPECs and are retained for further examination by calculating refinement-level hazard (ecological HQs) using refinement screening values (RSVs). Constituents with a

refinement HQ greater than 1 are identified as COPCs and brought forward in an uncertainty evaluation.

A recommendation of whether or not a constituent is identified as a RCOC is made following a refinement step. This step considers the following lines of evidence (same as HHRA):

- Unit related uncertainty related to the nature and extent of contamination, consistency with history of use, and presence in background
- Data quality and risk assessment uncertainties related to data quality and physical characteristics
- Risk assessment uncertainty related to toxicity data and changes in constituent concentrations, or lack thereof, due to natural decay or transformation

The results of this process determine remedial action need to be evaluated in order to protect ecological receptors. RAOs for protection of ecological receptors are developed for constituents identified as RCOCs and are discussed in more detail in Chapter 4.

3.6 Principal Threat Source Material Methodology

The PTSM evaluation for the GOSB OU is presented in Appendix E. The concept of principal threat waste and low-level threat waste, as developed by the USEPA in the National Contingency Plan (NCP) (40 CFR 300.430(a)(1)(iii)), is to be applied on a site-specific basis when characterizing source material. Source materials include or contain hazardous substances, pollutants, or contaminants that act as a reservoir for migration to surface water, or air, or that act as a source for direct exposure. The determination of whether or not the source materials present at a waste unit would be classified as PTSM is based principally on the USEPA guidance (USEPA 1991).

In determining whether the source should be preliminarily considered PTSM, the evaluation considers the cumulative effects of both the potential risk from carcinogenic constituents and the adverse health effects from non-carcinogens to human receptors. The toxicity assessment of the

source material is based on the potential exposure of an industrial worker, which is the most appropriate receptor scenario at the GOSB OU.

The source material (i.e., in both sediment and soil) from all depth intervals is preliminarily considered to be PTSM if the cumulative risk exceeds one of the following toxicity threshold criteria:

- Carcinogens: greater than 1E-03 industrial worker risk
- Non-carcinogens: industrial worker HI greater than 10

If the threshold criteria for PTSM is not exceeded based on a maximum concentration, then PTSM is not present and it is not necessary to carry the assessment into an uncertainty evaluation. An uncertainty evaluation is performed on potential PTSM constituents using similar criteria as that done for the identification of human health RCOCs. This includes, but is not limited to, ~~frequency of detection and~~ assessing the potential for natural degradation, or lack thereof, that would reduce concentrations over time, as applicable.

3.7 G-Area Oil Seepage Basin Interior Subunit

3.7.1 G-Area Oil Seepage Basin Interior Subunit Description

The GOSB is ~45-m (150-ft) long and ~28.5-m (95-ft) wide. The basin is ~3-m (10-ft) deep around the edges of the basin with berms on the northern and southern sides (0.9-m [3-ft] and 0.6-m [2-ft] high, respectively). The deepest part of the basin, near the center, is ~4.8-m (16-ft) bgs. Based on these dimensions, the basin has a volume of ~651,401 m^3 (852,000 yd^3). The volume in the basin fluctuates based on rainfall and evaporation. The basin was estimated to contain ~1,567,160.48 L (414,000 gal) of rainwater in 2017.

3.7.2 G-Area Oil Seepage Basin Interior Subunit Characterization and Data Summary

Ten composite basin floor/wall sediment samples from five locations were collected from within the basin in 2009. At each location, one composite sediment sample was collected from the 0- to 0.3-m (0- to 1-ft) depth interval and one composite sediment sample was collected from the

0.3- to 1.2-m (1- to 4-ft) depth interval. Sediment samples from the basin floor were collected below the leaf debris and decayed organic material. Paired surface water samples were collected at each of the sediment sample locations for a total of five basin water samples. Sediment and surface water samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. ~~The laboratory analyses of the 2009 GOSB Interior Subunit sediment samples from 0- to 0.3-m (0- to 1-ft) depth interval yielded seven constituents that exceed the respective RSL/PRG (Figure 3-2), including arsenic, benzo[a]pyrene, potassium-40, thallium, dieldrin, dichlorodiphenyldichloroethylene (DDE), and heptachlor epoxide.~~

Several of the surface water samples collected in 2009 had issues with high turbidity and yielded multiple exceedances. In 2015, the Core Team recommended additional sampling of the basin surface water (filtered and unfiltered) to further evaluate potential contamination from dissolved constituents. Six surface water samples were collected in 2016 from the within the basin and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. Constituents detected in these surface water samples included inorganics (metals), VOCs, and radiological indicators. The 2016 unfiltered samples reported concentrations above the MCL/RSL for only alpha- and beta-benzene hexachloride. The corresponding filtered results have no exceedances of MCLs/RSLs. Figure ~~3-3~~ 3-2 shows the 2009 surface water and 2016 unfiltered surface water exceedances.

3.7.3 G-Area Oil Seepage Basin Interior Subunit Nature and Extent of Contamination

Constituents identified as USCs for the GOSB Interior Subunit are shown in Table A.2.1. The primary contaminants in the basin interior are pesticides. A group of pesticides including alpha-Chlordane, gamma-Chlordane, dichlorodiphenyldichloroethane (DDD), dichlorodiphenyldichloroethylene (DDE), dieldrin, and heptachlor epoxide have been identified in sediment in the basin bottom of the GOSB Interior Subunit. Silver present in the basin sediments is likely associated with a silver-containing pesticide.

The horizontal and vertical extent of contamination at the GOSB OU is represented by a series of maps and cross-sections. The contaminants are generally co-located. Two pesticides, dieldrin and

gamma-Chlordane, have been selected to represent the extent of contamination because they are the most laterally and vertically extensive contaminants and pose some of the higher risks to human health and the environment. The highest concentrations of contaminants are located in the shallowest depth interval at the deepest portion of the basin.

The lateral extent of dieldrin at the GOSB is depicted in three maps (Figures 3-3 through 3-5). In Figure 3-3, the concentrations of dieldrin measured in sediment and soil samples taken from the 0- to 0.3-m (0- to 1-ft) depth interval are posted on a map of the entire GOSB OU. Three sample locations at this depth interval in the Basin Interior Subunit exceed human health and/or ecological risk-based standards. In Figure 3-4, the concentrations of dieldrin from samples taken from the 0.3- to 1.2-m (1- to 4-ft) depth interval are posted on the map. No samples from the 1- to 4-ft depth interval exceed risk-based standards for dieldrin.

The lateral extent of gamma-Chlordane at the GOSB is depicted in three maps (Figures 3-7 through 3-9). In Figure 3-7 and Figure 3-8, the concentrations of gamma-Chlordane measured in sediment and soil samples taken from the 0-to 0.3-m (0- to 1-ft) and 0.3- to 1.2-m (1- to 4-ft) depth intervals are posted on a map of the entire GOSB Operable Unit. All five sample locations at the Basin Interior Subunit exceed human health and/or ecological risk-based standards for gamma-Chlordane in both depth intervals. The highest concentrations occur in the shallowest interval in the deepest portion of the basin.

The vertical extent of contamination at the GOSB OU is presented in stylized cross-sections (Figure 3-6 and Figure 3-10). In general, contaminant concentrations are highest in the shallowest interval at the deepest portion of the basin and decrease in concentration with depth.

Soil, sediment, and groundwater sampling at the GOSB are sufficient to determine the nature and extent of contamination for the GOSB Interior Subunit, and the presence or absence of problems warranting response action. The highest concentrations of contaminants occur in the deepest portion of an open basin (that if filled in will be ~3 m (10 ft) below ground surface). The highest concentrations of contaminants are relatively immobile. A contaminant migration analysis has been performed as described in Section 3.7.4 *G-Area Oil Seepage Basin Interior Subunit Fate and Transport Evaluation Results*. Results of the contaminant migration evaluation indicate the

contaminants in the Basin Interior Subunit are not a potential source for groundwater contamination. Groundwater samples from temporary water table wells (Figures 3-11 and 3-12) were taken to confirm that contaminants had not migrated to groundwater. Groundwater samples taken from the water table at the GOSB were all non-detect for dieldrin and gamma-Chlordane.

~~Maximum detections of constituents observed in the GOSB Interior Subunit sediments were compared to two times the average SRS all-depths background concentrations (WSRC 2006). Constituents exceeding two times average background concentrations for the GOSB Interior Subunit included polycyclic aromatic hydrocarbons (PAHs) (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene), and naturally occurring inorganics (antimony, barium, cadmium, calcium, chromium, cobalt, copper, lead, magnesium, mercury, nickel, silver, thallium, zinc), and radionuclides (potassium-40). Additionally, seven constituents including arsenic, benzo[a]pyrene, thallium, dieldrin, DDE, heptachlor epoxide, and potassium-40 were detected above the RSL/PRG in five 0- to 0.3-m (0- to 1-ft) sediment samples. The volume of sediment in the basin is estimated to be ~170 m^3 (223 yd^3).~~

3.7.4 G-Area Oil Seepage Basin Interior Subunit Fate and Transport Evaluation Results

The Tier I screening for the GOSB Interior Subunit was modeled in VZCOMML© using a 6-m (20-ft) source layer, corresponding to the depth of the deepest available soil sample. Maximum concentrations were used for all constituents detected in the subunit. The water table was modeled at 5.4 m (18 ft), as the bottom of the basin extends to ~4.8-m (16-ft) bgs. This analysis identified eleven constituents as Tier 1 CM COPCs including benzo[a]anthracene, benzo[b]fluoranthene, aldrin, dieldrin, heptachlor epoxide, DDD, DDE, cobalt, silver, thallium soluble salts, and potassium-40. In the follow-up Tier II analysis, no Tier II CM COPCs were identified. Therefore, the GOSB Interior Subunit is not a potential source for groundwater contamination.

3.7.5 G-Area Oil Seepage Basin Interior Subunit Risk Assessment Results

Below is a summary of the risk assessment evaluations conducted for the GOSB Interior Subunit.

3.7.5.1 GOSB Interior Subunit Human Health Risk Assessment (HHRA)

The HHRA includes risk calculations for the resident and industrial worker scenarios for the GOSB Interior Subunit (Appendix C).

3.7.5.1.1 Sediment Media

Results of each step of the HHRA for sediment media are summarized below and shown in Figures 3-13 and 3-14:

- COPCs: chromium, cobalt, lead, silver, thallium, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, alpha-chlordane, gamma-chlordane, DDE, dieldrin, heptachlor epoxide, potassium-40, and uranium-238

- COCs include the following:
  - Resident scenario: chromium, lead, thallium, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, alpha-chlordane, gamma-chlordane, DDE, dieldrin, heptachlor epoxide, potassium-40, and uranium-238
  - Industrial worker scenario: chromium, gamma-chlordane, dieldrin, heptachlor epoxide, potassium-40, and uranium-238

- RCOCs for sediment include the following:
  - Resident scenario: alpha-chlordane (risk = 2.6E-06), gamma-chlordane (risk = 6.4E-06), DDE (risk = 2.3E-06), dieldrin (risk = 1.0E-05) and heptachlor epoxide (risk = 9.1E-06) with a total cumulative risk (TCR) = 3.0E-05
  - Industrial worker scenario: gamma-chlordane (risk = 1.4E-06), dieldrin (risk = 2.4E-06), and heptachlor epoxide (risk = 1.9E-06) with a TCR associated with these pesticide RCOCs = 5.7E-06

3.7.5.1.2 Surface Water Media

Results of each step of the HHRA for surface water media are summarized below and shown in Figure 3-15:

- COCs: aluminum, cadmium, chromium, cobalt, iron, lead, silver, alpha-benzene hexachloride, beta-benzene hexachloride, DDD, DDE, dieldrin, and bismuth-214

- RCOCs for surface water: none

3.7.5.2 GOSB Interior Subunit Ecological Risk Assessment

The ERA includes risk calculations for the ecological receptors for the GOSB Interior Subunit (Appendix D).

3.7.5.2.1 Sediment Media

Results of each step of the ERA for the sediment media are summarized below and shown in Figure 3-16:

- COPECs: 1,4-dichlorobenzene, 2-methylnaphthalene, alpha-chlordane, antimony, barium, benzo[a]anthracene, benzo[b]fluoranthene, cadmium, caprolactam, chromium, chrysene, copper, cyanide, DDD, DDE, dieldrin, fluoranthene, fluorene, gamma-chlordane, heptachlor, heptachlor epoxide, lead, lead-214, mercury, methylcyclohexane, nickel, phenanthrene, potassium-40, pyrene, silver, thallium, thallium-208, and zinc

- COPCs: 2-methylnaphthalene, alpha-chlordane, barium, cadmium, caprolactam, copper, DDD, DDE, dieldrin, fluoranthene, fluorene, gamma-chlordane, heptachlor epoxide, lead, lead-214, mercury, methylcyclohexane, phenanthrene, potassium-40, silver, thallium, and thallium-208

- RCOCs for sediment: alpha-chlordane, DDD, DDE, dieldrin, gamma-chlordane, heptachlor epoxide, and silver

3.7.5.2.2 Surface Water Media

Results of each step of the ERA for surface water media are summarized below and shown in Figure 3-17:

- COPECs: alpha-benzene hexachloride, alpha-chlordane, aluminum, barium, beryllium, bismuth-214, cadmium, caprolactam, chromium, cobalt, copper, cyanide, DDD, DDT, gamma-chlordane, iron, lead, lead-214, manganese, mercury, nickel, silver, vanadium, and zinc

- COPCs: alpha-benzene hexachloride, alpha-chlordane, aluminum, barium, beryllium, bismuth-214, cadmium, caprolactam, chromium, cobalt, copper, DDD, DDT, gamma-chlordane, iron, lead, lead-214, manganese, mercury, nickel, silver, vanadium, and zinc

- RCOCs for surface water: alpha-chlordane, gamma-chlordane, and silver

3.7.6 G-Area Oil Seepage Basin Interior Subunit Principal Threat Source Material

Below is a summary of the PTSM evaluation conducted for the GOSB Interior Subunit.

For the PTSM evaluation, data for the GOSB OU includes sediment and soil media combined from all depth intervals from all four subunits. Therefore, the results of the PTSM evaluation for the GOSB OU are used to apply to each of the four subunits. These results indicate that the HI is 0.88 and the cumulative risk is 3.9E-04. Based on the results, no PTSM RCOCs are identified for the GOSB Interior Subunit (Appendix E).

3.7.7 G-Area Oil Seepage Basin Interior Subunit Summary of Problems Warranting Action

The following are summaries of the problems warranting action for the GOSB Interior Subunit based on the CM, HHRA, ERA, and PTSM evaluations.

3.7.7.1 Fate and Transport

- Sediment (all depths): None

3.7.7.2 Human Health Risk Assessment

The following is a summary of the problems warranting action for human receptors:

- Sediment (0 to 0.3 m [0 to 1 ft]):

- Resident scenario: alpha-chlordane (risk = 2.6E-06), gamma-chlordane (risk = 6.4E-06), DDE (risk = 2.3E-06), dieldrin (risk = 1.0E-05), and heptachlor epoxide (risk = 9.1E-06) are identified as RCOCs with a TCR associated with these RCOCs = 3.0E-05
- Industrial worker scenario: gamma-chlordane (risk = 1.4E-06), dieldrin (risk = 2.4E-06), and heptachlor epoxide (1.9E-06) are identified as RCOCs with a TCR = 5.7E-06

- Surface Water: No RCOCs

3.7.7.3 Ecological Risk Assessment

The following is a summary of the problems warranting action for ecological receptors:

- Sediment (0 to 0.3 m [0 to 1 ft]): alpha-chlordane (HQ = 100), DDD (HQ = 50), DDE (HQ = 278), dieldrin (HQ = 12), gamma-chlordane (HQ = 148), heptachlor epoxide (HQ = 12) and silver (HQ = 40) are identified as RCOCs for benthic organisms

- Surface Water: alpha-chlordane (HQ = 9), gamma-chlordane (HQ = 9), and silver (HQ = 30) are RCOCs for aquatic organisms

3.7.7.4 Principal Threat Source Material

The following is a summary of the problems warranting action per the PTSM evaluation:

- Sediment/soil (all depths): No PTSM RCOCs

3.8 G-Area Oil Seepage Basin Berm Subunit

3.8.1 G-Area Oil Seepage Basin Berm Subunit Description

The GOSB Berm Subunit is comprised of the perimeter berms surrounding the GOSB Interior Subunit. The basin berm is highest on the north side at ~0.9-m (3-ft) high, the southern side is ~0.6-m (2-ft) high, while the remaining two sides are even with the surrounding grade. The volume of berm soil is estimated to be 286.7 m^3 (375 yds^3).

3.8.2 G-Area Oil Seepage Basin Berm Subunit Characterization and Data Summary

Thirty~~-~~-nine soil samples were collected from thirteen locations along the basin perimeter at 15-m (50-ft) intervals during the 2009 characterization sampling event. At each sampling location, soil samples were collected from the 0- to 0.3-m (0- to 1-ft), 0.3- to 1.2-m (1- to 4-ft), and 2.4- to 3-m (8- to 10-ft) intervals and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. ~~Constituents detected in the berm soil samples were inorganics (metals), pesticides, PAHs, PCBs, VOCs, SVOCs and radiological indicators. There were five constituents that exceed the RSL/PRG in the Berm soils (Figure 3-9, Figure 3-10, and Figure 3-11), including arsenic, iron, thallium, potassium-40, and cesium-137.~~ No data gaps were identified for the GOSB Berm Subunit at the December 9, 2015~~,~~ scoping meeting; therefore, no new data was collected for this subunit in the 2016-2017 sampling campaign.

3.8.3 G-Area Oil Seepage Basin Berm Subunit Nature and Extent of Contamination

Constituents identified as USCs for the GOSB Berm Subunit are shown in Table A.2.2. The primary contaminants at the GOSB Berm Subunit are pesticides. The lateral and vertical extent of dieldrin and gamma-Chlordane at the GOSB are depicted in six maps that show contamination at three depth intervals and two cross-sections (Figure 3~~-~~-3 through Figure 3~~-~~-10). Berm samples were taken at three depths (0- to 0.3-m [0- to 1-ft], 0.3- to 1.2-m [1- to 4-ft], and 2.4- to 3-m [8- to 10-ft]). There are no sample locations in the GOSB berm that exceed risk-based standards for dieldrin or gamma-Chlordane.

~~Maximum detections of constituents observed in the GOSB Berm Subunit were compared to two times the average SRS all-depths background concentrations (WSRC 2006). Constituents exceeding the background concentrations for the GOSB Berm Subunit were PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene), and naturally occurring inorganics (aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, zinc), and radionuclides (cesium-137 and potassium-40). Additionally, five constituents (arsenic, iron, thallium, potassium-40, and cesium-137) were reported in berm soil samples above the RSL as deep as 3-m (10-ft) bgs.~~

3.8.4 G-Area Oil Seepage Basin Berm Subunit Fate and Transport Evaluation Results

The Tier I screening for the GOSB Berm Subunit was modeled in VZCOMML© using a 2-m (7-ft) source layer, corresponding to the depth of the deepest available soil sample. Maximum concentrations were used for all detected constituents in the subunit. The GOSB Berm rises ~0.9-m (3-ft) above ground surface, and the deepest soil sample was collected at 3 m (10 ft); therefore, the source layer was set at 2.1 m (7 ft). The water table was modeled at 10.2-m (34-ft) bgs. The Tier I analysis identified eleven constituents as CM COPCs: benzo[a]anthracene, benzo[b]fluoranthene, dieldrin, DDD, DDE, Aroclor 1254, Aroclor 1260, arsenic, iron, lead, and potassium-40. In the follow-up Tier II analysis, no Tier II CM COPCs were identified for the GOSB Berm Subunit. Therefore, the GOSB Berm Subunit is not a potential source for groundwater contamination.

3.8.5 G-Area Oil Seepage Basin Berm Subunit Risk Assessment Results

Below is a summary of the risk assessment evaluations conducted for the GOSB Berm Subunit.

3.8.5.1 GOSB Berm Subunit Human Health Risk Assessment

The HHRA includes risk calculations for the resident and industrial worker scenarios for the GOSB Berm Subunit (Appendix C).

3.8.5.1.1 Soil Media

Results of each step of the HHRA for soil media are summarized below and shown in Figures 3-18 and 3-19:

- COPCs: aluminum, arsenic, chromium, iron, lead, vanadium, benzo[a]pyrene, benzo[b]fluoranthene, potassium-40, and uranium-238
- COCs include the following:
  - Resident scenario: arsenic, chromium, benzo[a]pyrene, benzo[b]flouranthene, potassium-40, and uranium-238
  - Industrial worker scenario: arsenic, chromium, potassium-40, and uranium-238

- RCOCs:
  - Resident scenario: None
  - Industrial worker scenario: None

3.8.5.2 GOSB Berm Subunit Ecological Risk Assessment

The ERA includes risk calculations for ecological receptors for the GOSB Berm Subunit (Appendix D).

3.8.5.2.1 Surface Soil

Results of each step of the ERA for the surface soil media (0 to 0.3 m [0 to 1 ft] are summarized below and shown in Figure 3-20 and 3-21:

- COPECs: aluminum, arsenic, bis(2-ethylhexyl)phthalate, chromium, copper, cyanide, endrin, endrin ketone, iron, lead, lead-214, methyl acetate, Aroclor 1254, potassium-40, thallium-208, and vanadium
- COPCs: aluminum, endrin ketone, iron, lead, lead-214, methyl acetate, potassium-40, thallium-208, and vanadium
- RCOCs for surface soil: None

3.8.5.2.2 Subsurface Soil (0.3 to 1.2 m [1 to 4 ft])

Results of each step of the ERA for the subsurface soil media (0.3 to 1.2 m [1 to 4 ft]) are summarized below and shown in Figure 3-15:

- COPECs: aluminum, arsenic, barium-133, caprolactam, chromium, iron, lead, lead-214, methyl acetate, thallium-208, and vanadium
- COPCs: aluminum, barium-133, caprolactam, iron, lead-214, methyl acetate, thallium-208, and vanadium
- RCOCs for subsurface soil media: None

3.8.6 G-Area Oil Seepage Basin Berm Subunit Principal Threat Source Material Results

Below is a summary of the PTSM evaluation conducted for the GOSB Berm Subunit.

For the PTSM evaluation, data for the GOSB OU includes sediment and soil media combined from all depth intervals from all four subunits. Therefore, the results of the PTSM evaluation for the GOSB OU are used to apply to each of the four subunits. These results indicate that the HI is 0.88 and the cumulative risk is 3.9E-04. Based on the results, no PTSM RCOCs are identified for the GOSB Berm Subunit (Appendix E).

3.8.7 G-Area Oil Seepage Basin Berm Subunit Summary of Problems Warranting Action

The following are summaries of the problems warranting action based on the CM, HHRA, ERA, and PTSM evaluation for the GOSB Berm Subunit.

3.8.7.1 Fate and Transport

- Soil media (all depths): None

3.8.7.2 Human Health Risk Assessment

The following is a summary of the problems warranting action for human receptors:

- Surface Soil (0 to 0.3 m [0 to 1 ft]): No soil RCOCs

3.8.7.3 Ecological Risk Assessment

The following is a summary of the problems warranting action for ecological receptors:

- Surface Soil (0 to 0.3 m [0 to 1 ft]): No soil RCOCs
- Subsurface Soil (0.3 to 1.2 m [1 to 4 ft]): No soil RCOCs

3.8.7.4 Principal Threat Source Material

The following is a summary of the problems warranting action per the PTSM evaluation:

- Sediment/soil media (all depths): No PTSM RCOCs

3.9 Pipeline Subunit

3.9.1 Pipeline Subunit Description

The Pipeline Subunit consists of ~57 m (190 ft) of abandoned vitrified clay pipeline at the northwest (inlet) end of the basin and ~153 m (510 ft) of pipeline at the southeast (outlet) end of the basin that discharged into an intermittent stream. Both inlet and outlet pipes are buried to a depth of ~1.8- to 2.4-m (6- to 8-ft) bgs. The basin received effluent via the pipeline from the Central Shops sanitary wastewater treatment plant from 1983 through 1992. Prior to 1983, the basin received effluent from a smaller wastewater treatment facility (WSRC 1991).

3.9.2 Pipeline Subunit Characterization and Data Summary

In 2009, twenty-nine soil samples were obtained from twenty-nine sample locations (GOSB-1 through GOSB-29), which were spaced ~7.5-m (25-ft) apart along both sections of the Pipeline Subunit. The data objective was to characterize the impact of any leaks from the pipeline. All pipeline samples were collected from the 2.4- to 3-m (8- to 10-ft) interval along the buried clay pipe and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. ~~Detected soil constituents included inorganics (metals), pesticides, VOCs, SVOCs, and radiological indicators. Arsenic, bismuth-214, lead-214, and potassium-40 were the only constituents reported in the sample set above the RSL/PRG.~~

3.9.3 Pipeline Subunit Nature and Extent of Contamination

Constituents identified as USCs for the GOSB Pipeline Subunit are shown in Table A.2.3. Samples were taken at a depth of 2.4- to 3-m (8- to 10-ft) below ground surface at the Pipeline Subunit to evaluate any potential leaks from the pipeline. Results for dieldrin and gamma-Chlordane are depicted on Figures ~~3.~~-5 and Figure 3.-9. There are no samples from locations in the Pipeline Subunit that had detections of either dieldrin or gamma-Chlordane.

~~Maximum detections of constituents observed in the Pipeline Subunit soils were compared to two times the average SRS all-depths background concentrations (WSRC 2006). Constituents~~

~~exceeding two times average background concentrations for the Pipeline Subunit were naturally-occurring inorganics (arsenic, calcium, chromium, copper, iron, lead, nickel, potassium, selenium, sodium, vanadium, zinc) and radionuclides (potassium-40). As discussed above, arsenic, bismuth-214, lead-214, and potassium-40 were reported in Pipeline Subunit soil samples above the RSL/PRG as deep as 3-m (10-ft) bgs (Figure 3-16).~~

3.9.4 Pipeline Subunit Fate and Transport Evaluation Results

The Tier I screening for the Pipeline Subunit was modeled in VZCOMML© using a 3-m (10-ft) source layer, corresponding to the depth of the deepest available soil sample. Maximum concentrations were used for all detected constituents in the subunit. The water table was modeled at 10.2-m (34-ft) bgs. The Tier I analysis identified three constituents as CM COPCs: arsenic, iron, and potassium-40. In the follow-up Tier II analysis, no Tier II CM COPCs were identified. Therefore, the Pipeline Subunit is not a potential source for groundwater contamination.

3.9.5 Pipeline Subunit Risk Assessment Results

As discussed above, the Pipeline Subunit consists of a pipe that is ~1.8- to 2.4-m (6- to 8-ft) bgs and is inaccessible to human and ecological receptors. Therefore, no risk assessments were performed on the deep soils of the Pipeline Subunit.

3.9.6 Pipeline Subunit Principal Threat Source Material

Below is a summary of the PTSM evaluation conducted for the Pipeline Subunit.

For the PTSM evaluation, data for the GOSB OU includes sediment and soil media combined from all depth intervals from all four subunits. Therefore, the results of the PTSM evaluation for the GOSB OU are used to apply to each of the four subunits. These results indicate that the HI is 0.88 and the cumulative risk is 3.9E-04. Based on the results, no PTSM RCOCs are identified for the Pipeline Subunit (Appendix E).

3.9.7 Pipeline Subunit Summary of Problems Warranting Action

The following are summaries of the problems warranting action for the Pipeline Subunit based on the CM, HHRA, ERA, and PTSM evaluations.

3.9.7.1 Fate and Transport

- Soil media (all depths): None

3.9.7.2 Human Health Risk Assessment

The following is a summary of the problems warranting action for human receptors:

- Surface Soil (0 to 0.3 m [0 to 1 ft]): No soil RCOCs

3.9.7.3 Ecological Risk Assessment

The following is a summary of the problems warranting action for ecological receptors:

- Surface Soil (0 to 0.3 m [0 to 1 ft]): No soil RCOCs
- Subsurface Soil (0.3 to 1.2 m [1 to 4 ft]): No soil RCOCs

3.9.7.4 Potential Threat Source Material

The following is a summary of the problems warranting action for PTSM:

- Sediment/Soil (all depths): No PTSM RCOCs

3.10 Effluent Discharge Subunit

3.10.1 Effluent Discharge Subunit Description

The Effluent Discharge Subunit lies southeast of the basin ~30 m (100 ft) from the outlet pipe. An intermittent stream conveys drainage from the surrounding topography, including basin discharge, to an unnamed tributary of Pen Branch ~900-m (3,000-ft) southeast of the GOSB.

3.10.2 Effluent Discharge Subunit Characterization and Data Summary

Six soil samples were collected from the Effluent Discharge Subunit during the 2009 sampling event from three locations (GOSB-30 through GOSB-32) at depth intervals of 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft). Samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. ~~Detected soil constituents included inorganics (metals), pesticides, VOCs, SVOCs and radiological indicators.~~ In the December 9, 2015~~,~~ scoping meeting, the Core Team determined that more soil samples were needed to further determine the nature and extent of contamination at the end of the pipeline.

In 2016, six additional soil samples were collected from three locations (GOSB-54 through GOSB-56) at intervals of 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) to further characterize the Effluent Discharge Subunit area between the end of the Pipeline Subunit (sample location GOSB-29) and the three soil sample locations from the 2009 sampling event. The 2016 soil samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. ~~Detected soil constituents included VOCs, pesticides, PCBs, inorganics (metals), and radiological indicators. The gross alpha radionuclide trigger (20 pCi/g) was exceeded in two locations, GOSB-56 (0- to 0.3-m [0- to 1-ft] and 0.3- to 1.2-m [1- to 4-ft] intervals) and GOSB-54 (0.3- to 1.2-m [1- to 4-ft] interval). Based on the results of the radiological indicators, speciation was performed for uranium-233/234, uranium-235, uranium-238, radium-226/228, thorium-228, thorium-230, and thorium-232. As shown on Figure 3-17, arsenic, potassium-40, cesium-137, tritium, radium-226, radium-228, thorium-228, thorium-230, thorium-232, uranium-233/234, uranium-235, and uranium-238 were reported at concentrations above their respective RSL/PRG.~~

3.10.3 Effluent Discharge Subunit Nature and Extent of Contamination

Constituents identified as USCs for the GOSB Effluent Discharge Subunit are shown in Table A.2.4. Samples were taken at the 0- to 0.3-m (0- to 1-ft) and 0.3- to 1.2-m (1- to 4-ft) depth intervals at the Effluent Discharge Subunit. The lateral and vertical extent of dieldrin and gamma-Chlordane are depicted in four maps that show contamination at two depths (Figure 3-3, Figure 3-4, Figure 3-7, and Figure 3-8). There are no exceedances of risk-based standards for

dieldrin or gamma-Chlordane at the Effluent Discharge Subunit.~~Maximum detections of constituents observed in the Effluent Discharge Subunit were compared to two times the average SRS all-depths background concentrations (WSRC 2006). Maximum detections exceeding two times average background concentrations for the Effluent Discharge Subunit were PAHs (benzo[a]pyrene, benzo[b]fluoranthene), inorganics (aluminum, arsenic, barium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, vanadium, zinc); and radionuclides (cesium-137, radium-226, radium-228, thorium-228, thorium-230, thorium-232, uranium-235, uranium-238). Additionally, arsenic, benzo[a]pyrene, cesium-137, potassium-40, tritium, radium-226, radium-228, thorium-228, thorium-230, thorium-232, uranium-233/234, uranium-235, and uranium-238 were the constituents reported above the RSL/PRG from the Effluent Discharge Subunit. This volume of contaminated sediments is estimated to be ~1,437 m^3 (1,879 yds^3).~~

3.10.4 Effluent Discharge Subunit Fate and Transport Evaluation Results

The Tier I screening for the Effluent Subunit was modeled in VZCOMML© using a 1.2 m (4 ft) source layer, corresponding to the depth of the deepest available soil sample. Maximum concentrations were used for all detected constituents in the subunit. The water table was modeled at 10.2-m (34-ft) bgs. The Tier I analysis identified thirteen constituents as CM COPCs: DDE, Aroclor 1242, Aroclor 1254, Aroclor 1260, arsenic, cobalt, iron, manganese, potassium-40, radium-226, radium-228, thorium-230, and thorium-232. In the follow-up Tier II analysis, no Tier II CM COPCs were identified. Therefore, the Effluent Discharge Subunit is not a potential source for groundwater contamination.

3.10.5 Effluent Discharge Subunit Risk Assessment Results

Below is a summary of the risk assessment evaluations conducted for the Effluent Discharge Subunit.

3.10.5.1 Effluent Discharge Human Health Risk Assessment

The HHRA includes results of the risk calculations for the resident and industrial worker scenarios for the Effluent Discharge Subunit (Appendix C).

3.10.5.1.1 Soil Media

Results of each step of the process for the evaluation of the soil media are summarized below and shown in Figures 3-22 and 3-23:

- COPCs: aluminum, arsenic, chromium, cobalt, iron, vanadium, benzo[a]pyrene, thorium-232, and uranium-238
- COCs include the following:
  - Resident scenario: arsenic, chromium, benzo[a]pyrene, thorium-232, and uranium-238
  - Industrial worker scenario: arsenic, chromium, thorium-232, and uranium-238
- RCOCs:
  - Resident scenario: None
  - Industrial worker scenario: None

3.10.5.2 Effluent Discharge Ecological Risk Assessment

The ERA includes risk calculations for ecological receptors for the Effluent Discharge Subunit (Appendix D)

3.10.5.2.1 Surface Soil

Results of each step of the ERA for surface soil media (0 to 0.3 m [0 to 1 ft]) are summarized below and shown in Figure 3-24:

- COPECs: alpha-chlordane, aluminum, arsenic, copper, cyanide, iron, lead, lead-214, mercury, methyl acetate, Aroclor 1254, radium-228, selenium, silver, thallium-208, and vanadium
- COPCs: aluminum, iron, lead-214, mercury, methyl acetate, thallium-208, and vanadium
- RCOCs for surface soil: None

3.10.5.2.2 Subsurface Soil

Results of each step of the ERA for the subsurface soil media (0.3 to 1.2 m [1 to 4 ft]) are summarized below and shown in Figure 3-25:

- COPECs: aluminum, arsenic, chloromethane (methyl chloride), iron, lead, lead-214, manganese, methyl acetate, Aroclor 1254, selenium, thallium-208, and vanadium
- COPCs: aluminum, chloromethane (methyl chloride), iron, lead-214, methyl acetate, thallium-208, and vanadium
- RCOCs for subsurface soil media: None

3.10.6 Effluent Discharge Subunit Principal Threat Source Material

Below is a summary of the PTSM evaluation conducted for the Effluent Discharge Subunit.

For the PTSM evaluation, data for the GOSB OU includes sediment and soil media combined from all depth intervals from all four subunits. Therefore, the results of the PTSM evaluation for the GOSB OU are used to apply to each of the four subunits. These results indicate that the HI is 0.88 and the cumulative risk is 3.9E-04. Based on the results, no PTSM RCOCs are identified for the Effluent Discharge Subunit (Appendix E).

3.10.7 Effluent Discharge Subunit Summary of Problems Warranting Action

The following are summaries of the problems warranting action for the Effluent Discharge Subunit based on the CM, HHRA, ERA, and PTSM Evaluation for the Effluent Discharge Subunit.

3.10.7.1 Fate and Transport

- Soil media (all depths): None

Human Health Risk Assessment

The following is a summary of the problems warranting action for human receptors:

- Surface Soil media (0 to 0.3 m [0 to 1 ft]): No RCOCs

3.10.7.2 Ecological Risk Assessment

The following is a summary of the problems warranting action for ecological receptors:

- Surface Soil (0 to 0.3 m [0 to 1 ft]): No soil RCOCs
- Subsurface Soil (0.3 to 1.2 m [1 to 4 ft]): No soil RCOCs

3.10.7.3 Principal Threat Source Material

The following is a summary of the problems warranting action:

- Sediment/soil media (all depths): No PTSM RCOCs

3.11 Applicable or Relevant and Appropriate Requirements Evaluation

Analytical data from the GOSB OU are compared to the chemical-specific applicable or relevant and appropriate requirements (ARARs) for sediment/soil and surface water media. The ARAR evaluation for sediment and soil media considers the GOSB OU dataset as a whole and is not performed separately for each subunit. The ARAR evaluation summarizes the results of the HHRA and ERA presented in Appendices C and D, respectively.

3.11.1 Sediment/Soil

There are no established ARARs for sediment media. The GOSB OU sediment/soil media is considered to be soil for the purposes of this conservative evaluation. For soil, chemical-specific ARARs or to be considered (TBC) requirements exist under federal and state regulations for PCBs and lead. PCBs are governed by the Toxic Substances Control Act (40 Code of Federal Regulations [CFR] Part 761). The final rule for PCB disposal was established on August 20, 1998; it addresses residual levels of PCB remediation waste that can be left in place. Action levels are based on site-specific conditions.

For high-occupancy areas (both residential and industrial scenarios), 40 CFR 176.125 (4)(v) states that spills be decontaminated to 10 milligrams per kilogram (mg/kg) PCBs, provided that soil is excavated to a minimum depth of 25 cm (10 in) and that the excavated soil is replaced with clean soil (i.e., soil containing less than 1 mg/kg PCBs). For low-occupancy areas (e.g., the most likely

onsite worker scenario), the regulation requires that action levels be established in the range of 25 to 50 mg/kg and recognizes that PCB concentrations near the high end of this range may be protective of human health and the environment at sites where exposure is limited through institutional controls. Sediment/soil in the GOSB OU was evaluated against the more conservative high-occupancy remediation level of 10 mg/kg. The maximum detected concentration of PCBs is 0.0366 mg/kg (Aroclor 1254) (Appendix A, Table A.5.1). The highest detected concentration of PCBs in GOSB OU sediment/soil is below the ARAR soil screening level.

For lead in soil, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) value of 400 mg/kg was set by the USEPA Office of Solid Waste Emergency Response and adopted as a TBC for the screening process. The maximum detected concentration of lead is 72.9 mg/kg (Appendix A, Table 5.1). The highest detected concentration of lead in GOSB OU sediment/soil is below the ARAR soil screening level.

There are no ARAR RCOCs for sediment/soil media in the GOSB OU.

3.11.2 Surface Water

ARARs for surface water are identified as 1) MCLs promulgated under USEPA Drinking Water Regulations and Health Advisories, or 2) SCDHEC Ambient Water Quality Criteria (AWQC) (SC R.61-68), and 3) USEPA National AWQC. However, the surface water present in the GOSB OU (i.e., GOSB Interior Subunit) is accumulated rainwater with the level within the basin fluctuating based on rain events and thus not considered a Water of the State. Therefore, ARARs for surface water do not apply.

3.12 Summary of Refined Constituents of Concern and Refined Conceptual Site Models

The four subunits at the GOSB OU were investigated to determine the nature and extent of contamination, the risk to the resident, industrial worker, and the environment, the presence of PTSM, and if there are constituents that are a contaminant migration concern. Surface water and soil samples were collected, evaluated, and screened against the appropriate regulatory thresholds and protocols to identify constituents of concern that may warrant further consideration for remedial action. Results of the evaluations performed indicate that RCOCs were identified only

in sediment media within the GOSB Interior Subunit (Table 3-1). Human health RCOCs were identified (Appendix C) in sediment only for the resident (five RCOCs with a TCR = 3.0E-05) and industrial worker receptors (three RCOCs for a TCR of 5.7E-06). Ecological RCOCs were identified (Appendix D) in surface water (three RCOCs with HQs varying from 9 to 30) and sediment (six RCOCs with HQs varying from 12 to 278) for aquatic organisms and benthic organisms, respectively. Based on the results of the PTSM evaluation, no PTSM RCOCs were identified (Appendix E). Finally, the contamination migration analysis (Appendix B) concluded that there is no contamination migration from the GOSB OU into underlying groundwater.

With the results of the HHRA, ERA, PTSM and CM evaluations, the preliminary CSMs (Figures 2-8 through 2-11) are upgraded to refined CSMs to provide a visual summary of the potential risks/hazards for each receptor by exposure route. Filled circles within boxes beneath applicable receptors indicate a potential unacceptable exposure as a result of a quantitative evaluation. Below is a summary of the elements of the refined CSMs by GOSB subunit by exposure medium in which potential impacts are noted.

3.12.1 GOSB Interior Subunit

Figure 3-23 presents the refined CSM for the GOSB Interior Subunit. Two media presents (surface water and sediment) and their potential for migration to groundwater, were evaluated.

3.12.1.1 Surface Water

Contact with surface water present in the basin by aquatic organisms only may result in unacceptable risk from the contaminants alpha-chlordane, gamma-chlordane, and silver (Figure 3-26). Therefore, surface water represents an exposure medium that requires further evaluation in the CMS/FS for potential remedial action (Chapter 5).

3.12.1.2 Sediment

Contact with surface sediment (via inhalation, ingestion, and dermal contact) by both a resident and industrial worker may result in unacceptable risk associated with the contaminants alpha-chlordane, gamma-chlordane, DDE, dieldrin, and heptachlor epoxide (Figure 3-23). Also, contact with sediments (via ingestion and dermal contact) by aquatic organisms associated with the

contaminants alpha-chlordane, gamma-chlordane, DDD, DDE, dieldrin, heptachlor epoxide, and silver may result in unacceptable risk to these ecological receptors. Therefore, sediment represents an exposure medium that requires further evaluation in the CMS/FS for potential remedial action (Chapter 5).

3.12.1.3 GOSB Berm Subunit

The refined CSM for the GOSB Berm Subunit (Figure 3-27) indicates that no further evaluations of surface, subsurface, or deep soils within this subunit are required in the CMS/FS.

3.12.1.4 Pipeline Subunit

The refined CSM for the Pipeline Subunit (Figure 3-28) indicates that no further evaluations of surface, subsurface, or deep soils within this subunit are required in the CMS/FS.

3.12.1.5 Effluent Discharge Pipeline

The refined CSM for the Effluent Discharge Subunit (Figure 3-29) indicates that no further evaluations of surface, subsurface, or deep soils within this subunit are required in the CMS/FS.

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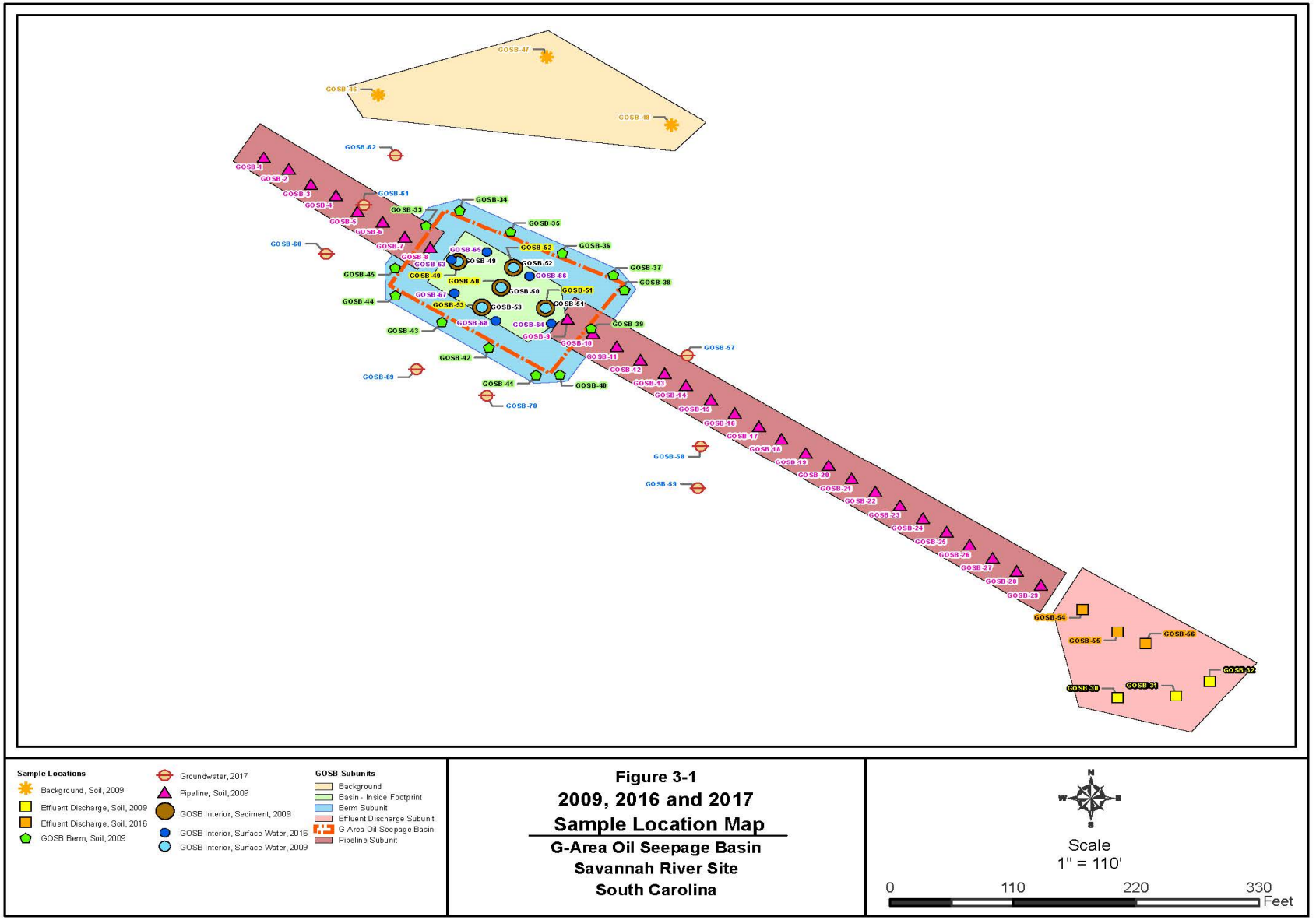


Figure 3-1. 2009, 2016, and 2017 Sample Location Map

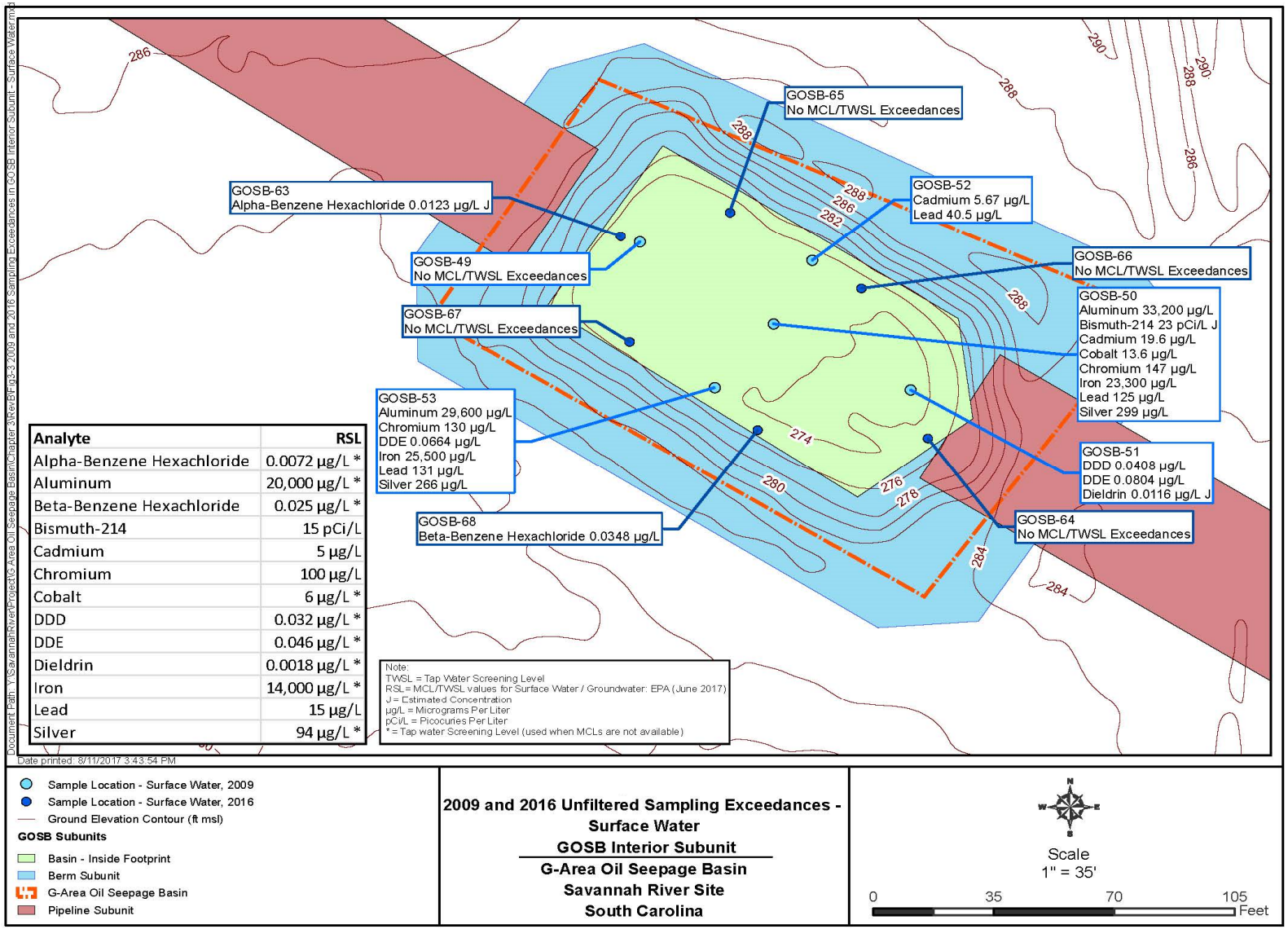


Figure 3-2. ~~GOSB Dieldrin Detections - Soil and Sediment (0 to 1 ft)~~2009 and 2016 Unfiltered Sampling Exceedances, Surface Water

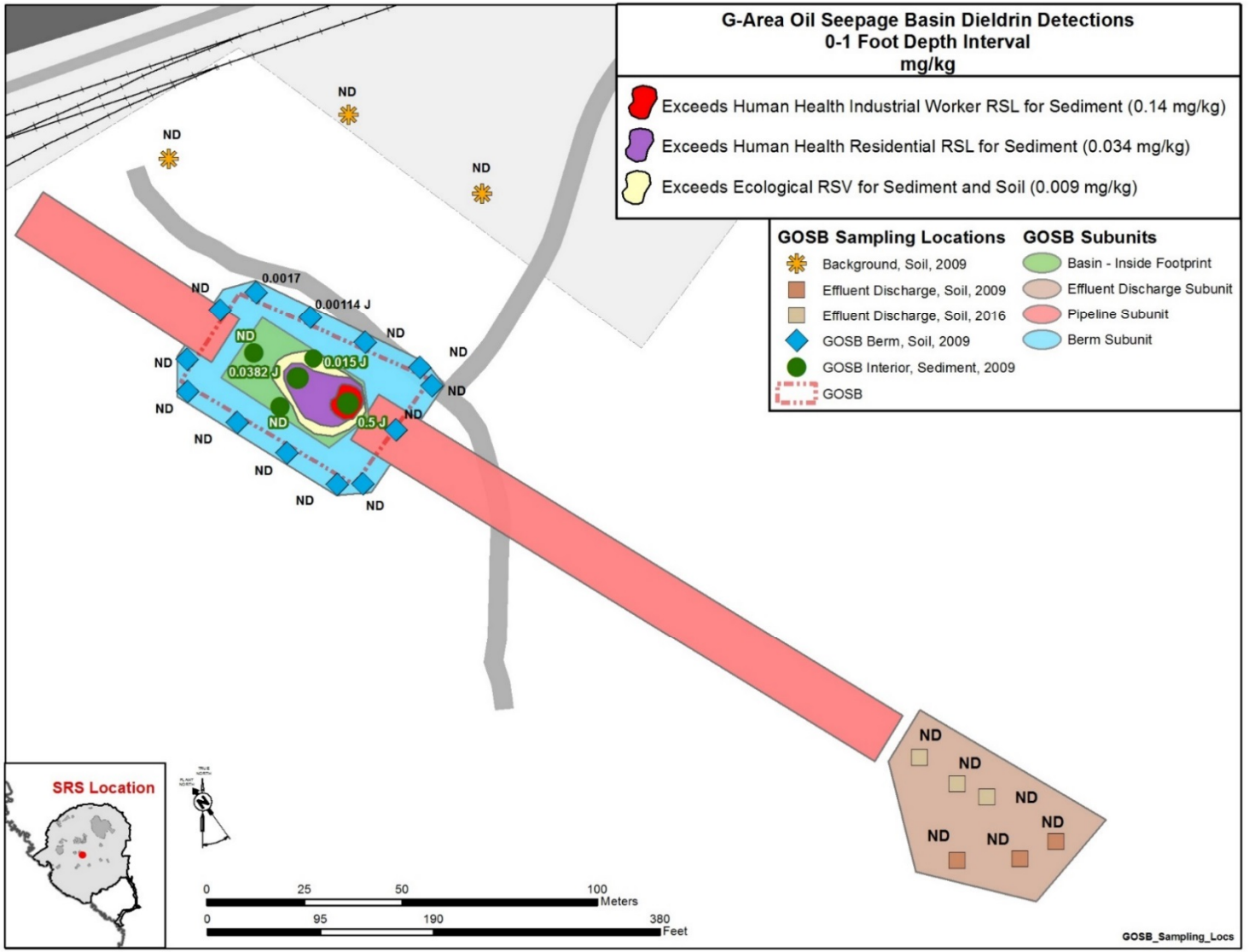


Figure 3-3. GOSB Dieldrin Detections – Soil and Sediment (0 to 1 ft)

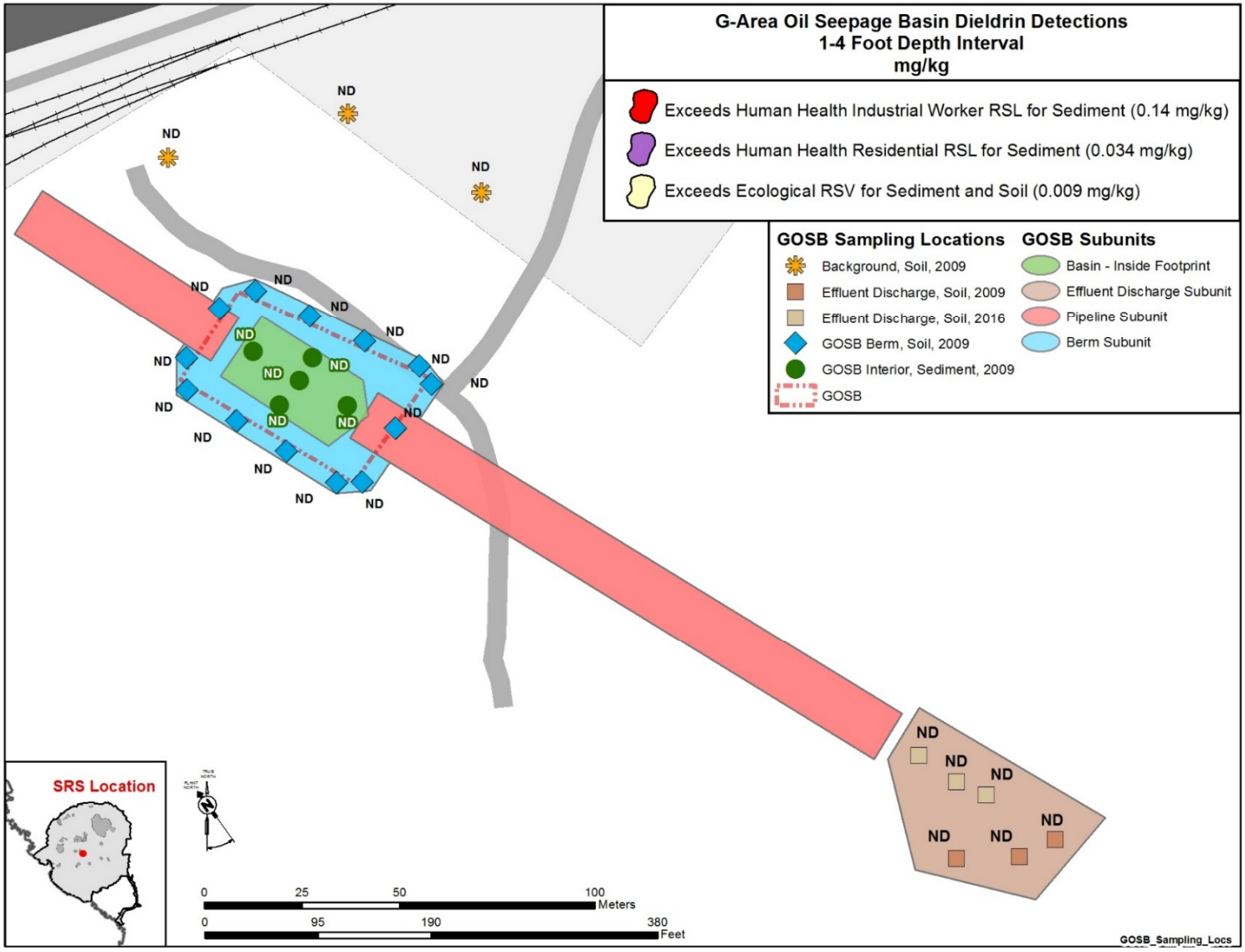


Figure 3-4. GOSB Dieldrin Detections – Soil and Sediment (1 to 4 ft)

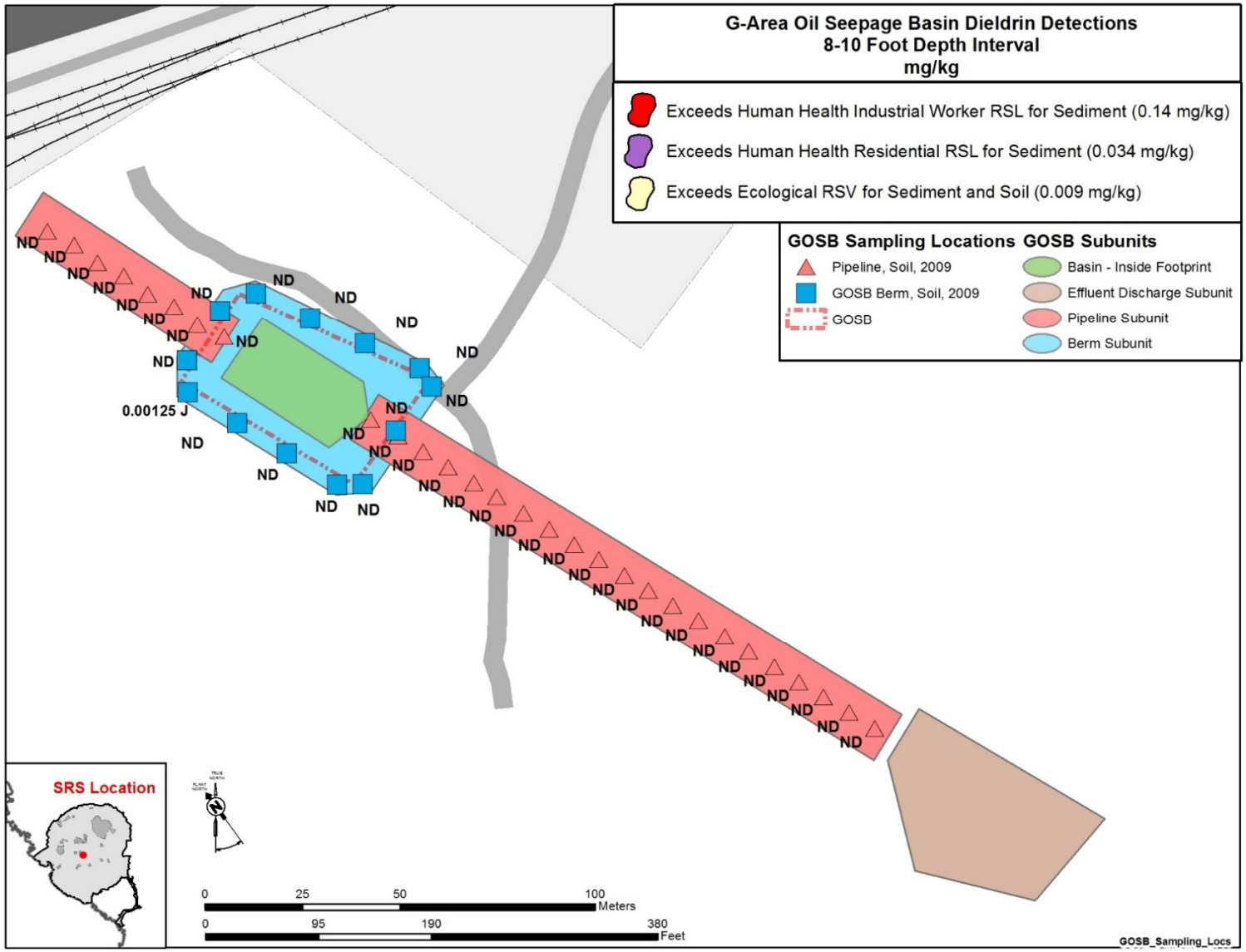


Figure 3-5. GOSB Dieldrin Detections – Soil (8 to 10 ft)

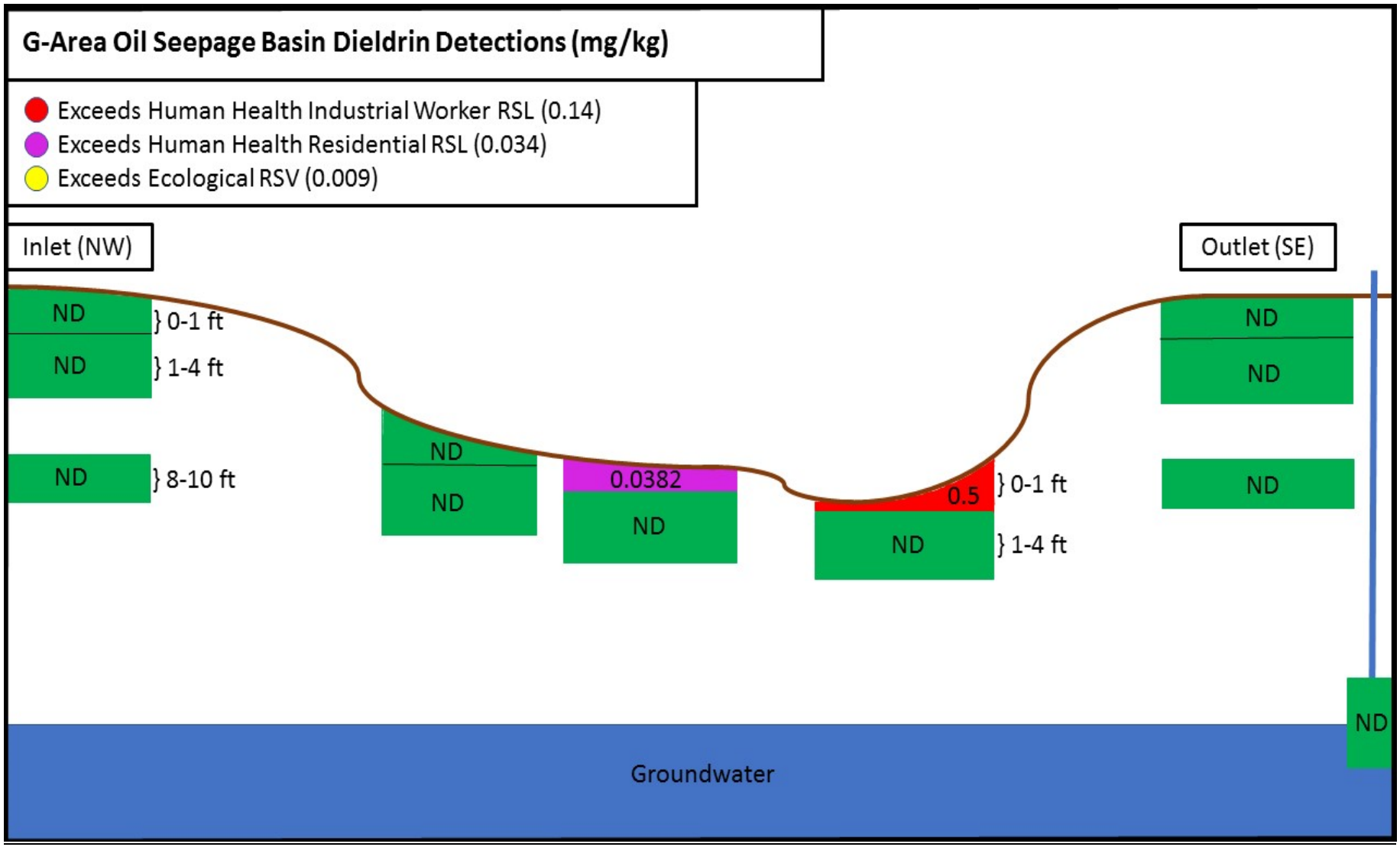


Figure 3-6. Cross-Section of GOSB Dieldrin Detections – Soil, Sediment, and Groundwater

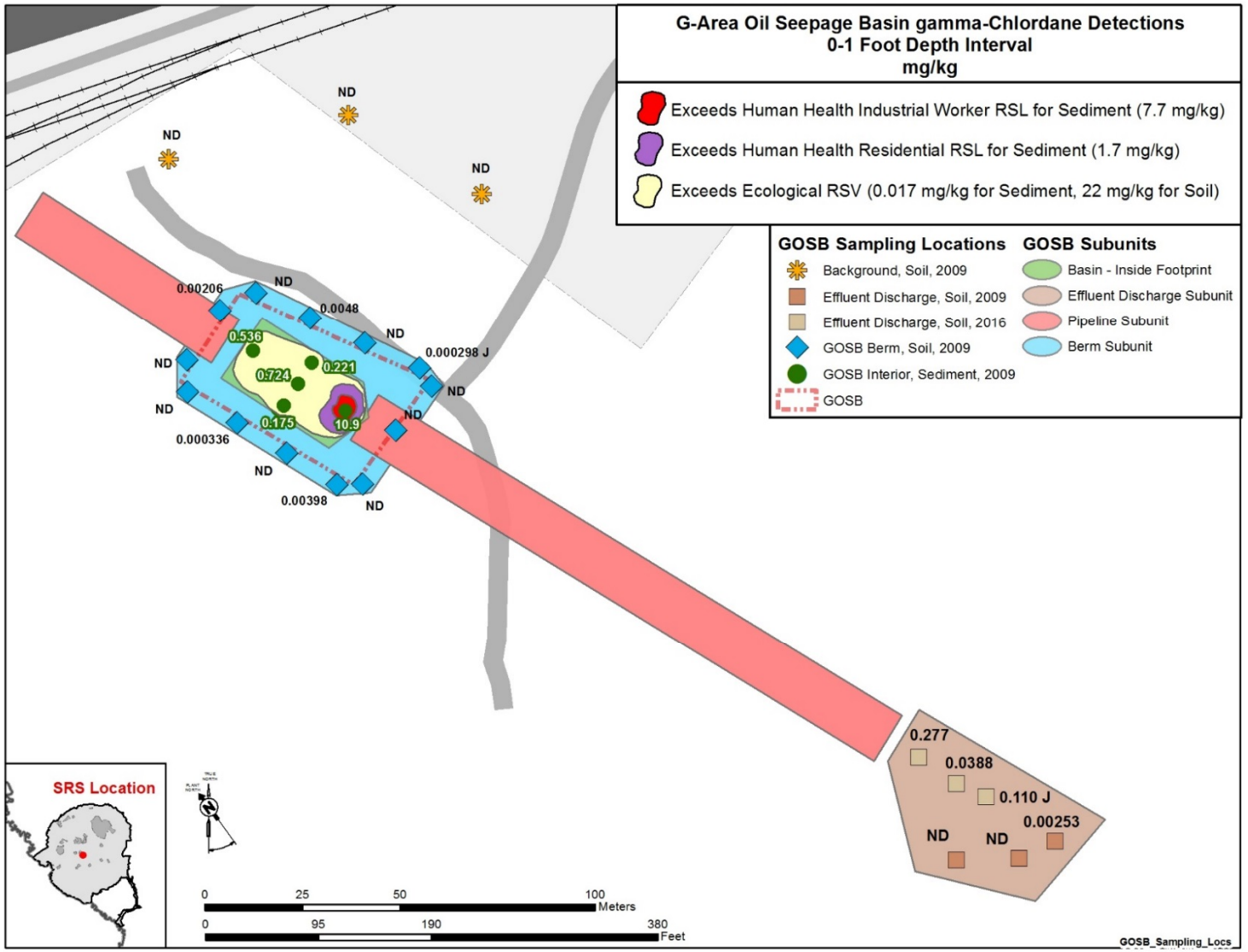


Figure 3-7. GOSB gamma-Chlordane Detections – Soil and Sediment (0 to 1 ft)

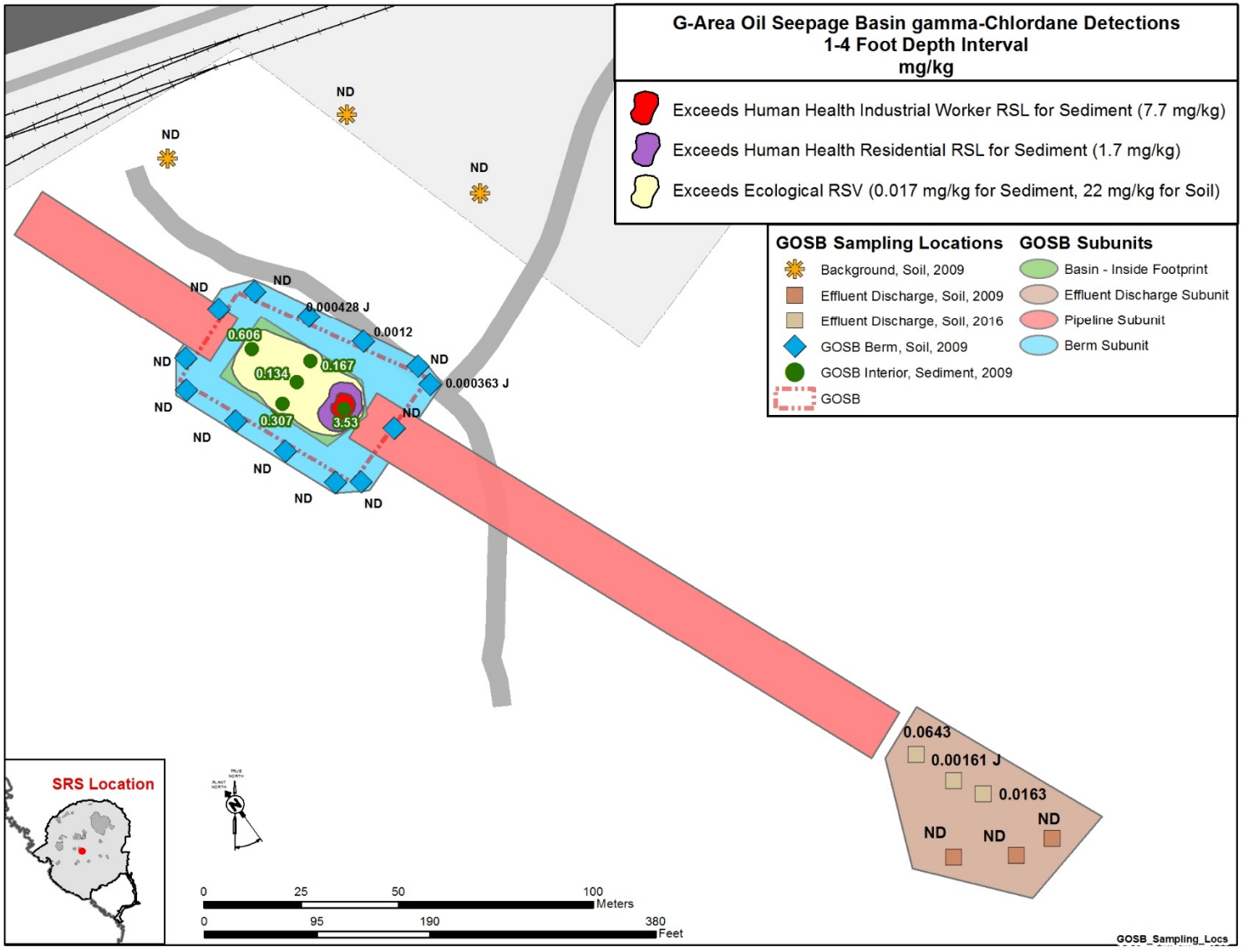


Figure 3-8. GOSB gamma-Chlordane Detections – Soil and Sediment (1 to 4 ft)

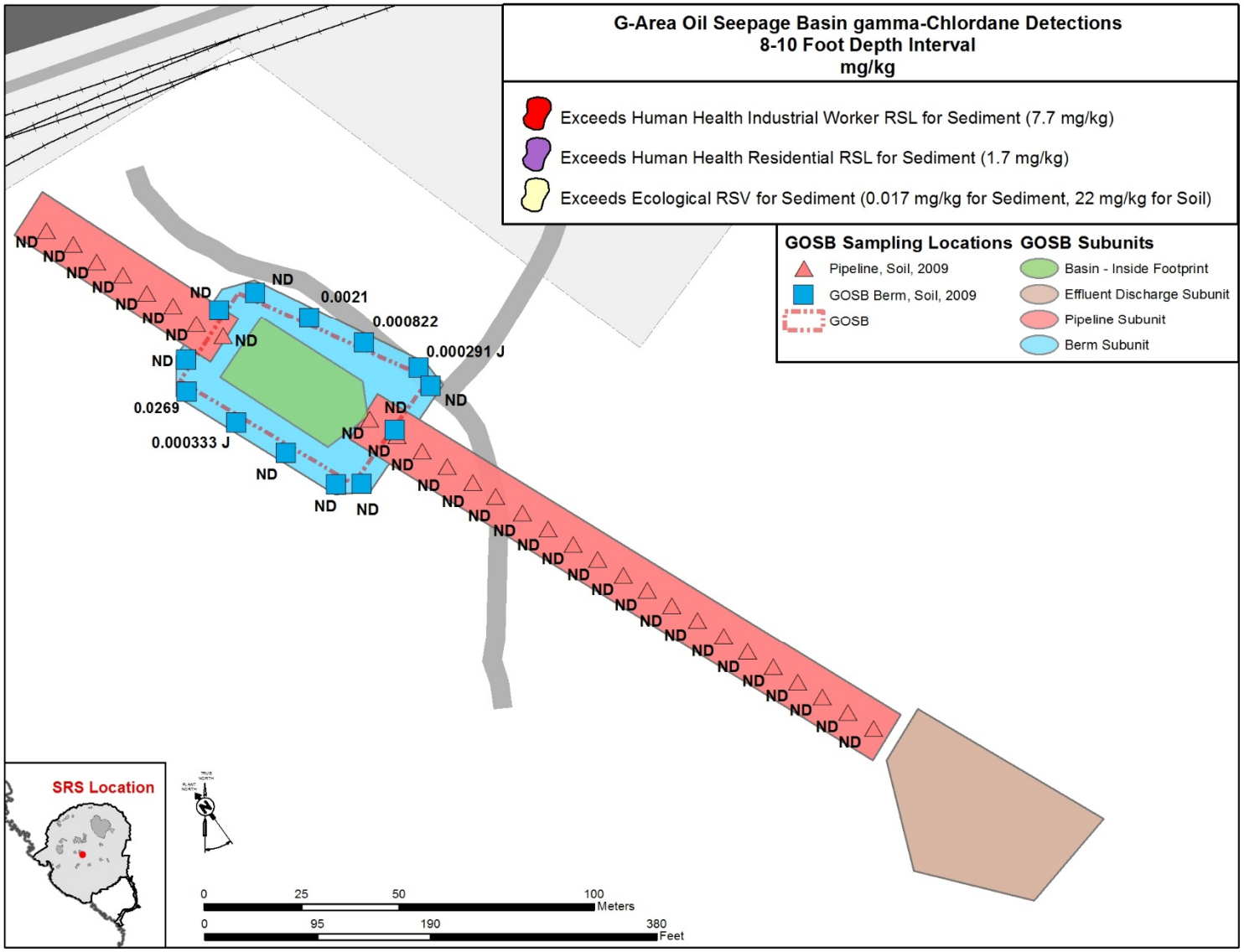


Figure 3-9. GOSB gamma-Chlordane Detections – Soil (8 to 10 ft)

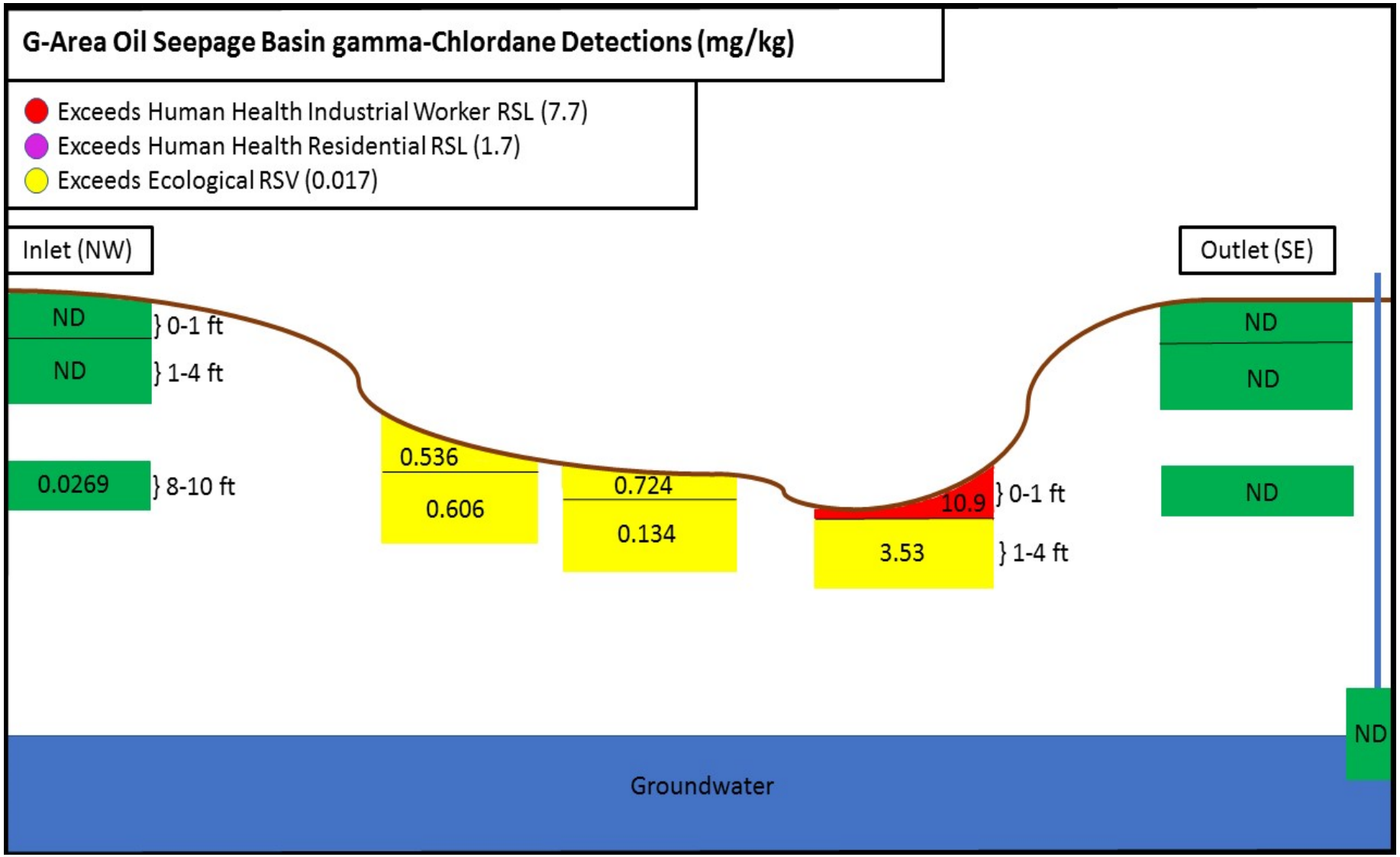


Figure 3-10. Cross-Section of GOSB gamma-Chlordane Detections – Soil, Sediment, and Groundwater

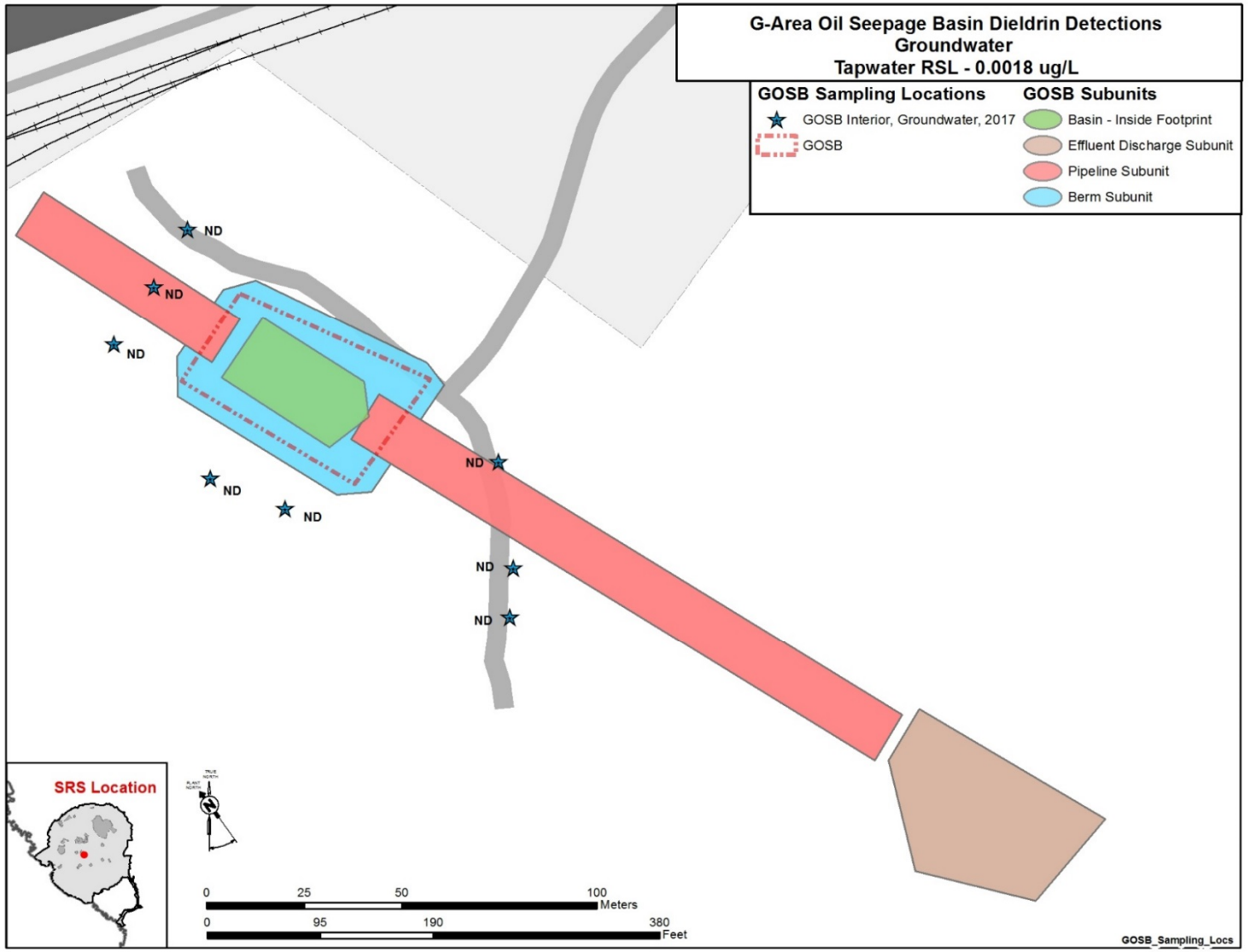


Figure 3-11. GOSB Dieldrin Detections - Groundwater

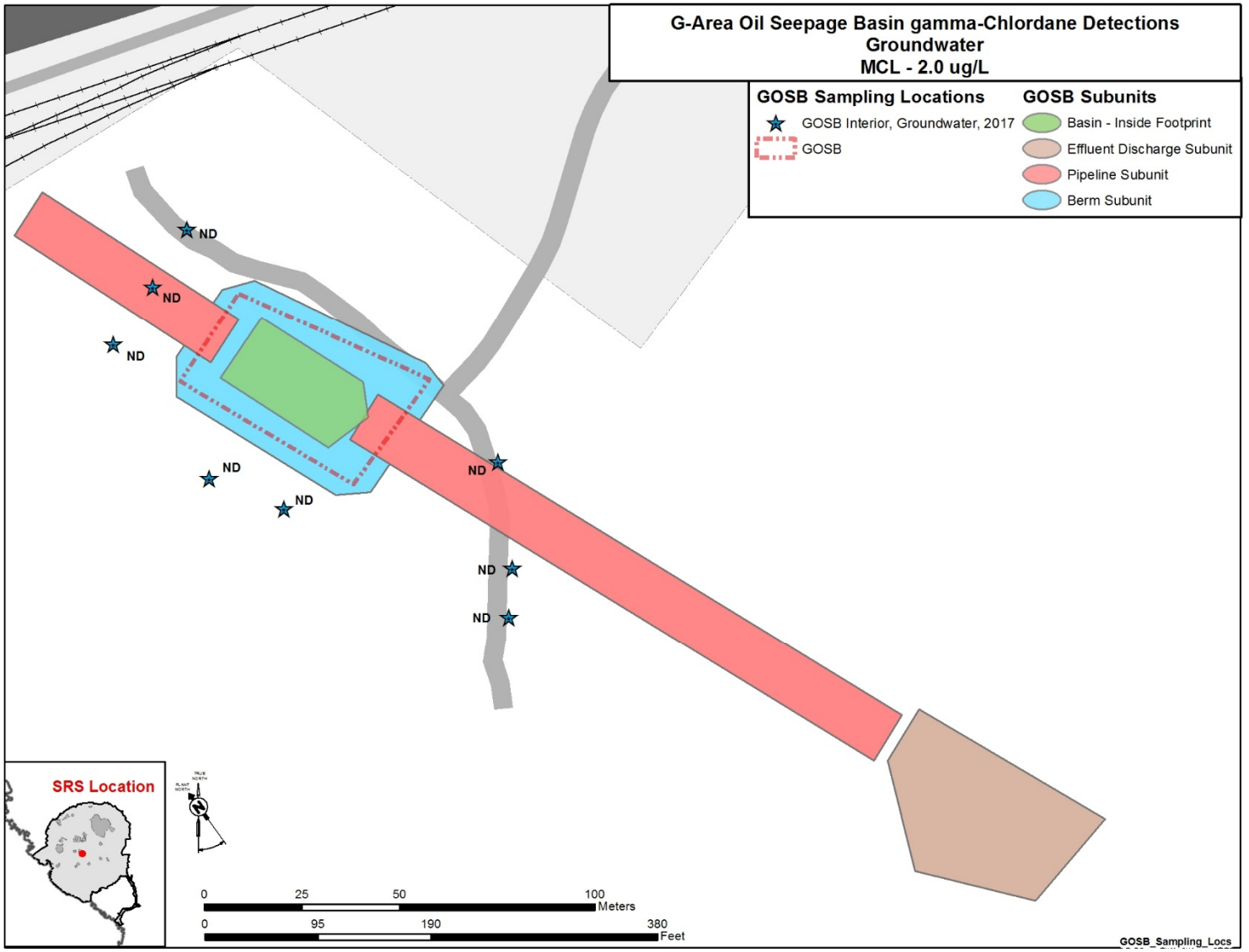


Figure 3-12. GOSB gamma-Chlordane Detections - Groundwater

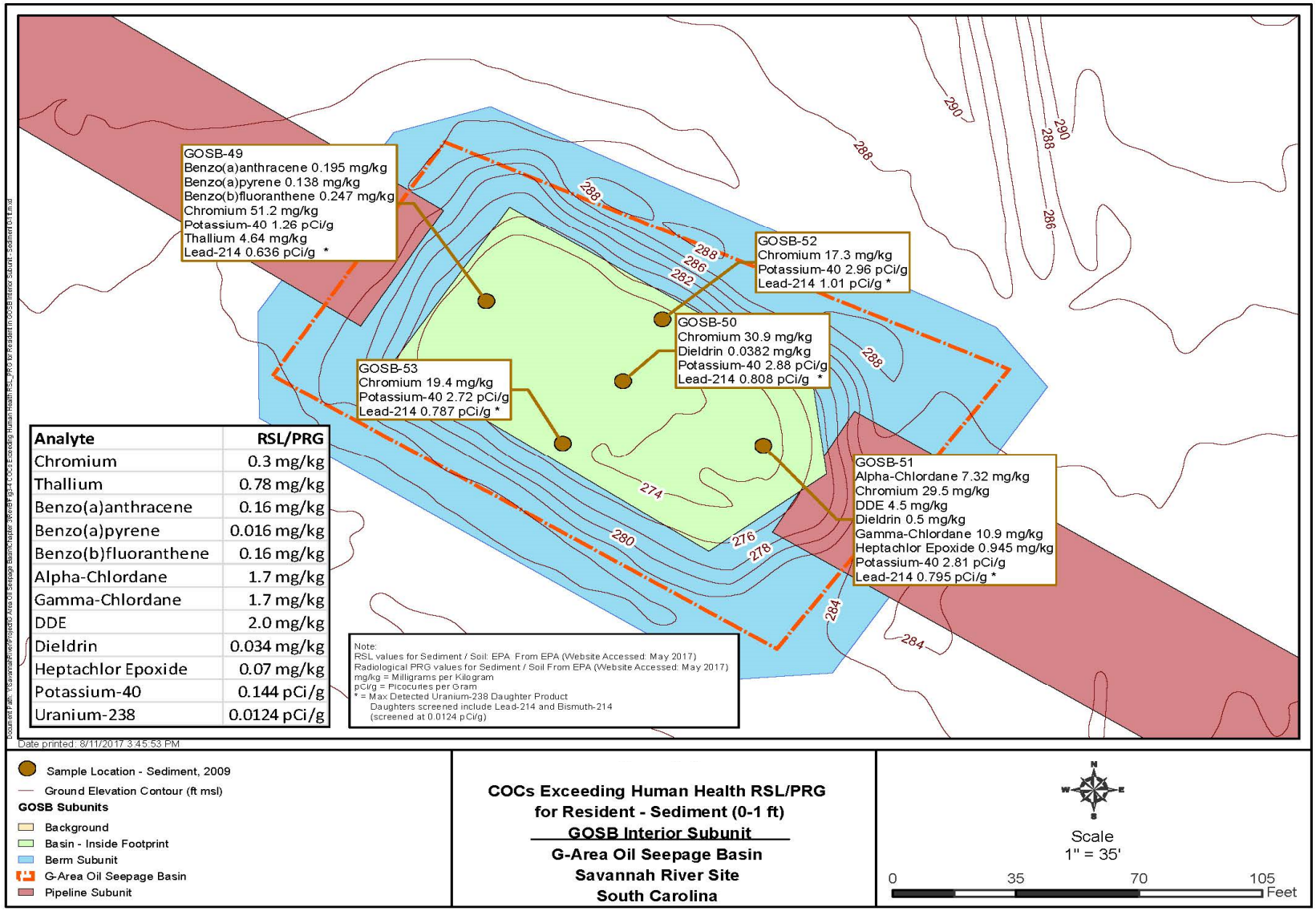


Figure 3-13. COCs Exceeding Human Health RSL/PRG for Resident – Sediment (0 to 1 ft)

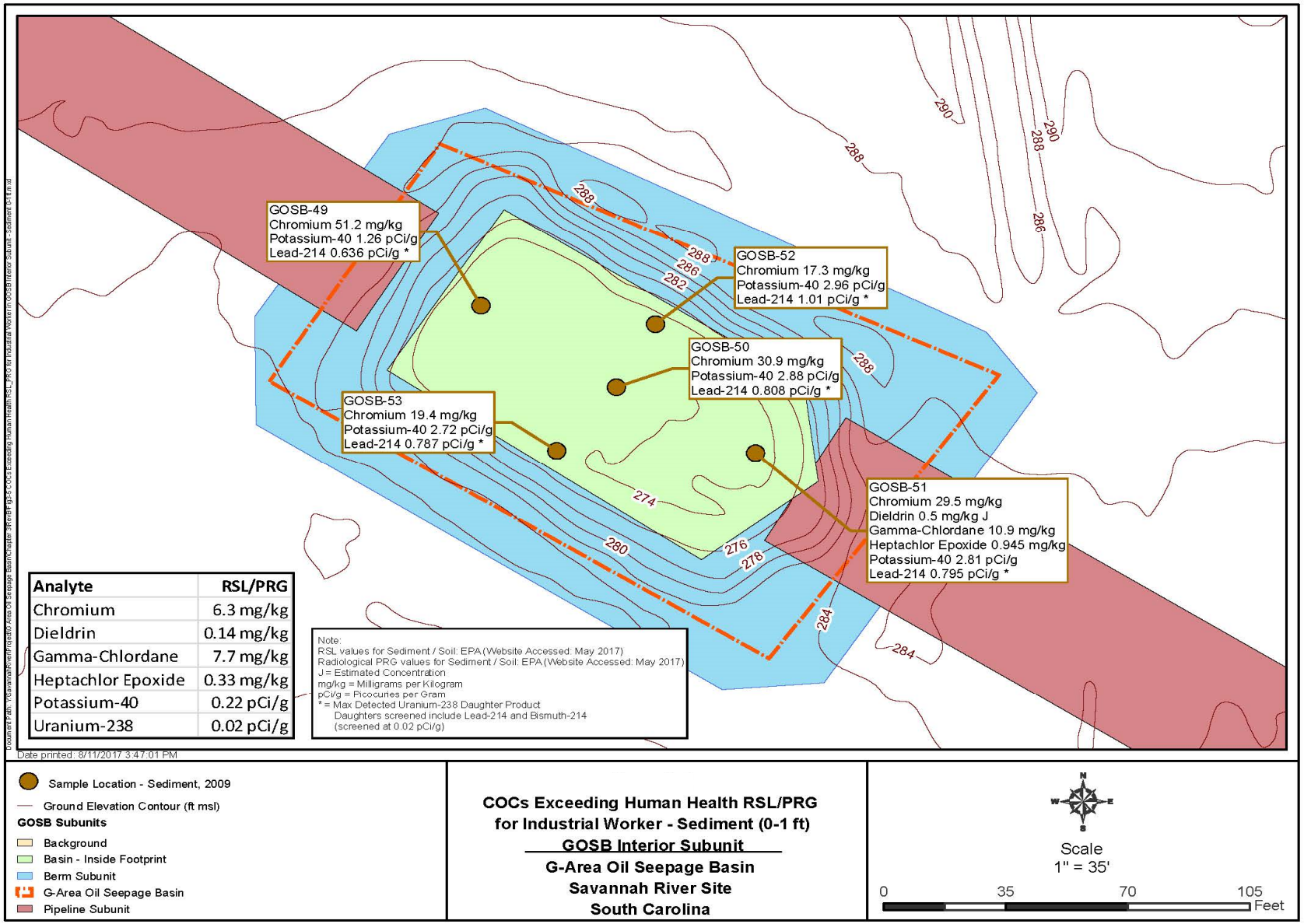


Figure 3-14. COCs Exceeding Human Health RSL/PRG for Industrial Worker – Sediment (0 to 1 ft)

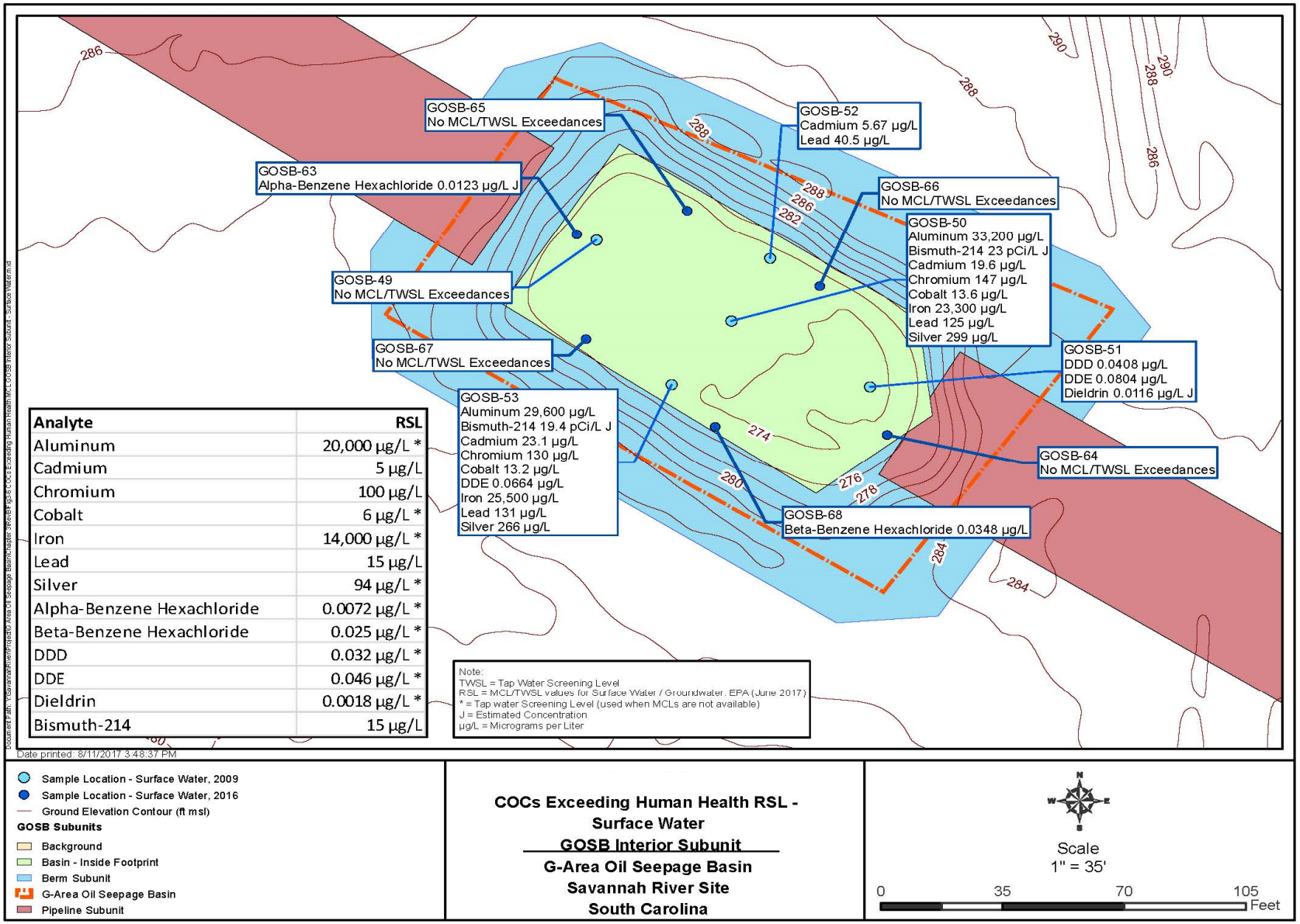
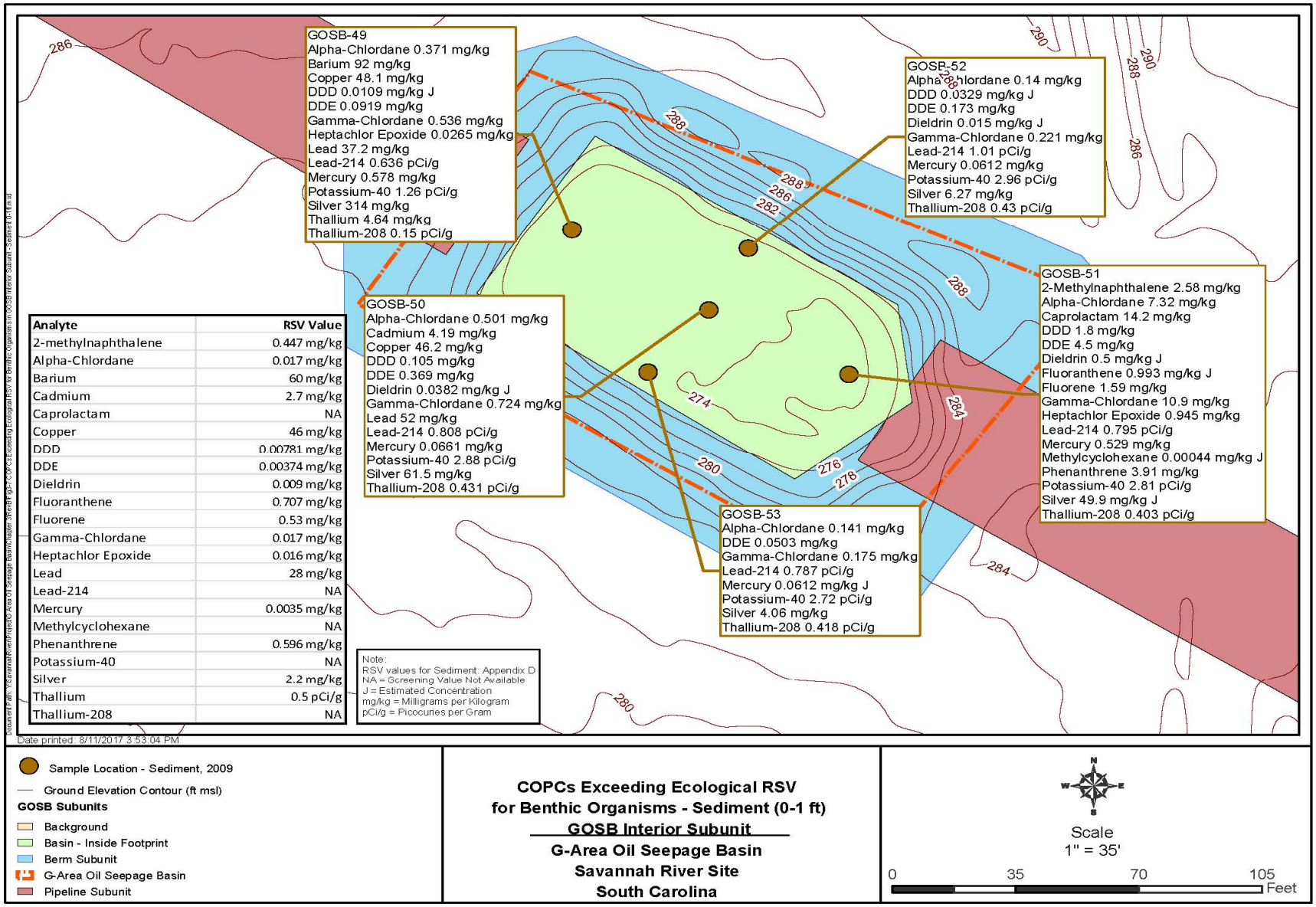


Figure 3-15. COCs Exceeding Human Health RSL – Surface Water



Analyte	RSV Value
2-methylnaphthalene	0.447 mg/kg
Alpha-Chlordane	0.017 mg/kg
Barium	60 mg/kg
Cadmium	2.7 mg/kg
Caprolactam	NA
Copper	46 mg/kg
DDD	0.00781 mg/kg
DDE	0.00374 mg/kg
Dieldrin	0.009 mg/kg
Fluoranthene	0.707 mg/kg
Fluorene	0.53 mg/kg
Gamma-Chlordane	0.017 mg/kg
Heptachlor Epoxide	0.016 mg/kg
Lead	28 mg/kg
Lead-214	NA
Mercury	0.0035 mg/kg
Methylcyclohexane	NA
Phenanthrene	0.596 mg/kg
Potassium-40	NA
Silver	2.2 mg/kg
Thallium	0.5 pCi/g
Thallium-208	NA

Figure 3-16. COPCs Exceeding Ecological RSV for Benthic Organisms – Sediment (0 to 1 ft)

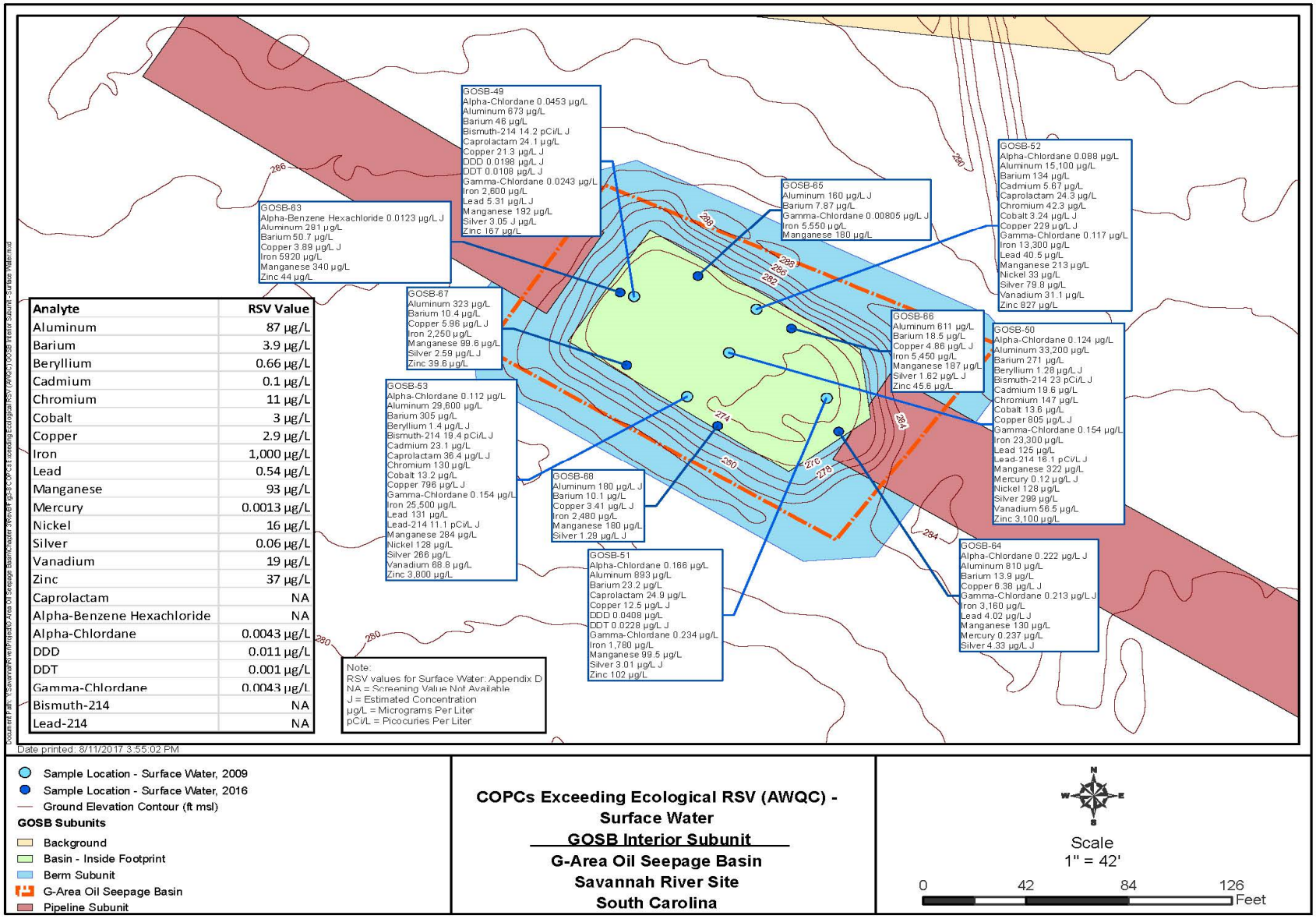


Figure 3-17. COPCs Exceeding Ecological RSV (AWQC) – Surface Water

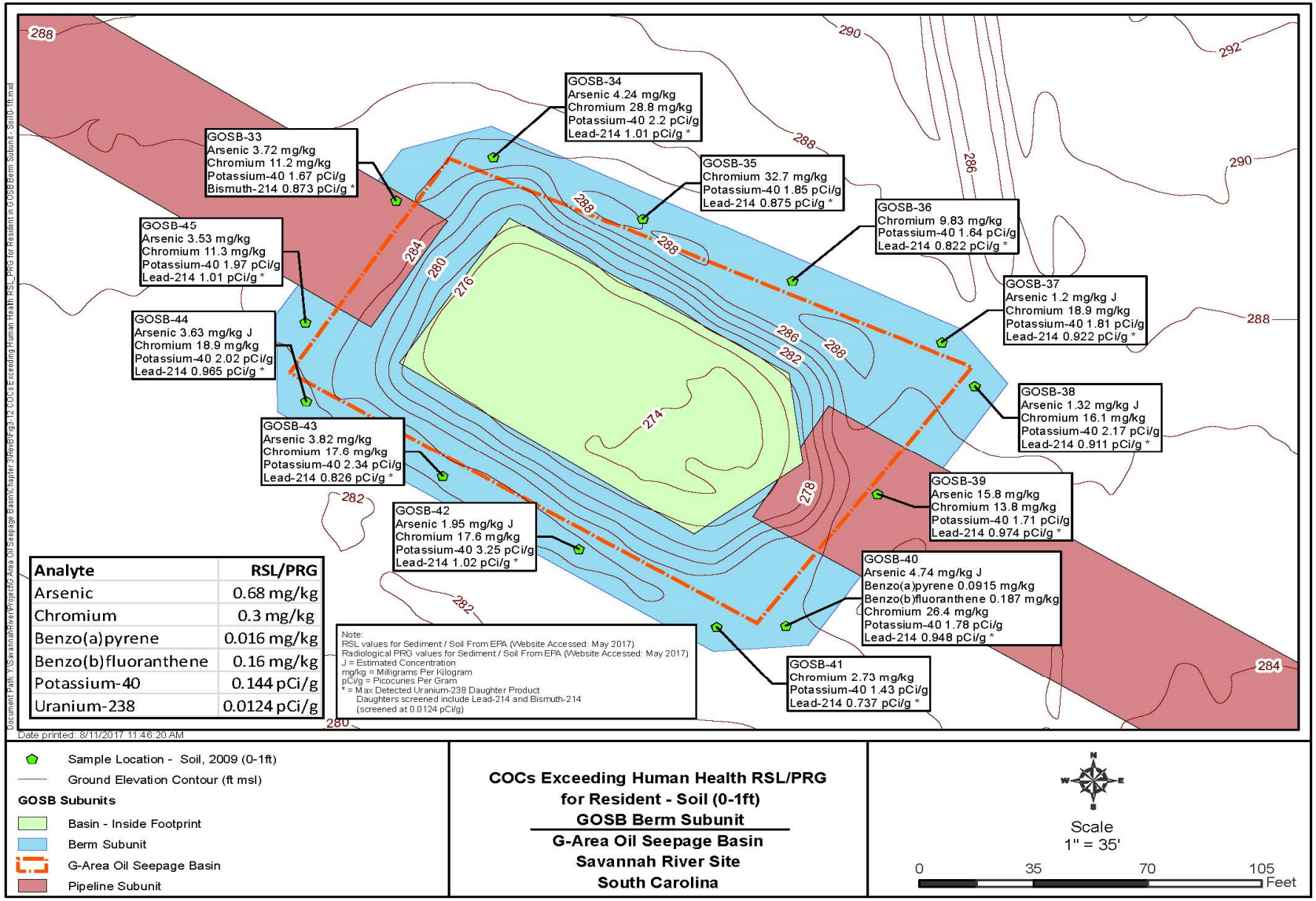


Figure 3-18. COCs Exceeding Human Health RSL/PRG for Resident – Soil (0 to 1 ft)

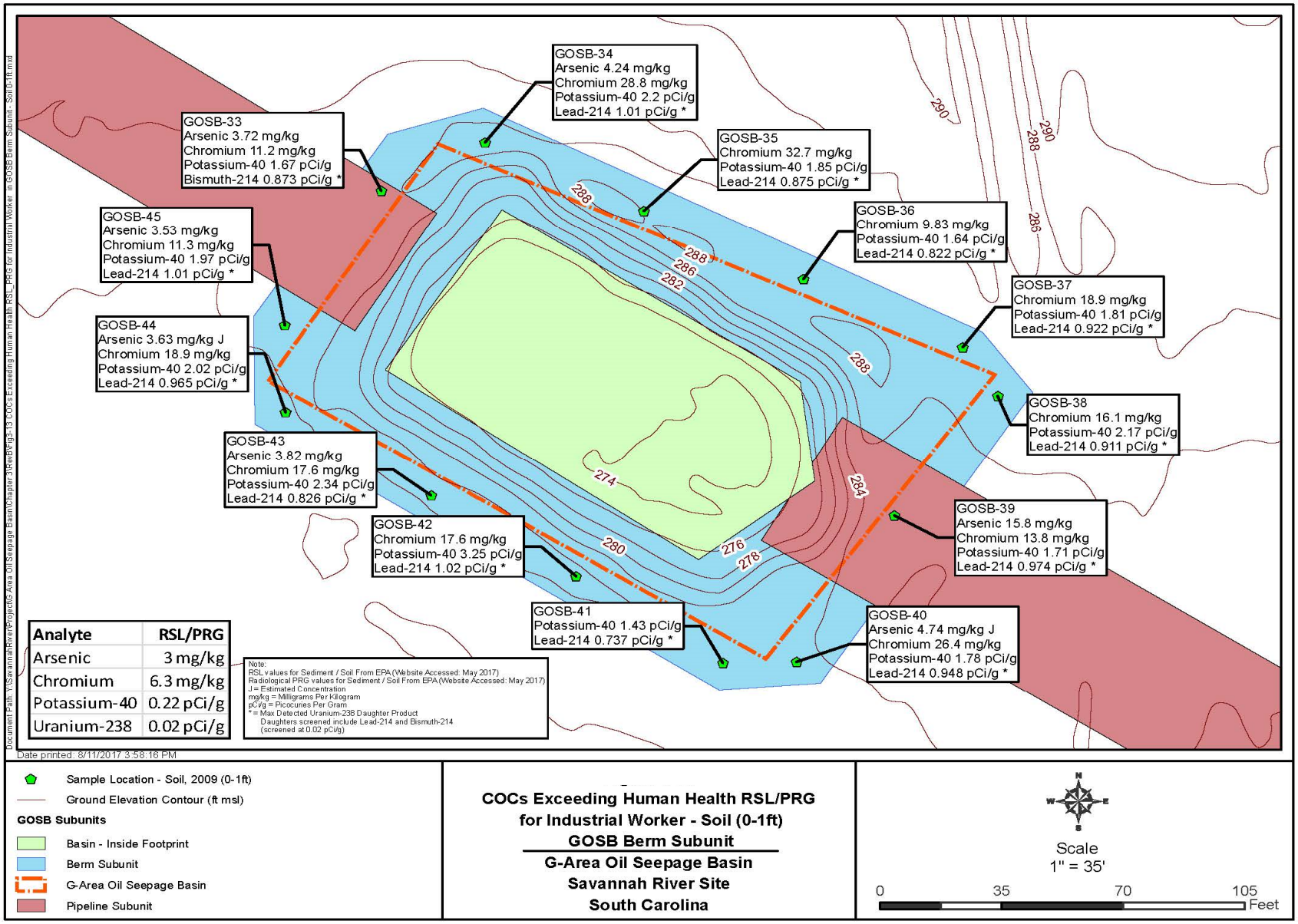


Figure 3-19. COCs Exceeding Human Health RSL/PRG for Industrial Worker – Soil (0 to 1 ft)

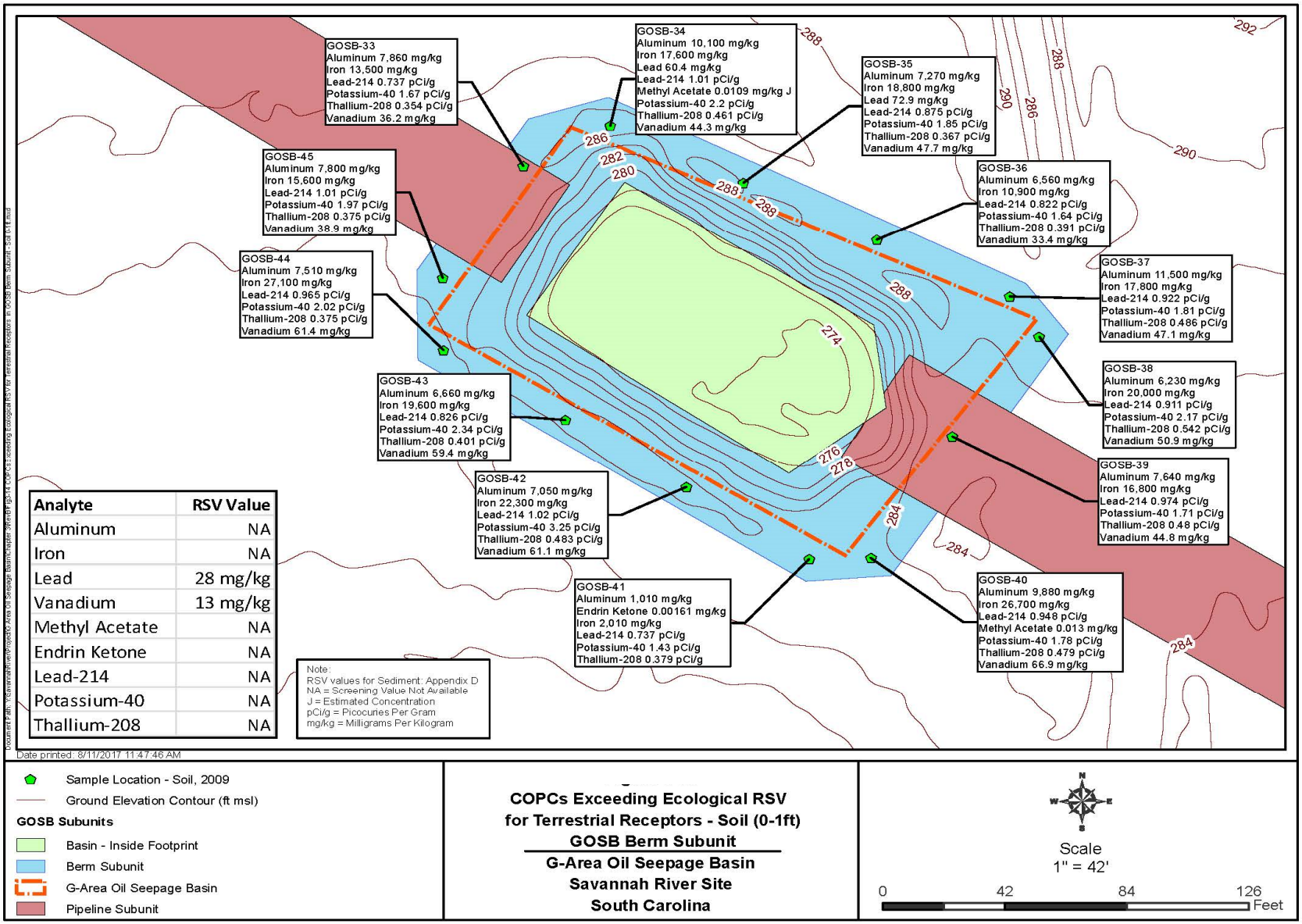


Figure 3-20. COPCs Exceeding Ecological RSV for Terrestrial Receptors – Soil (0 to 1 ft)

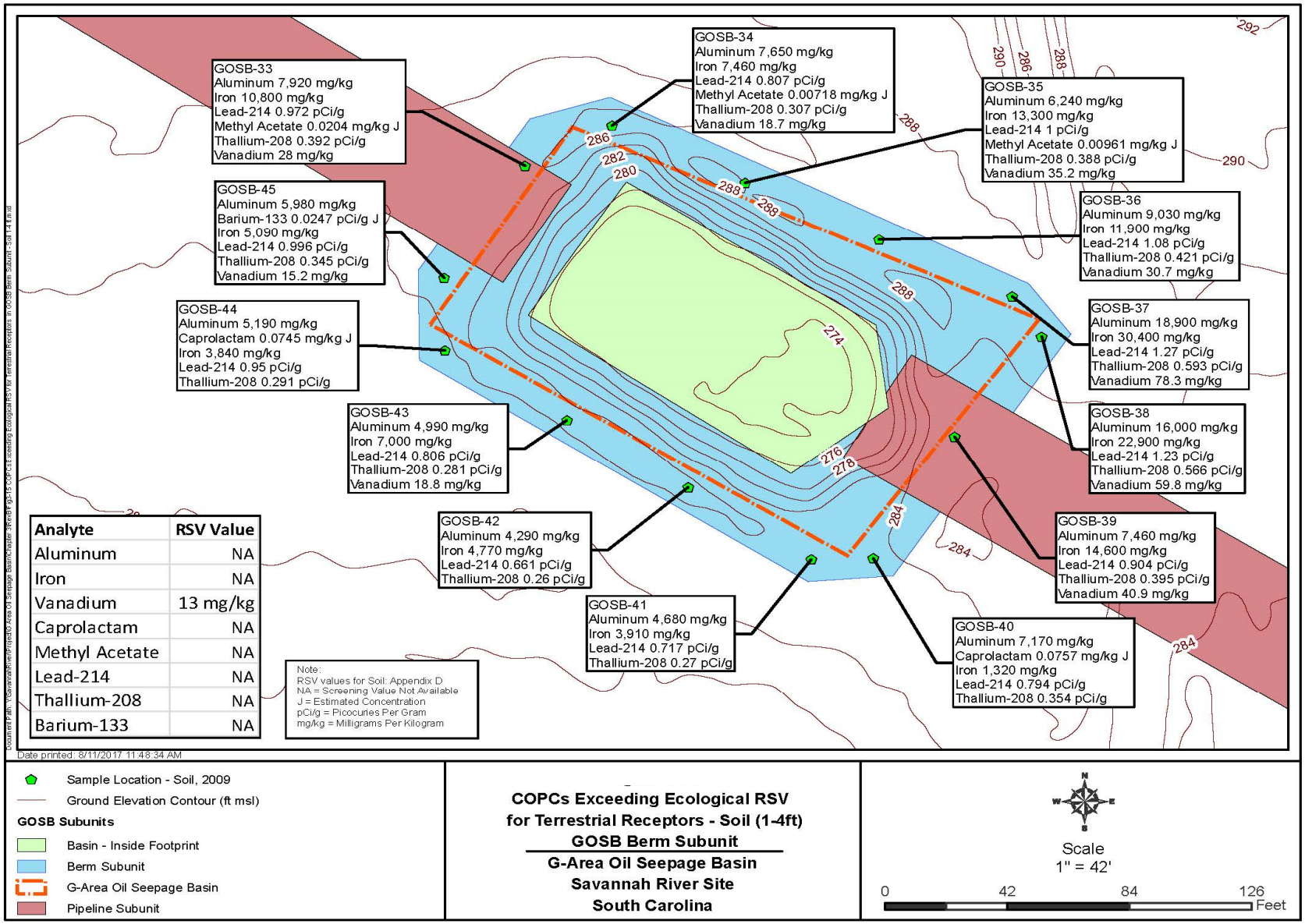


Figure 3-21. COPCs Exceeding Ecological RSV for Terrestrial Receptors – Soil (1 to 4 ft)

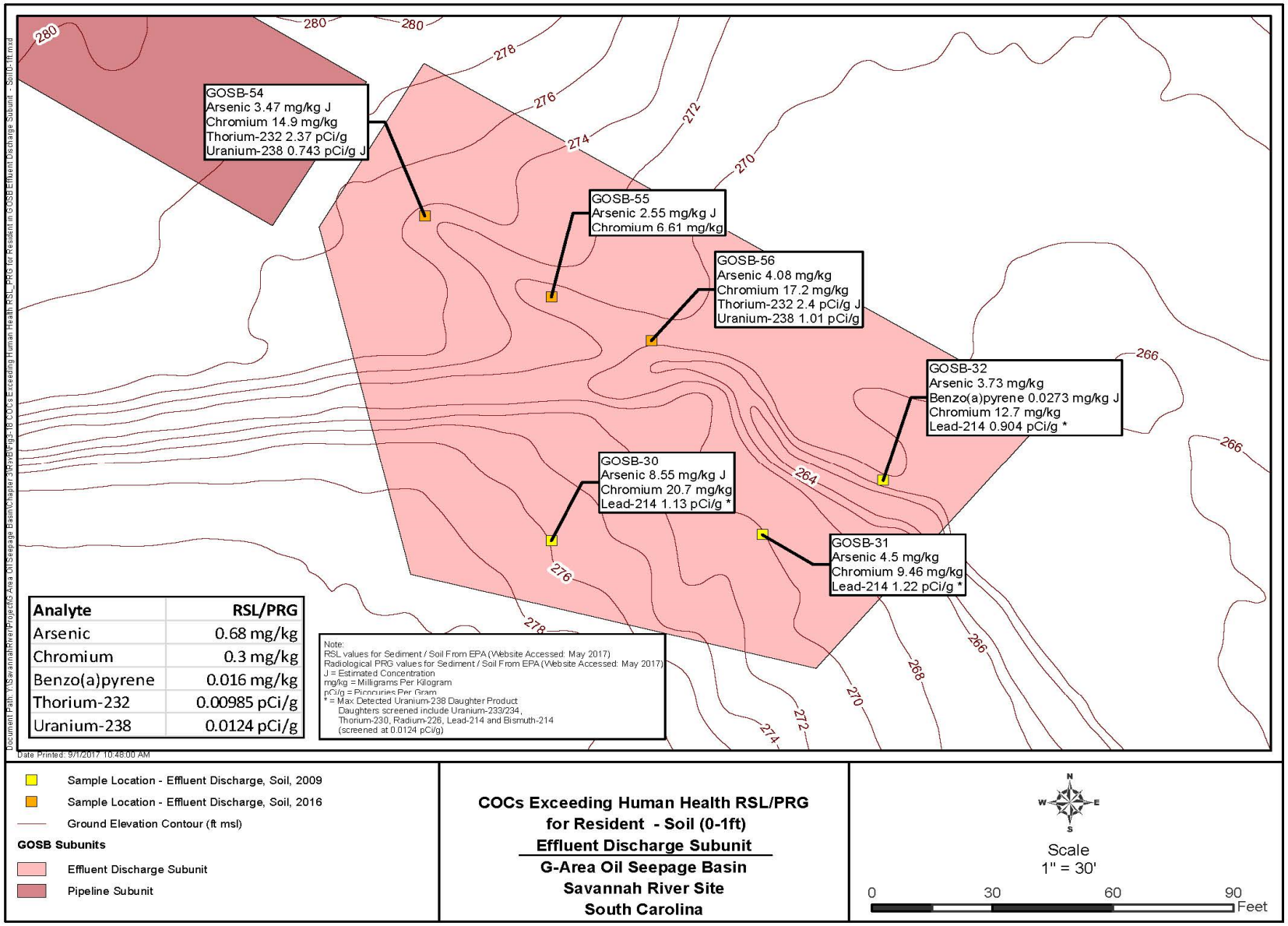


Figure 3-22. COCs Exceeding Human Health RSL/PRG for Resident – Soil (0 to 1 ft)

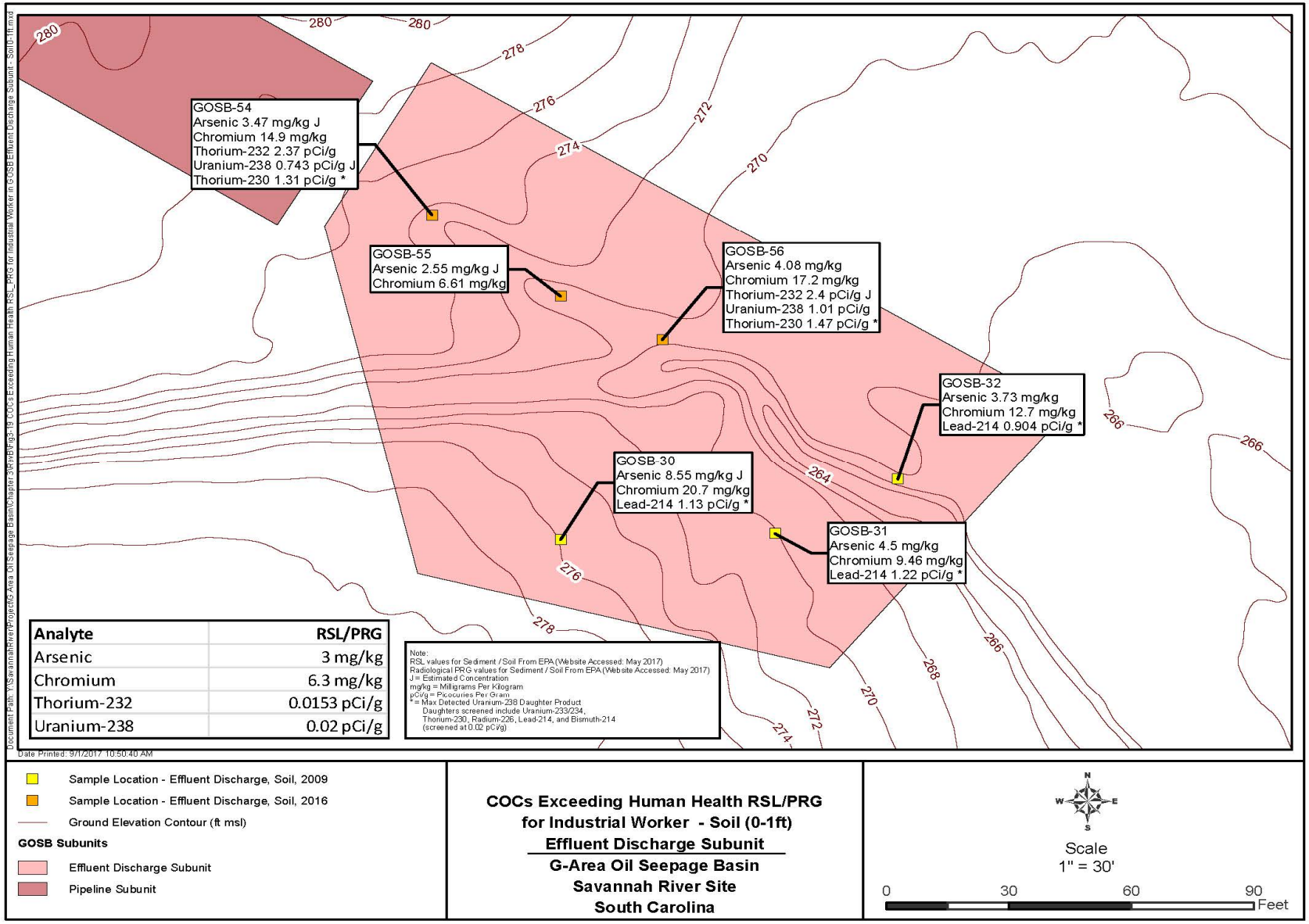


Figure 3-23. COCs Exceeding Human Health RSL/PRG for Industrial Worker – Soil (0 to 1 ft)

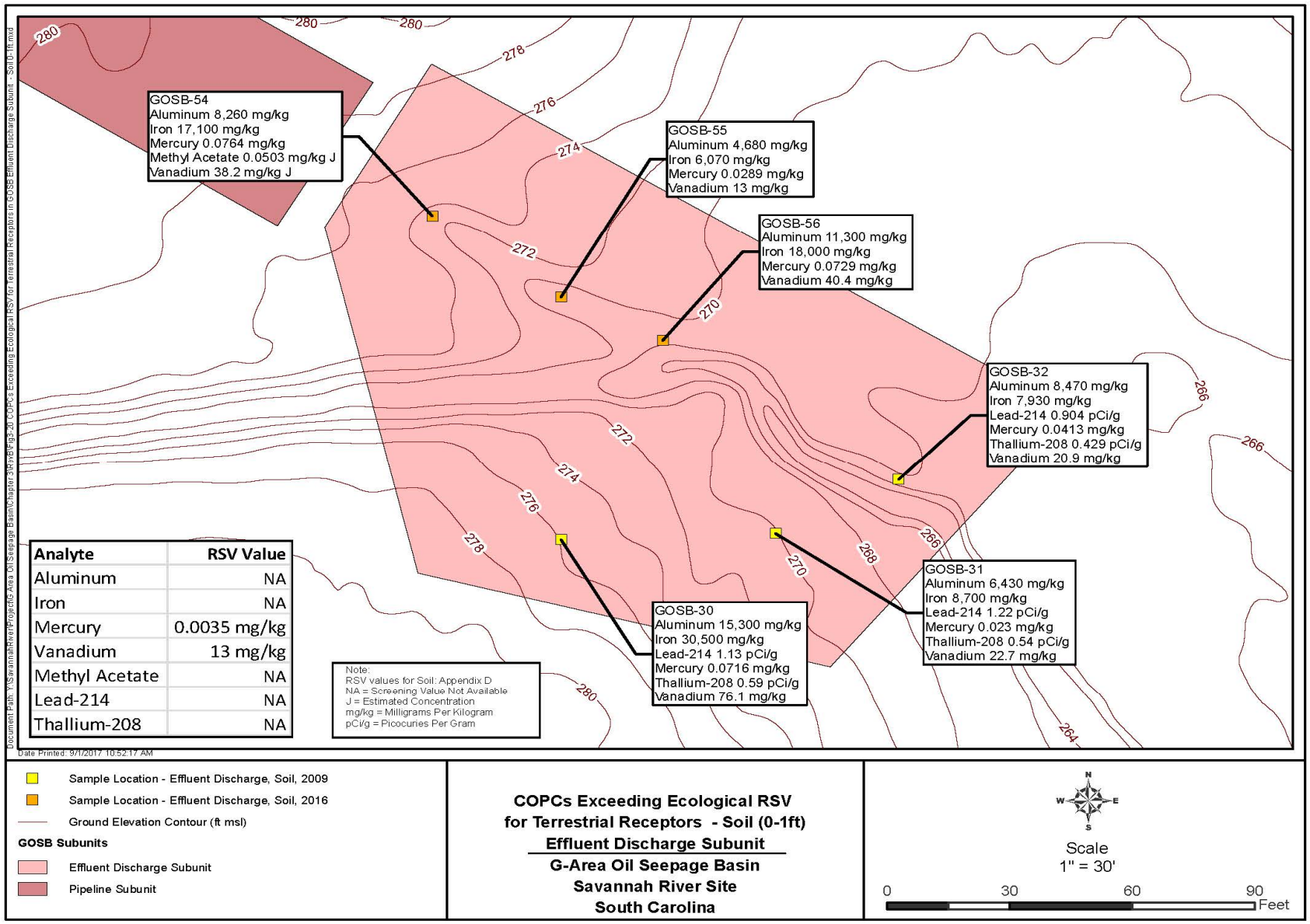


Figure 3-24. COPCs Exceeding Ecological RSV for Terrestrial Receptors – Soil (0 to 1 ft)

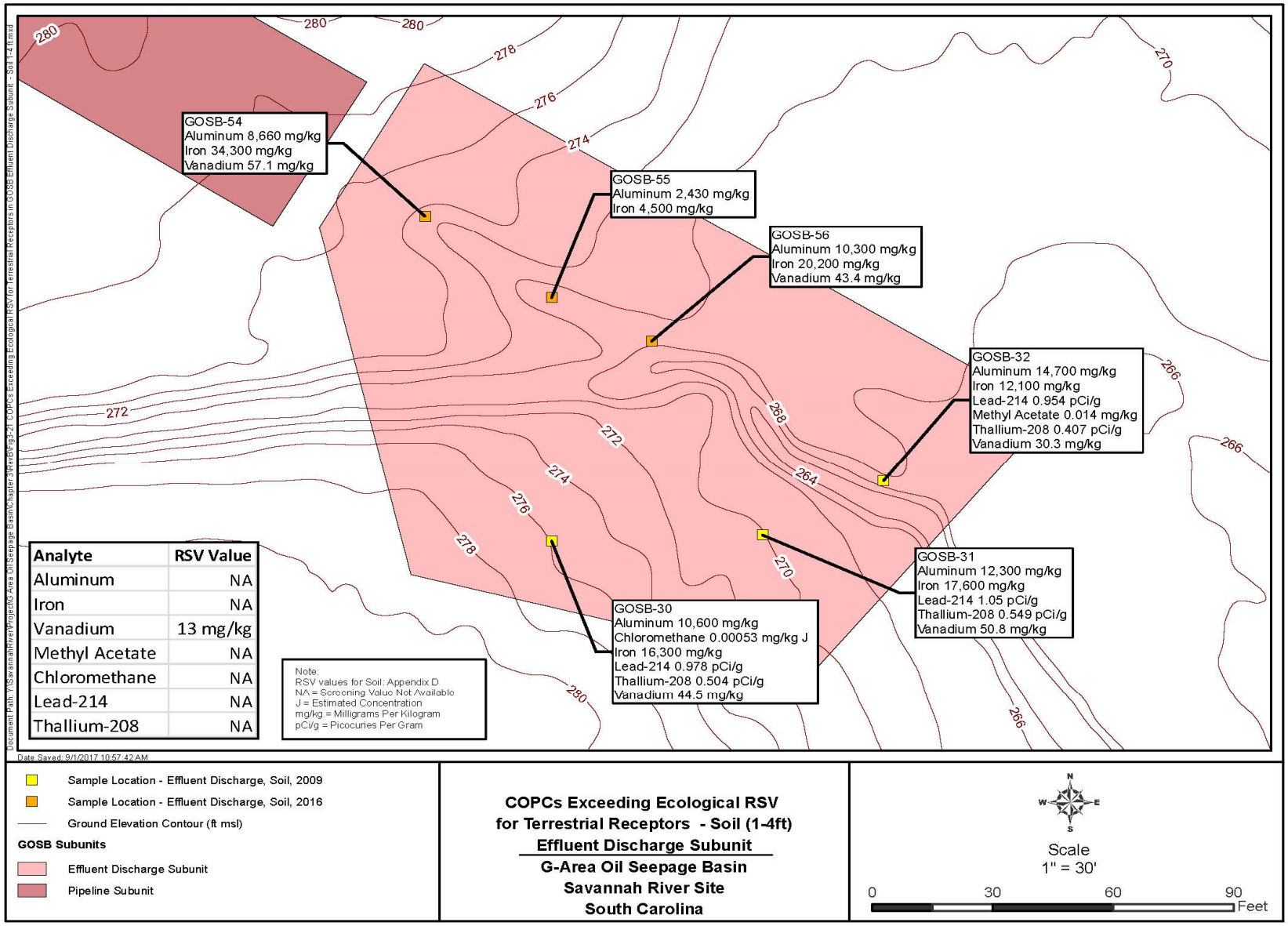
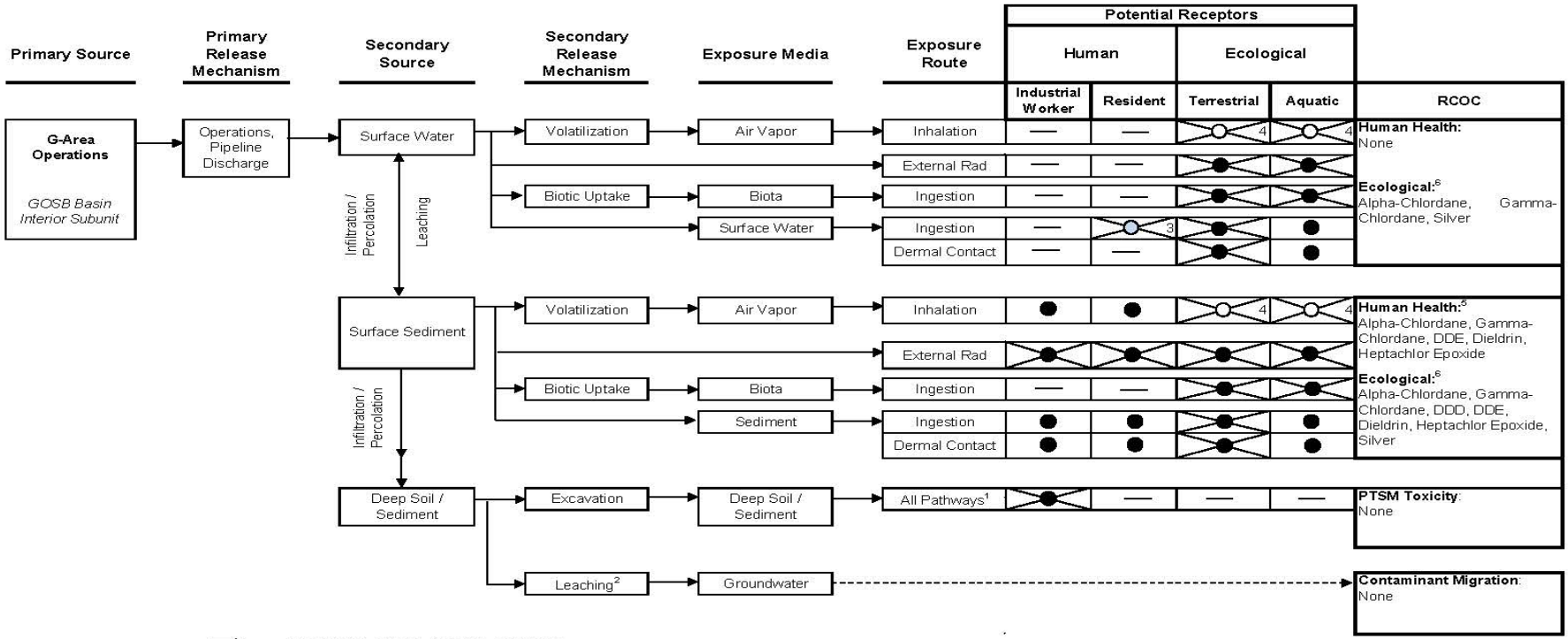


Figure 3-25. COPCs Exceeding Ecological RSV for Terrestrial Receptors – Soil (1 to 4 ft)



1 All pathways represents ingestion, inhalation, dermal contact, and external radiation exposure for the principal threat source material (PTSM) evaluation for toxicity.

2 Leaching represents the potential of a contaminant in soil to migrate to groundwater above MCLs per the contaminant migration analysis and does not represent a human or ecological exposure route.

3 Surface water media evaluated by comparison to MCLs.

4 In general, toxicity information for the inhalation pathway is not available for ecological receptors.

5 HH RCOCs sediment media: Resident scenario- Alpha-Chlordane (risk = 2.6E-06), Gamma-Chlordane (risk = 6.4E-06), DDE (risk = 2.3E-06), Dieldrin (risk = 1.0E-05), Heptachlor Epoxide (risk = 9.1E-06); TCR = 3.0E-05. Industrial Worker scenario- Gamma-Chlordane (risk = 1.4E-06), Dieldrin (risk = 2.4E-06), Heptachlor Epoxide (risk = 1.9E-06); TCR = 5.7E-06

6 ECO RCOCs surface water media: Alpha-Chlordane (HQ = 9) , Gamma-Chlordane (HQ = 9), Silver (HQ = 30) for aquatic organisms.

ECO RCOCs sediment media: Alpha-Chlordane (HQ = 100), Gamma-Chlordane (HQ = 148), DDD (HQ = 50), DDE (HQ = 278), Dieldrin (HQ = 12), Heptachlor Epoxide (HQ = 12), Silver (HQ = 40) for benthic organisms

Figure 3-26. Refined CSM for the GOSB Interior Subunit

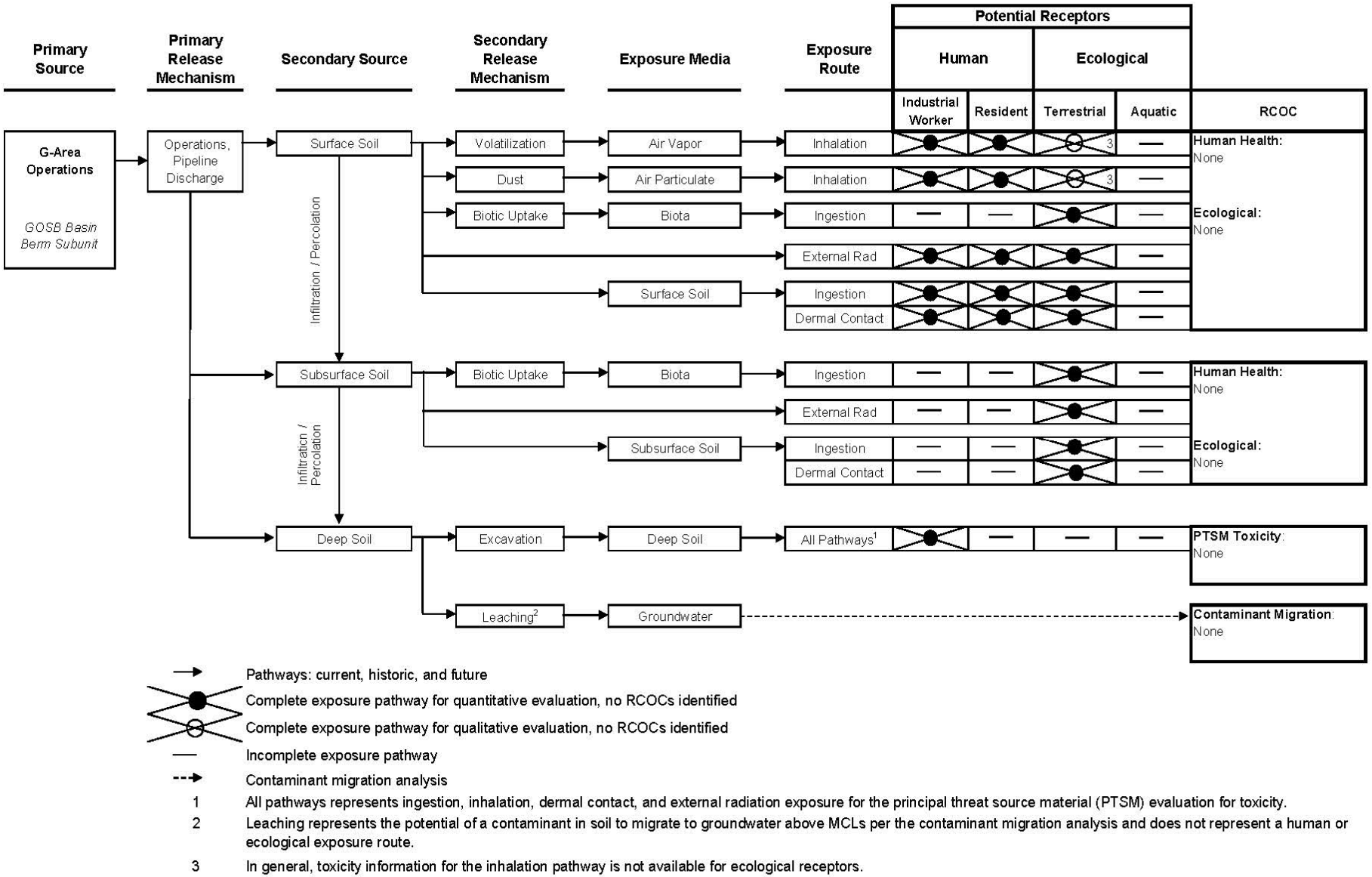


Figure 3-27. Refined CSM for the GOSB Berm Subunit

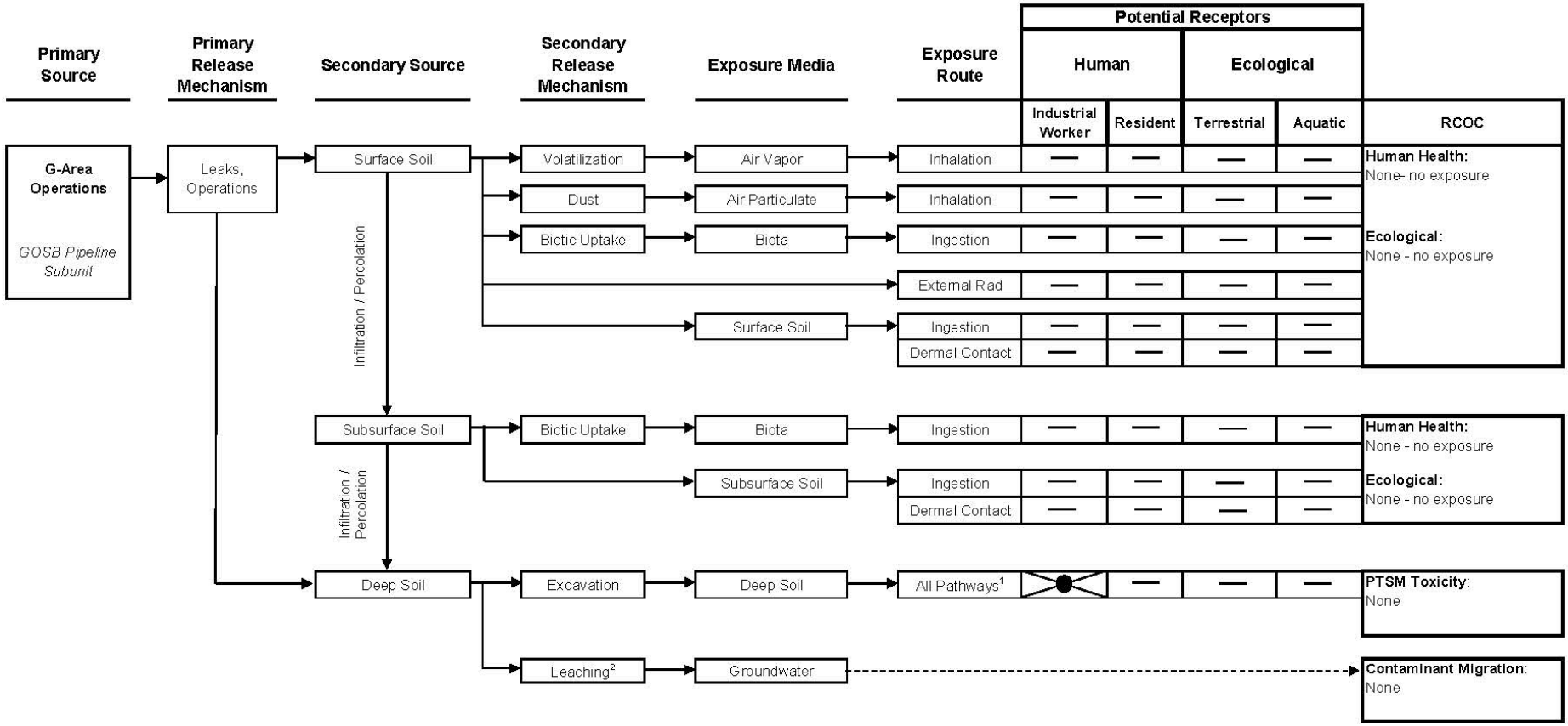


Figure 3-28. Refined CSM for the Pipeline Subunit

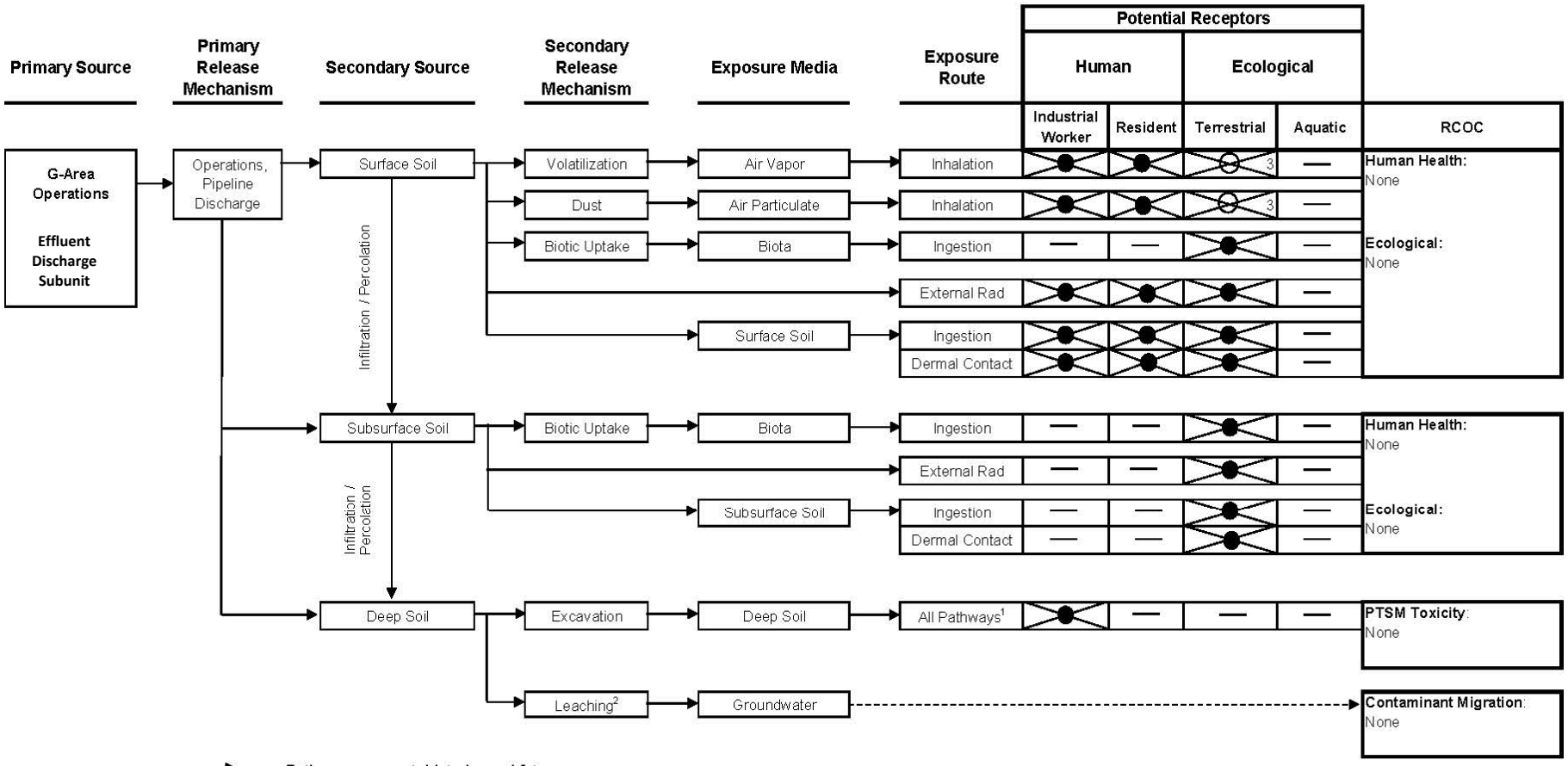


Figure 3-29. Refined CSM for the Effluent Discharge Subunit

Table 3-1. GOSB OU Risk Summary/Refined Constituents of Concern

Subunit	Human Health[1] Sediment RCOCs	Human Health Surface Water RCOCs	Human Health Soil RCOCs	PTSM RCOCs	Contaminant Migration	Ecological Sediment RCOCs	Ecological Surface Water RCOCs	Ecological Soil RCOCs
GOSB Interior Subunit	Resident alpha-Chlordane risk = 2.6E-06 gamma-Chlordane risk = 6.4E-06 DDE risk = 2.3E-06 Dieldrin risk = 1.0E-05 Heptachlor epoxide risk = 9.1E-06 TCR[2] = 3.0E-05 Industrial Worker Dieldrin risk = 2.4E-06 Gamma-Chlordane risk = 1.4E-06 Heptachlor Epoxide risk = 1.9E-06 TCR[2] = 5.7E-06	None	NA	None	None	Benthic Organisms Alpha-chlordane (HQ = 100) DDD (HQ = 50) DDE (HQ = 278) Dieldrin (HQ = 12) Gamma-chlordane (HQ = 148) Heptachlor epoxide (HQ = 12) Silver (HQ = 40)	Aquatic Organisms Alpha-chlordane (HQ = 9) Gamma-chlordane (HQ = 9) Silver (HQ = 30)	NA
GOSB Berm Subunit	NA	NA	None	None	None	NA	NA	None
Pipeline Subunit	NA	NA	NA	None	None	NA	NA	NA
Effluent Discharge	NA	NA	None	None	None	NA	NA	None

RCOC = Refined constituent of concern
[1] human health RCOCs and risk levels identified for resident and industrial worker receptor scenarios.
[2] TCR = total cumulative risk
NA = Media not present in the subunit

4.0 REMEDIAL GOAL OBJECTIVES AND REMEDIAL GOAL OPTIONS

4.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) are site-specific or media-specific objectives for protection of human health and the environment. RAOs usually specify refined constituents of concern (RCOCs) for the potential receptors, media of concern, and exposure pathways. RAOs describe what the remediation must accomplish and are used as framework for developing remedial alternatives for the Corrective Measures Study (CMS)/Feasibility Study (FS).

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1980), as amended by the Superfund Amendments and Reauthorization Act (1986), requires that remedial action comply with requirements or standards set forth under Federal and State environmental laws (i.e., applicable, relevant, and appropriate requirements [ARARs]), as well as, non-promulgated advisories, guidance, or proposed standards that are not legally binding but provide useful approaches or recommendations (called "To-be-considered" [TBC] requirements).

ARARs and TBCs include action-specific, location-specific, and chemical-specific requirements that are to be achieved unless a waiver is invoked. In addition, the National Contingency Plan (NCP) requires the development of health-based, site-specific levels for constituents (i.e., risk-based levels) where such promulgated limits do not exist and where there is a concern with their potential health or environmental effects. RAOs are developed, as applicable, from ARARs, TBCs, or risk-based levels that address the constituent, receptor, and media of concern. RAOs are presented by subunit within the G-Area Oil Seepage Basin (GOSB) (761-13G) Operable Unit (OU) in which RCOCs have been identified from the assessments performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material). RAOs are presented below by subunit.

4.1.1 G-Area Oil Seepage Basin Interior Subunit

4.1.1.1 Sediment

According to the analysis performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material), and the results summarized in Chapter 3, the following are problems warranting action for sediment media in the GOSB Interior Subunit:

- Alpha-chlordane, gamma-chlordane, dichlorodiphenyldichloroethylene (DDE), dieldrin, and heptachlor epoxide in sediment within the 0- to 0.3-m (0- to 1-ft) interval pose a total cumulative risk of 3.0E-05 to the resident (Figure 4-1), and gamma-chlordane, dieldrin, and heptachlor epoxide in sediment within the 0- to 0.3-m (0- to 1-ft) interval pose a total cumulative risk of 5.7E-06 to the industrial worker (Figure 4-2)

- Alpha-chlordane (HQ = 100), gamma-chlordane (HQ =148), DDD (HQ = 50), DDE (HQ =278), dieldrin (HQ = 12), heptachlor epoxide (HQ = 12), and silver (HQ = 40) within the 0 to 0.3 m (0 to 1 ft) sediment interval pose risk to benthic organisms (Figure 4-3)

Based on the problems warranting action, the following RAOs apply for GOSB Interior Subunit sediment media:

- Protect a resident receptor from exposure to alpha-chlordane, gamma-chlordane, DDE, dieldrin, and heptachlor epoxide in sediment within the 0 to 0.3 m (0 to 1 ft) interval that exceeds 1E-06 risk based threshold level. Also, protect an industrial worker receptor from exposure to the pesticides gamma-chlordane, dieldrin, and heptachlor epoxide in sediment within the 0- to 0.3-m (0- to 1-ft) interval that exceeds 1E-06 risk based threshold level. The primary route of exposure for both scenarios is the incidental ingestion pathway

- Protect ecological receptors from exposure to alpha-chlordane, gamma-chlordane, DDD, DDE, dieldrin, heptachlor epoxide and silver in sediment that exceed an HQ = 1. The primary route of exposure is the direct contact pathway

4.1.1.2 Surface Water

According to the analysis performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material), and the results summarized in Chapter 3, the following is a problem warranting action for surface water media in the GOSB Interior Subunit:

- Alpha-chlordane (HQ = 9), gamma-chlordane (HQ = 9) and silver (HQ = 30) are present in surface water at levels that exceed an HQ = 1 for aquatic organisms (Figure 4-4)

Based on the problem warranting action, the following RAO applies for GOSB Interior Subunit surface water media:

- Protect ecological receptors from exposure to alpha-chlordane, gamma-chlordane, and silver in surface water that exceed an HQ = 1. The primary route of exposure is the direct contact pathway

4.1.2 G-Area Oil Seepage Basin Berm Subunit

According to the analysis performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material), and the results summarized in Chapter 3, there are no CM, human health (HH), ecological, or principal threat source material (PTSM) RCOCs identified for the GOSB Berm Subunit.

4.1.3 G-Area Oil Seepage Basin Pipeline Subunit

According to the analysis performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material), and the results summarized in Chapter 3, there are no CM, HH, ecological, or PTSM RCOCs identified for the Pipeline Subunit.

4.1.4 G-Area Oil Seepage Basin Effluent Discharge Subunit

According to the analysis performed in Appendices B (Contaminant Fate and Transport), C (Human Health Risk Assessment), D (Ecological Risk Assessment), and E (Principal Threat Source Material), and the results summarized in Chapter 3, there are no CM, HH, ecological, or PTSM RCOCs identified for the Effluent Discharge Subunit.

4.2 Remedial Goal Development

Remedial Goal Options (RGOs) represent the preliminary media-specific goals and serve as a standard by which to measure whether a selected remedial action has met its RAO. RGOs can be qualitative statements (e.g., indirect actions that prevent receptor contact), numerical values often expressed as concentrations in media (e.g., risk-based sediment or surface water concentrations) or specific actions to eliminate contact with contaminated media (e.g., installation of engineered barriers, placement of caps and covers, etc.) that achieve the RAO. RGOs become finalized as remedial goals (RGs) following public comment and approval of the Statement of Basis/ Proposed Plan. The RGOs for the selected remedy are documented as final cleanup goals or RGs in the Record of Decision. Numerical RGOs consist of a range of risk-based concentrations for RCOCs that provide a basis for selecting the final remedial action to achieve such values. Risk-based RGO calculations for the GOSB OU are provided in Appendix F.

The selection of final RG~~O~~s is made by the risk managers for the Savannah River Site (SRS). The risk managers are the key decision makers and include representatives of the United States Department of Energy, South Carolina Department of Health and Environmental Control, and the U.S. Environmental Protection Agency (USEPA).

The development of RGOs for the GOSB OU is described below.

4.2.1 Fate and Transport Remedial Goal Options

The CM analysis is presented in Appendix B of this document. No CM RCOCs were identified for any subunits within the GOSB OU. Therefore, no CM RGOs are developed.

4.2.2 Human Health Remedial Goal Options

As presented in Section 4.1.1, HH RCOCs were identified for sediment media only in the GOSB Interior Subunit. There were no RCOCs identified for surface water media in the GOSB Interior Subunit or soil media in the Berm Subunit, the Pipeline Subunit, or the Effluent Discharge Subunit. The HH RGOs for the GOSB OU are presented in Appendix F. RGOs represent media based concentrations that are protective of specific receptor under specific exposure conditions that are the basis for evaluating baseline risks in the human health baseline risk assessment (see Appendix C).

For carcinogenic constituents, RGOs are calculated at the risk levels 1E-06, 1E-05, and 1E-04.

For noncarcinogenic constituents, RGOs are calculated at the HQ levels 0.1, 1, and 3.

Human health RGOs are developed for the resident and industrial worker exposure scenarios. Table 4-1 provides a summary of the human health RGOs applicable to the GOSB OU sediment media.

4.2.3 Ecological Remedial Goal Options

As presented in Section 4.1.1, ecological RCOCs were identified for sediment media and surface water media for the GOSB Interior Subunit. There were no RCOCs identified for the soil media in the Berm Subunit, Pipeline Subunit, or the Effluent Discharge Subunit. The ecological risk assessment (ERA) is presented in Appendix D of this document. Risk-based RGOs are the refinement screening values for sediment and surface water that equate to a HQ of 1. The ECO RGOs for sediment media are provided in the Table 4-2.

4.2.4 Principal Threat Source Material Remedial Goal Options

As presented in Chapter 3, there are no PTSM RCOCs for the GOSB OU. Therefore, no PTSM RGOs are developed.

4.2.5 Applicable or Relevant and Appropriate Requirements Remedial Goal Options

Analytical data from the GOSB OU are compared to the chemical-specific ARARs for sediment/soil and surface water media. The ARAR evaluation for sediment and soil media considers the GOSB OU dataset as a whole and is not performed separately for each subunit. The ARAR evaluation summarizes the results of the Human Health Risk Assessment and ERA presented in Appendices C and D, respectively.

For sediment/soil media, chemical-specific ARARs or TBC requirements exist under federal and state regulations for polychlorinated biphenyls (PCBs) and lead. PCBs are governed by the Toxic Substances Control Act (40 Code of Federal Regulations [CFR] Part 761), which includes a soil remediation level of 10 milligrams per kilogram (mg/kg). For lead in soil, the CERCLA level of 400 mg/kg was set by the USEPA Office of Solid Waste Emergency Response and adopted as a TBC for the screening process.

As presented in Chapter 3, the maximum detected concentrations of PCBs and lead are below their respective ARAR soil screening levels. As such, there are no ARAR RCOCs identified for the GOSB OU. Therefore, no ARAR RGOs are developed.

4.3 Most Restrictive and Most Likely Remedial Goal Options

The most restrictive RGO is listed by media and represents the lowest value selected from the various RGOs listed above (see Table 4-3). Additionally, a range of background values is also presented in order to assist in the selection of the most restrictive, applicable RGO.

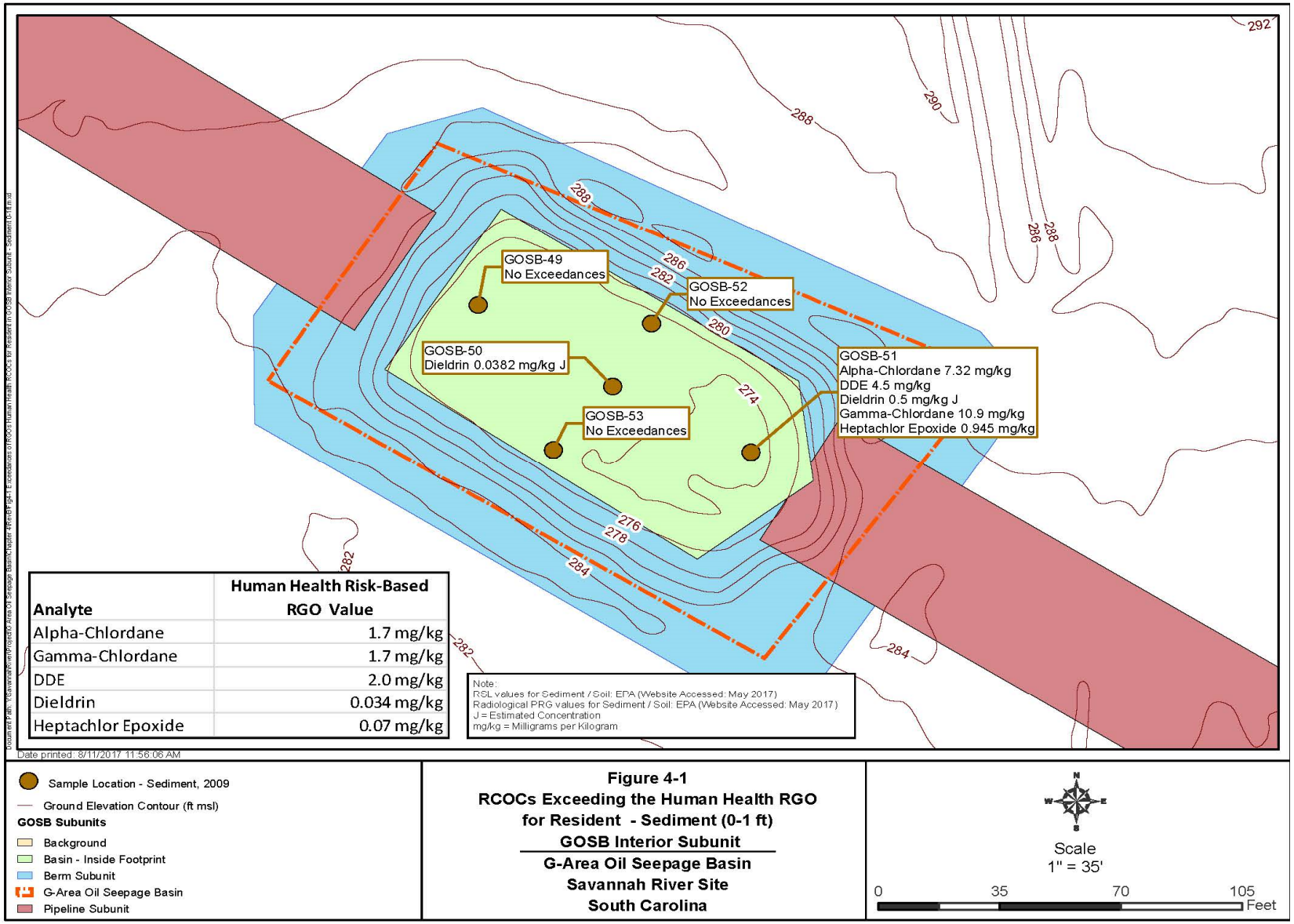


Figure 4-1. RCOCs Exceeding the Human Health RGO for Resident – Sediment (0 to 1 ft)

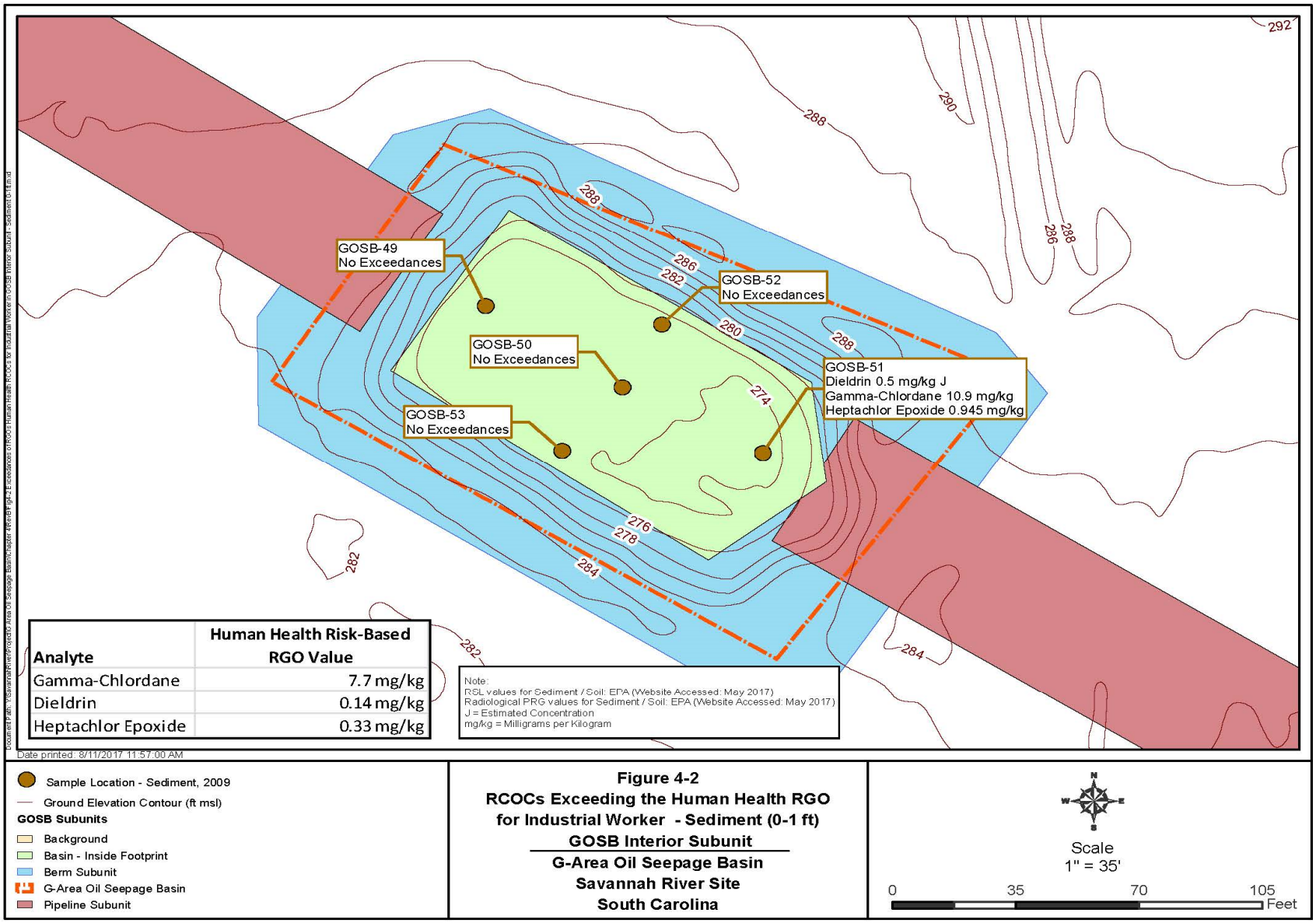


Figure 4-2. RCOCs Exceeding the Human Health RGO for Industrial Worker – Sediment (0 to 1 ft)

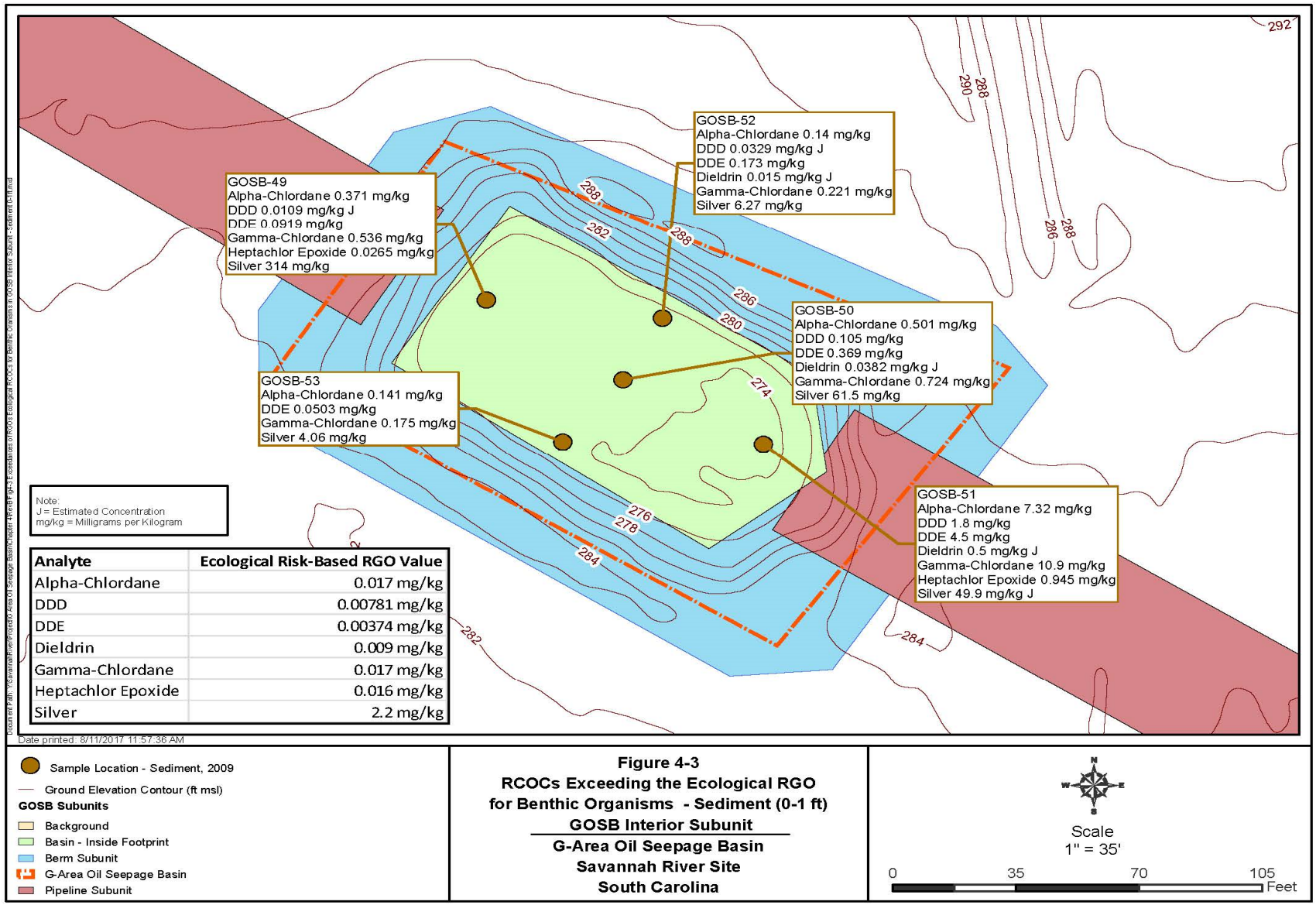


Figure 4-3. RCOCs Exceeding the Ecological RGO for Benthic Organisms – Sediment (0 to 1 ft)

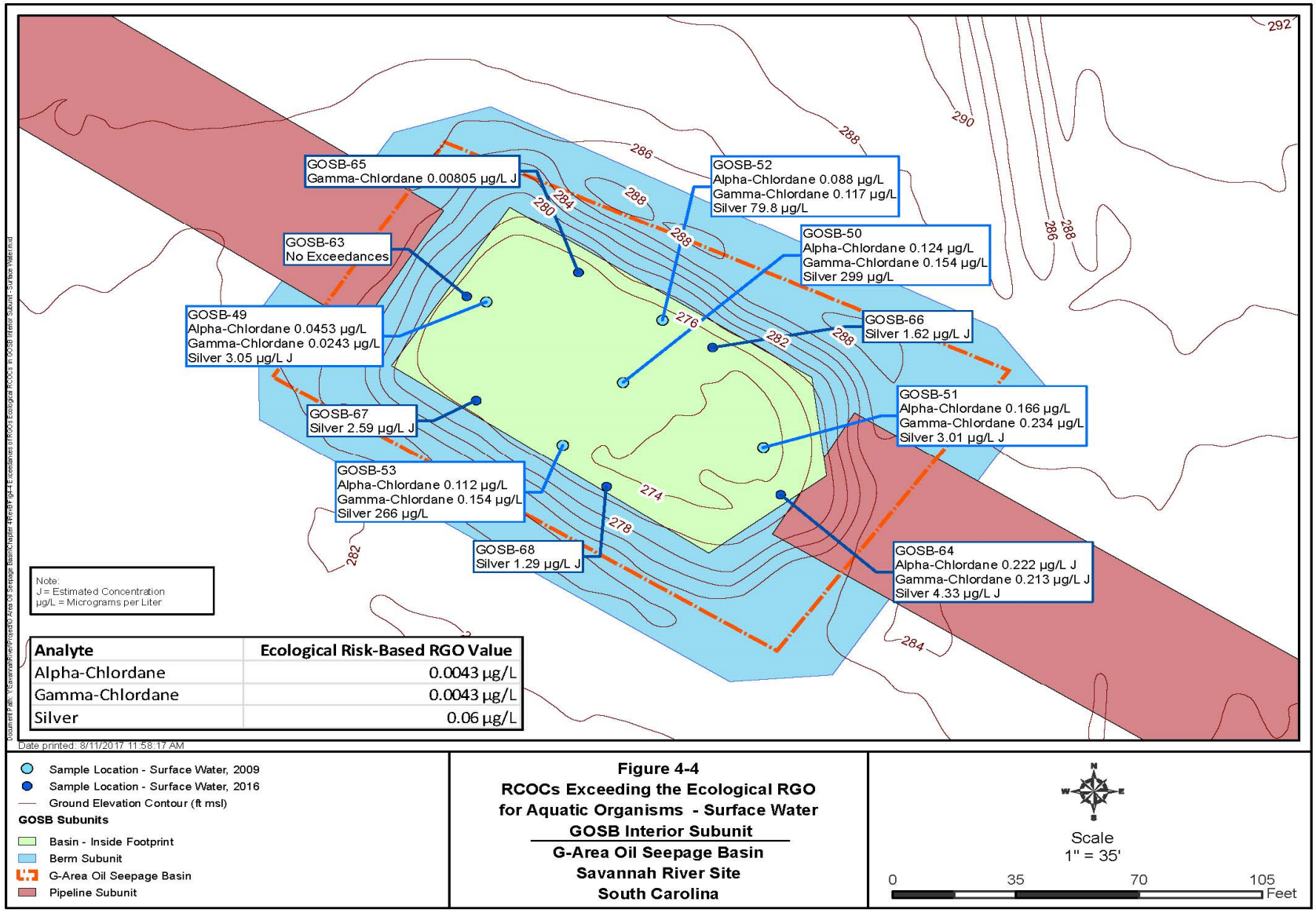


Figure 4-4. RCOCs Exceeding the Ecological RGO for Aquatic Organisms – Surface Water

Table 4-1. Human Health Risk-Based RGOs for Sediment Media

HH RCOC	Resident *(mg/kg)*						Industrial Worker *(mg/kg)*					
	Risk = 1E-06	Risk = 1E-05	Risk = 1E-04	HQ = 0.1	HQ = 1	HQ = 3	Risk = 1E-06	Risk = 1E-05	Risk = 1E-04	HQ = 0.1	HQ = 1	HQ = 3
Alpha-chlordane	1.7	17	170	3.5	35	105	-	-	-	-	-	-
Gamma-chlordane	1.7	17	170	3.5	35	105	7.7	77	770	45	450	1,350
DDE	2	20	200	-	-	-	-	-	-	-	-	-
Dieldrin	0.034	0.34	3.4	0.32	3.2	9.6	0.14	1.4	14	4.1	41	123
Heptachlor epoxide	0.07	0.7	7	0.1	1	3	0.33	3.3	33	1.5	15	45

HH = human health – = not applicable
HQ = hazard quotient
RCOC = refined constituent of concern
RL = risk level

Table 4-2. Ecological Risk-Based RGOs for Sediment and Surface Water Media

Media	Receptor	Constituent	RGO	HQ Basis
Sediment	Benthic organisms	Alpha-chlordane *(mg/kg)*	0.017	HQ = 1
Sediment	Benthic organisms	DDD *(mg/kg)*	0.00781	HQ = 1
Sediment	Benthic organisms	DDE *(mg/kg)*	0.00374	HQ = 1
Sediment	Benthic organisms	Dieldrin *(mg/kg)*	0.009	HQ = 1
Sediment	Benthic organisms	Gamma-chlordane *(mg/kg)*	0.017	HQ = 1
Sediment	Benthic organisms	Heptachlor epoxide	0.016	HQ = 1
Sediment	Benthic organisms	Silver *(mg/kg)*	2.2	HQ = 1
Surface water	Aquatic organisms	Alpha-chlordane *(µg/L)*	0.0043	HQ = 1
Surface water	Aquatic organisms	Gamma-chlordane *(µg/L)*	0.0043	HQ = 1
Surface water	Aquatic organisms	Silver *(µg/L)*	0.06	HQ = 1

HQ = hazard quotient
RGO = remedial goal option
µg/L = micrograms per liter

Table 4-3. Most Restrictive RGO

Medium	Constituent	Receptor	HH RGO Range *(mg/kg)*	Ecological RGO *(mg/kg or µg/L)*	Background[1] *(mg/kg or µg/L)*	MR RGO *(mg/kg or µg/L)*
Sediment	Alpha-chlordane	Resident	1.7 - 170		NA	0.017
		Benthic Organism		0.017		
	DDD	Benthic Organism		0.00781	NA	0.00781
	DDE	Resident	2 - 200		NA	0.00374
		Benthic Organism		0.00374		
	Dieldrin	Resident	0.034 – 3.4		NA	0.009
		Industrial Worker	0.14 - 14			
		Benthic Organism		0.009		
	Gamma-chlordane	Resident	1.7 - 170		NA	0.017
		Industrial Worker	7.7 - 770			
		Benthic Organism		0.017		
	Heptachlor epoxide	Resident	0.07 - 7		NA	0.016
		Industrial Worker	0.33 - 33			
		Benthic Organism		0.016		
	Silver	Benthic Organism		2.2	0.24 – 1.96	2.2
Surface Water	Alpha-chlordane	Aquatic Organism		0.0043	NA	0.0043
	Gamma-chlordane	Aquatic Organism		0.0043	NA	0.0043
	Silver	Aquatic Organism		0.06	NA	0.06

HH = human health
MR = most restrictive
RGO = remedial goal option
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
NA = not applicable

[1]Range from minimum detect to maximum detect from Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1 (WSRC 2006), Appendix B-2 (all depths ft interval)

5.0 CORRECTIVE MEASURES STUDY / FEASIBILITY STUDY

This chapter describes the general response actions for the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU), identifies potential remedial technologies for each general response action, and screens remedial technologies with respect to effectiveness, implementability, and cost for the GOSB Interior Subunit. According to the analyses performed in Appendix B (Contaminant Fate and Transport), Appendix C (Human Health Risk Assessment), Appendix D (Ecological Risk Assessment, and Appendix E (Principal Threat Source Material), the only GOSB OU subunit requiring remediation is the GOSB Interior Subunit.

The GOSB Interior Subunit is the only subunit at the GOSB OU that presents unacceptable risks to human health and the environment. Pesticides are present in basin sediments at levels that have been determined to pose a risk to human health and the environment. In addition, pesticide levels in the basin water pose a risk to ecological receptors. There are no problems warranting action for the GOSB Berm, Pipeline, or Effluent Discharge Subunits.

This initial list of action technologies applicable to the GOSB OU is based upon the approved likely response actions from the July 19, 2017, scoping meeting, as well as experience with similar remedial actions and several sources of remedial listings, including the following:

- Superfund Innovative Technology Evaluation Program (SITE) Technology Profiles Tenth Edition (NRMRL 1999)

- U. S. Environmental Protection Agency (USEPA) Technology Innovation and Field Services Division (CLU-IN) (USEPA 1996)

- Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA 1988)

5.1 Identification and Screening of Technologies

The purpose of this section is to describe the applicability of the specific technology types identified for the GOSB OU. Identified technologies are screened using the National Contingency Plan (NCP) criteria effectiveness, implementability, and cost. Technologies that pass this screening are retained and carried forward into the development of remedial action alternatives.

5.1.1 General Response Actions

General response actions are unit-specific actions that achieve remedial action objectives (RAOs) and satisfy the requirements of the NCP. General response actions have been identified for the GOSB OU:

- No action
- Land Use Controls
- Containment
- Removal and Disposal

These response actions may be implemented singularly or in combination.

5.1.1.1 No Action

The No Action response is not a technology, but is required by the NCP as a baseline for comparison with other remedial actions. In this scenario, no efforts would be taken to monitor, remove, treat, or otherwise mitigate the potential spread of contaminants from the GOSB OU. Contaminant reduction would be achieved only through any natural attenuation that may occur.

5.1.1.2 Land Use Controls

Land use controls (LUCs) include engineering controls (i.e., access controls) and institutional controls (i.e., administrative measures) that minimize the potential for human exposure to contaminants. Although institutional controls (such as deed restrictions on land or water use) are usually effective in achieving RAOs, they can, in many instances be protective of human health. Generally, LUCs are retained for use if necessary, in conjunction with other remedial alternative(s) ultimately selected at the area or as a stand-alone alternative. LUCs that already exist at Savannah River Site (SRS) and that can be implemented at the GOSB OU include: physical access controls (e.g., fencing) and administrative controls.

Access controls involve temporary or permanent physical restrictions to prevent or reduce human exposure to contaminants. Controls also can be used to prevent vandalism of on-site remedial equipment or disturbance of contaminated systems. Regular monitoring and maintenance of access controls are required for this technology to effectively deter site entry. Access controls may include, but are not limited to signs, fencing, barricades, or exclusion devices. Access controls are retained to deter intruders.

Administrative controls can be used to prevent or reduce future human exposure to contaminants remaining on the site. For example, excavation permit restrictions can be used to permanently prohibit excavation or subsurface construction. Administrative controls also can be temporary measures used while other remedial actions are taking place.

In the long-term, if the property is ever transferred to nonfederal ownership, the U.S. Government would, in compliance with Section 120(h) of CERCLA, create a deed for the new property owner. The deed would include notification disclosing the former waste management and disposal activities as well as remedial actions taken onsite and any continuing groundwater monitoring commitments.

5.1.1.3 Containment

Containment technologies minimize or eliminate human and ecological exposure to contaminants and minimize leaching, erosion, and bio-uptake of contaminated media using engineered barriers including covers and caps.

5.1.1.4 Removal and Disposal

Removal (or excavation) and disposal can be accomplished by scraping, cutting, digging, and vacuuming, with heavy moving equipment and using conventional construction methods.

5.1.2 Screening of Technologies

Various technologies and approaches exist for implementing the general response actions for the GOSB Interior Subunit. The NCP requires that these potential technologies be screened against criteria of effectiveness, implementability, and cost.

- Effectiveness. An effective technology must achieve specified RAOs, be compatible with contaminant characteristics and waste unit conditions, and be protective of human health and the environment in both short-term and long-term scenarios. Technologies that do not meet RAOs, are significantly less effective than comparable approaches, or that have not been demonstrated successfully at similarly contaminated site are eliminated from further consideration.

- Implementability. Technologies are evaluated based on the technical feasibility, availability of resources and equipment, and the administrative or institutional feasibility of implementation. Implementable technologies are those that can be readily installed in a cost-effective and timely fashion and that will not elicit substantial public concern from the surrounding community. Mobilization and permitting requirements must be workable and must have been previously demonstrated at similar projects. Consideration is also given to regulatory constraints such as waste handling, disposal, and treatment requirements that would affect the implementation of a technology.

- Cost. A qualitative cost evaluation is provided so that comparisons can be made among the alternatives. Qualitative evaluations take into consideration capital costs and operation and maintenance costs. For screening purposes, the costs of technologies are typically described as high, medium, or low relative to others in the same general category.

Technologies were identified and screened initially during the scoping meeting conducted on July 19, 2017. Technologies that pass this screening are retained and carried forward for consideration as remedial alternatives. Table 5-1 summarizes the results of this screening.

5.1.2.1 No Action

This response would take no action to monitor, remove, treat, or otherwise mitigate the potential spread of contaminants from the GOSB OU. The No Action response could be readily implemented and would be the least expensive response.

Although the No Action response is ineffective at achieving RAOs or preventing access to the GOSB Interior Subunit contaminants, it is required by the NCP and is retained as a baseline for

comparison with other remedial actions. Therefore, No Action is retained for further consideration in the development of alternatives.

5.1.2.2 Land Use Controls

This response action leaves hazardous substances in place that present a potential risk for ~~a~~ residential and industrial worker scenarios as well as ecological receptors. Both administrative and engineering controls would prevent exposure of potential human receptors to contaminants by limiting access to the land or resource use. LUCs are relatively simple and inexpensive to implement and may be retained as an independent alternative or in conjunction with another remedial alternative(s). LUCs may also be used to supplement engineering controls to ensure their continued effectiveness. Engineering barriers such as warning or no trespassing signs, fencing, and barricades can prevent human access to contaminated media.

LUCs are relatively low in cost, provide a high degree of protection of human health, and are relatively simple to implement. LUCs would not be protective in preventing exposure of ecological receptors. However, LUCs would prevent further damage to GOSB OU caused by earth moving activities from more aggressive removal technologies. Therefore, LUCs are retained for further consideration in the development of alternatives.

5.1.2.3 Containment

Containment technologies involve the construction of engineered caps and soil cover systems to isolate contaminated media. Technologies include soil covers, horizontal barriers, synthetic membrane covers/liners, and low permeability soil cover systems. Properly constructed and maintained containments are effective and reliable at preventing direct exposure to contaminants and at minimizing leaching, erosion, mobility, and bio-uptake.

For the GOSB OU, there are no contaminant migration concerns. Therefore, a low permeability cover system to reduce infiltration will not be necessary. Containment needs simply to break the pathway for human and ecological receptors to be exposed to contaminants in the basin sediments and water.

The effectiveness of containment technologies depends upon the materials used and the design and effectiveness of the soil cover. ~~Cover integrity must be maintained for as long as contaminants will persist or until degradation or decay of the contaminants renders them harmless.~~ Generally, cover integrity can be ensured using robust construction techniques and/or through continued maintenance as needed. Maintenance activities include inspections, and monitoring for settlement and erosion.

Cost for containment is considered relatively high. Containment is considered a standard construction practice that has been performed at several basins at SRS, including basins containing saturated sediments. Therefore, containment is retained for further consideration in the development of alternatives. Two separate containment alternatives have been developed for the GOSB OU: 1) place 0.6 m (2 ft) of clean fill in the bottom of the basin and manage surface water, and 2) backfill basin to ground surface with clean fill and manage surface water.

5.1.2.4 Removal and Disposal

Removal (excavation) and disposal of contaminated sediment media in an appropriate facility is one of the most aggressive approaches to remediation. Prior to excavation, the basin will be dewatered. Dewatering activities will be managed as a non-discharge land application. Contaminated sediment media could be excavated and hauled to an approved disposal facility, such as ~~Three Rivers Landfill~~ Three Rivers Solid Waste Authority Class Three Landfill (Three Rivers Landfill) [Permit #024202-1101]. Removing contaminated sediment from the GOSB OU would lower risk levels for human and ecological receptors by permanently removing and disposing of the sediment in an approved waste disposal facility.

The earthwork required for excavating the sediment is a standard construction practice and is readily accomplished. The cost of this action could be substantial based upon the volume of contaminated media and the distance the sediment must be hauled to an approved waste disposal facility. Therefore, removal and disposal will be retained for further consideration in the development of alternatives.

5.2 Development and Screening of Alternatives

Potential alternatives have been developed to address the sediment at the GOSB OU. In accordance with the NCP, it is desirable to offer a range of diverse alternatives to compare during the detailed analysis. The range of alternatives includes options that 1) reduce the contaminant volume and need for long-term management; or 2) limit future exposure to contaminated media. Some alternatives have been developed that involve little or no treatment, yet provide protection to human health and the environment by preventing or controlling exposure to, or migration of, the contaminants through LUCs. As required by the NCP, the No Action alternative is provided as a baseline for comparison.

The RAOs for GOSB Interior Subunit sediment and surface water media are:

- Prevent a residential receptor from exposure to contaminants in sediment within the 0- to 0.3-m (0- to 1-ft) interval
- Prevent an industrial worker from exposure to contaminants in sediment within the 0 to 0.3 m (0- to 1-ft) interval
- Prevent ecological receptors from exposure to the contaminants in sediment
- Prevent ecological receptors from exposure to contaminants in surface water

5.2.1 Development of Remedial Alternatives

Based on the technology screening and the RAOs for the GOSB OU, five remedial alternatives have been developed for detailed evaluation.

5.2.1.1 Alternative A-1: No Action

The No Action alternative is required by the NCP to serve as a baseline for comparison with other remedial alternatives. Under this alternative, no effort would be made to control access, limit exposure, or reduce toxicity, mobility, or volume of constituents of concern at the GOSB OU. This alternative would leave the GOSB Interior Subunit in its current condition with no additional controls. This alternative does not include 5-year remedy reviews.

5.2.1.2 Alternative A-2: Land Use Controls

This alternative involves the use of LUCs to ~~limit access to the entire~~ prevent or reduce human exposure to contaminants remaining in place at the GOSB OU. ~~LUCs, which limit the human health exposure pathway, have been implemented successfully within Savannah River Site (SRS) and are fully employed in all areas of the site to limit access at the site boundary and facilities.~~ LUCs ~~would be implemented at the GOSB OU by posting~~ will include warning and no trespassing signs to alert on-site workers to the presence of hazardous substances and to prevent unknowing entry and unrestricted use. LUCs will include administrative measures as managed through the SRS Site Use/Site Clearance Program to require authorization before beginning work activities at the site. Other administrative measures include property record notices and restrictions in the event that the property is ever transferred to non-federal ownership to disclose former waste management and disposal activities, as well as remedial actions taken at the GOSB OU. The unit-specific LUCs for the GOSB OU will be included in the final ROD. This alternative includes five-year remedy reviews. ~~, implementation of a Land Use Control Implementation Plan, and deed restrictions in the event the property is ever sold. Any additional LUCs could be easily applied and would be protective of the industrial worker receptor as well as the hypothetical future resident scenario.~~

5.2.1.3 Alternative A-3: Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water

Alternative A-3 consists of placing a 0.6-m (2-ft) layer of clean fill over the impacted basin-bottom sediments to break the direct exposure pathway. Specifically, this remedial alternative includes de-watering of the basin, clearing ~0.27 hectares (ha [0.67 acres {ac}]), installation of erosion control measures such as silt fencing along portions of the haul roads and as necessary to protect nearby outfalls, hauling and placing ~466 m^3 (610 yd^3) of clean soil to cover the basin bottom sediments. Clean fill will be verified in accordance with SRS fill and cover material verification protocols. It is anticipated that clean soil will be obtained from an on-site source. Minimal amounts of debris are anticipated based on observations of the basin during a period of dry conditions when there was little water present. Disposal of any debris encountered will be sent to an approved waste disposal facility. Trees cleared to gain access to the basin will be pushed aside and left near the site. Sampling of rainwater collected in the basin after remedial action completion

would be necessary to confirm the effectiveness of the remedy. A Sampling and Analysis Plan, which will include a sampling design as well as sample collection and analytical methods, will be developed and presented in the Corrective Measures Implementation (CMI)/Remedial Action Implementation Plan (RAIP). Alternative A-3 would ~~not~~ require LUCs ~~or~~ and 5-year remedy reviews.

5.2.1.4 Alternative A-4: Backfill Basin and Manage Surface Water

Alternative A-4 consists of backfilling the basin to the natural grade with clean soil and construction of a soil and vegetated cover over the basin footprint soil. The thickness of the required fill material, a minimum of 3.05 m (10 ft) in the shallow end of the basin and a minimum of 4.9 m (16 ft) in the deeper end of the basin, will prevent exposure to pesticides buried at depth. ~~Specifically~~Specific activities associated with this remedial alternative include~~s~~ dewatering of the basin, clearing ~~and grubbing~~ ~0.27 ha (0.67 ac), ~~installation of temporary erosion control measures~~ excavation of the berms, backfilling the basin with ~4,460 m^3 (5,834 yd^3) of clean soil and berm soil, compacting fill material to mitigate subsidence followed by compaction testing, and grading and construction of a soil and vegetated cover over the basin footprint. Temporary erosion control measures such as silt fencing along the haul roads and as necessary to protect nearby outfalls will be used during construction activities.

Controlled compaction is expected to be adequate to mitigate settlement and erosion~~,~~; however, additional construction techniques~~,~~ such as the use of an aggregate bridging material layer~~,~~ may be used if the sediment is determined to be unstable. Clean fill will be verified in accordance with the approved SRS protocol for verification of fill and cover material. No debris is anticipated based on observations of the basin when it was drained in the early 1990's. However, any debris encountered will be managed as CERCLA waste and disposed of at an approved waste disposal facility. Trees cleared to gain access to the basin will be pushed aside and left near the site. Disturbance of the fill material and vegetative cover at the GOSB OU will be prevented by existing administrative site use procedures that prohibit unauthorized excavations at SRS. Alternative A-4 would not require LUCs or 5-year remedy reviews.

5.2.1.5 Alternative A-5: Excavate and Manage Surface Water

Alternative A-5 consists of excavation of the contaminated sediments in the basin with off-site disposal. Specifically, this remedial alternative includes de-watering of the basin, clearing ~~and grubbing~~ ~0.27 ha (0.67 ac), installation of erosion control measures such as silt fencing along portions of the haul roads and as necessary to protect nearby outfalls, excavation and hauling of ~566 m^3 (740 yd^3) of contaminated basin sediments, located 1.2-m (4-ft) below the basin bottom, to an off-site solid waste disposal facility. No debris is anticipated based on observations of the basin when it was drained in the early 1990's. Offsite disposal of any debris encountered will be managed as CERCLA waste and disposed of at an approved waste disposal facility. Trees cleared to gain access to the basin will be pushed aside and left near the site. Post-excavation confirmation samples will be collected and analyzed to confirm that the RAO concentrations have been achieved. A Sampling and Analysis Plan, which will include a sampling design as well as sample collection and analytical methods, will be developed and presented in the CMI/RAIP. For estimating purposes 10 post-excavation confirmation samples (pesticides and metals) and 10 waste characterization samples (Toxicity Characteristic Leaching Procedure [TCLP] were assumed to be adequate. Alternative A-5 would not require LUCs or 5-year remedy reviews.

5.2.2 Screening of Alternatives for Effectiveness, Implementability, and Costs

In this section, the alternatives for the GOSB Interior Subunit are evaluated against the CERCLA criteria of effectiveness, implementability, and cost. The retained alternatives will be analyzed in detail in Section 5-3.

For an alternative to be effective, it must achieve specified objectives, must be compatible with the contaminant characteristics and unit conditions, and must be protective of human health and the environment in the long term. The alternative must also be effective in reducing the risk to human health and the environment in the short term (during construction and construction execution). In addition, each alternative should be effective in decreasing the inherent threats or risks associated with hazardous substances or media by reducing their toxicity, mobility, or volume through treatment. Permanence of the action is also considered. Alternatives that do not provide adequate protection of human health and the welfare of the environment or that do so to a much

lesser extent than a comparable alternative are screened out and not considered during the detailed analysis.

Implementability addresses both the technical and institutional feasibility of applying a technology. Under this criterion, technologies are evaluated based on the technical feasibility to construct, reliably operate, and meet technology-specific regulations for the particular treatment operation, maintenance, and monitoring of technical components of the alternative, if required, after the remedial action is complete. Institutional feasibility of an alternative refers to the ability to obtain necessary approvals and the availability of treatment, storage, and disposal services and capacity, as needed, as well as availability of specific equipment, technical specialists, and other related components.

The nature of the alternative should be such that it can be implemented in a cost effective and timely manner. In addition, the implementation of the technology should not elicit substantial public concerns in the community. Site accessibility, available area, and potential future use of the property may affect the implementation of a specific technology. Mobilization and permitting or approval requirements must be workable and previously demonstrated at similar projects. Preliminary consideration is also given to regulatory constraints such as waste handling, disposal, and treatment requirements that would affect the implementation of a technology. These considerations will be evaluated further during the detailed analysis for retained alternatives when action-specific applicable or relevant and appropriate requirements (ARARs) are developed. Screened out alternatives will not be considered during the detailed analysis.

A qualitative cost evaluation is provided so that cost comparisons can be made among the alternatives. Remedial alternative costs are described as high, medium, or low relative to other technologies in the same general response action category. Qualitative evaluations take into consideration capital costs and operation and maintenance (O&M) costs. These estimates are based on prior estimates, previous experience, and engineering judgment. Alternatives demonstrating comparable levels of applicability, effectiveness, and implementability but at a significantly greater cost will be rejected. Otherwise, cost will not be used as a criterion to screen technologies at this point in the Corrective Measures Study/Feasibility Study (CMS/FS) process.

The five proposed remedial alternatives for the GOSB Interior Subunit were evaluated against the initial screening criteria. The results of the evaluation are presented in the following sections and summarized in Table 5-1.

5.2.2.1 Alternative A-1: No Action

The No Action Alternative is not appropriate for the GOSB Interior Subunit as it does not meet the RAO goals defined in Chapter 4. However, in accordance with the NCP, this alternative is carried forward to serve as a baseline for comparison with other remedial alternatives.

5.2.2.2 Alternative A-2 Land Use Controls

Land Use Controls alone are not appropriate for the GOSB Interior Subunit as it does not meet the RAO for protection of ecological receptors. Therefore, Alternative A-2 is not carried forward for detailed analysis.

5.2.2.3 Alternative A-3: Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water

Alternative A-3 consists of placing 0.6-m (2-ft) (minimum) clean fill over impacted basin sediments after dewatering the basin. Human health and the environment are protected in the long term, so the remedial alternative is determined to be effective. This alternative is readily implementable with common construction methods and equipment. This alternative is considered to have moderate cost for the de-watering of the basin (including spray irrigation of the water to a nearby stand of pine trees), transportation and placement of the clean soil. Therefore, this alternative is retained for detailed analysis.

5.2.2.4 Alternative A-4: Backfill Basin and Manage Surface Water

Alternative A-4 proposes backfilling of the interior basin with clean fill to the surrounding grade after dewatering the basin. Human health and the environment are protected in the long term, so the remedial alternative is determined to be effective. This alternative is readily implementable with common construction methods and equipment. This alternative is considered to have moderate cost for the de-watering of the basin (including spray irrigation of the water to a nearby stand of pine trees), transportation and placement of the backfill, and final grading. Therefore, this alternative is retained for detailed analysis.

5.2.2.5 Alternative A-5: Excavate and Manage Surface Water

Alternative A-5 consists of excavation of the contaminated sediments in the basin, after dewatering, ~~-~~with off-site disposal. While no treatment is proposed, excavation and disposal of the contaminated media will significantly reduce the mobility and mass of the contaminated basin sediments since they are permanently removed from the subunit and safely interred in an approved disposal facility. The basin water would be used to irrigate a nearby stand of pine trees. Human health and the environment are protected in the long term, so the remedial alternative is determined to be effective. This alternative is readily implementable with common construction methods and equipment. SRS has significant experience in earth moving and disposal of solid waste. ~~This alternative is considered to have a comparatively higher cost since the sediments must be excavated from the base of a de-watered basin, then loaded and hauled a distance to an approved disposal facility.~~ Therefore, this alternative is retained for detailed analysis.

5.3 Analysis Criteria

The NCP [40 CFR 300.430(e) (91)] requires that potential remedial alternatives undergo detailed analysis using relevant criteria that will be used by decision makers to select a final remedy. The results of the detailed analysis are then examined to compare alternatives and identify key tradeoffs among alternatives.

Remedial alternatives under consideration may or may not address injuries to the natural resources. Although a comparative analysis of alternatives is provided in this CMS/FS report, this document does not propose a preferred alternative. The preferred alternative will be presented in the Statement of Basis (SB)/Proposed Plan (PP). The preferred alternative will be based on information contained in this report and comments received from the USEPA, South Carolina Department of Health and Environmental Control (SCDHEC), and the public prior to finalization in the Record of Decision (ROD).

Based upon the technology screening and the RAO for the GOSB Interior Subunit, four alternatives are being carried forward for detailed alternatives analysis against the CERCLA criteria listed in the NCP. Although a comparative analysis of alternatives is provided, this

document does not propose a preferred alternative. The statutory requirements that guide the evaluation of remedial alternatives under CERCLA state that a remedial action must:

- Be protective of human health and the environment
- Attain ARARs or define criteria for invoking a waiver
- Be cost effective
- Use permanent solutions to the maximum extent

USEPA has established nine evaluation criteria to address these statutory requirements under CERCLA. These criteria fall into the categories of threshold criteria, primary balancing criteria, and modifying criteria. Modifying criteria (i.e., State or support agency acceptance and community acceptance) will be evaluated after the public comment period on the SB/PP and are not considered in the detailed analysis in Section 5.4.

5.3.1 Threshold Criteria

Each alternative must meet the following threshold criteria to be selected as a permanent remedy under CERCLA:

- **Overall protection of human health and the environment** – The overall protection of human health and the environment is evaluated for each alternative on the basis of how the alternative reduces the risk of exposure to contaminants from potential exposure pathways through engineered barriers or LUCs. Each alternative is examined as to whether it creates any unacceptable short-term risks to human health.

- **Compliance with ARARs** – Remedial actions under CERCLA must attain all ARARs. ARARs are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal, State, or local environmental law that specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

5.3.2 Primary Balancing Criteria

Primary balancing criteria are factors that identify key tradeoffs among alternatives.

- **Long-term Effectiveness and Permanence** – Long-term effectiveness and permanence are evaluated for each alternative on the basis of the magnitude of residual risk and the adequacy and reliability of controls used to manage contaminated media that remain after response objectives have been achieved. Alternatives that offer long-term effectiveness and permanence halt or otherwise mitigate any potential for offsite contaminant transport and minimize the need for future engineered controls.

- **Reduction of Mobility, Toxicity, or Volume through Treatment** – The statutory preference is to select a remedial action that employs treatment to reduce the toxicity, mobility, or volume of hazardous substances. The degree to which alternatives employ recycling or treatment is assessed, including how treatment is used to address the principal threats posed by the waste unit.

- **Short-term Effectiveness** – Evaluation of alternatives for short-term effectiveness takes into account protection of remedial workers, members of the community, and the environment during implementation of the remedial action and the time required to achieve RAOs/remedial goal objectives (RGOs). Schedule estimates are based on projected availability of materials and labor and may have to be updated at the time of remediation.

- **Implementability** – Each alternative is evaluated with respect to the technical and administrative feasibility of implementing the alternatives as well as the availability of necessary equipment and services. This criterion includes the ability to obtain services, capacities, equipment, and specialists necessary to construct components of the alternative; the ability to operate the technologies and monitor their performance and effectiveness; and the ability to obtain necessary approvals from other agencies.

- **Cost** – Accuracy of present-worth costs is +50/-30% according to USEPA guidance. Detailed cost estimates are derived from current information including vendor quotes, conventional cost

estimating guides, and costs associated with serial costs, site conditions, competitive market conditions, final project scope, and implementation schedule at the time that the remedial activities are initiated. Real interest rates on U.S. Treasury notes and bonds of specific maturity were used to estimate present-worth costs. Present worth costs for O&M activities are provided for each alternative and are based on an estimated time frame of operation.

5.3.3 Modifying Criteria

Modifying criteria (i.e., State or support agency acceptance, community acceptance) will be considered during remedy selection.

- **State or Support Agency Acceptance** – The preferred alternative should be acceptable to State and support agencies. The State acceptance criterion is evaluated based on scoping meetings held between the United States Department of Energy (USDOE), USEPA, and SCDHEC, and based on comments received on this CMS/FS, which are addressed in the final SB/PP document.

- **Community Acceptance** – The concerns of the community should also be considered in presenting alternatives that would be acceptable to the community. Community acceptance is evaluated based on comments on the SB/PP received during the public comment period. These comments are considered in the final remedy selection for the ROD and the issuance of a Resource Conservation and Recovery Act (RCRA) permit modification.

5.4 Detailed Analysis of Alternatives

The four carried-forward alternatives will be evaluated against the seven CERCLA Threshold and Balancing Criteria that provide the basis for evaluating the alternatives and selecting a remedy. The purpose of this section is to identify key advantages and disadvantages of each alternative. The results of the evaluation are discussed below. The remaining two modifying criteria will be evaluated in the SB/PP. The detailed analysis of the four alternatives is presented in the following sections.

5.4.1 Alternative A-1 No Action

Alternative A-1 was carried forward required by the NCP to serve as a baseline for comparison with other remedial alternatives. Alternative A-1 consists of performing no action to address contamination at the GOSB OU. Contaminated media would remain in place and no LUCs or active remediation would be conducted to control current and/or future potential risk; to treat or remove contaminated media; or to reduce toxicity, mobility, or volume of the contaminated media.

5.4.1.1 Protection of Human Health and the Environment

The No Action alternative would not address the risk to resident or industrial workers to the contaminated sediments or the risks to aquatic and benthic organisms via exposure to the contaminated sediments and surface water.

5.4.1.2 Compliance with ARARs

No chemical-specific, location-specific, or action-specific ARARs are associated with the No Action alternative.

5.4.1.3 Long-Term Effectiveness

Residual risk to human health and the environment under future conditions at the GOSB OU would remain unchanged under the No Action alternative. This alternative does not provide for long-term effectiveness or permanence.

5.4.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Active treatment or removal of contaminated media to reduce toxicity, mobility, or volume is not associated with the No Action alternative; therefore, there is no reduction in the toxicity, mobility or volume of contaminated media.

5.4.1.5 Short-Term Effectiveness

The No Action alternative would not endanger the surrounding communities or remedial workers; however, this alternative does not meet the RAOs and will continue to adversely affect the environment.

5.4.1.6 Implementability

Since this alternative requires no action, implementability is not a consideration.

5.4.1.7 Cost

There is no present-worth cost estimated for the No Action alternative since there is no action implemented and no 5-year remedy review. Detailed cost estimates are included as an attachment to this chapter. A summary of the estimates cost is below.

Total Present-Worth Cost *$0*

5.4.2 Alternative A-2 Land Use Controls

LUCs were not retained for detailed analysis.

5.4.3 Alternative A-3 Place 0.6-meter (2-foot) Clean Fill Layer and Manage Surface Water

Alternative A-3 was carried forward for a detailed analysis. Alternative A-3 consists of placing 0.6-m (2-ft) of clean fill over the impacted basin-bottom sediments to break the direct exposure pathway. Specifically, this remedial alternative includes de-watering of the basin, site clearing for equipment staging, installation of temporary erosion control measures, and road improvements for the purpose of hauling and placing ~466 m^3 (610 yd^3) of clean fill to cover the basin bottom sediments.

Access for Alternative A-3 as shown on Figure 5-1, will be via the gravel road off of SRS Road C. Approximately 0.27 ha (0.67 ac) of the GOSB OU will be cleared ~~and grubbed~~. For the purpose of developing a cost estimate, de-watering of the ~1,567,160.48 L (414,000 gal) of rainwater in the basin is assumed to be accomplished by pumping and spray irrigating at the location shown on Figure 5-2. The area that will receive the rainwater is a pine forest downgradient and east of the basin. The irrigation will promote tree growth and mitigate runoff.

After the basin is de-watered, a portion of the basin side wall will be removed for access to the basin floor for placement of the clean fill hauled from an onsite borrow pit. A minimum of 0.6 m (2 ft) of clean fill will be placed to cover the basin-bottom sediment. Figures 5-3 and 5-4

show the limit of disturbance and proposed construction elements. As shown on the design, the basin berms will remain in-place to prevent rainwater run-in. Rainwater that accumulates in the basin after the remedial action will require sampling and reporting. For estimating purposes, sampling and reporting is assumed to be required once per year for a period of 5 years. LUCs are assumed to be required for 30 years because RCOCs, will remain in place below the 0.6 m (2 ft) clean fill above the contaminated sediments. A time period of 30 years was deemed sufficient because the contamination is limited in extent to the deeper end of the relatively small basin.

5.4.3.1 Protection of Human Health and the Environment

De-watering and covering basin-bottom sediments provides protection of human health and the environment and would achieve RAOs in a short period (several months) of time.

5.4.3.2 Compliance with ARARs

Chemical-Specific ARARs: None.

Location-Specific ARARs: None.

Action-Specific ARARs: To minimize erosion of sediment and manage storm water runoff that may occur during the remedial actions, best management practices will be employed.

5.4.3.3 Long-Term Effectiveness

Placement of the soil cover and maintaining the basin berms to prevent storm water run-in will break the exposure pathway, however, there is uncertainty associated with long-term effectiveness due to the impacts from rainwater accumulation. Residual risk from exposure to RCOCs is possible if degradation of the 0.6-m (2-ft) cover material were to occur. Sampling of accumulated water will be necessary to ensure that contaminants beneath the soil layer do not affect future rainwater collected in the basin. Continued long-term effectiveness will be managed via engineering controls to monitor and maintain an adequate cover over the contaminants remaining in place and LUCs will prevent exposure to contaminated sediments.

5.4.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not employ any treatment to reduce the toxicity, mobility, or volume of the contaminated media.

5.4.3.5 Short-Term Effectiveness

This alternative can be completed in a short timeframe while posing no ~~significant~~ risk to the community ~~or workers~~. Initial protection against the threats associated with exposure to contaminated sediments and achievement of the RAOs would be achieved in less than 6 months from the commencement of construction activities. Remedial workers will have the greatest risk of exposure during construction activities. Use of best management practices during construction and strict adherence to the project-specific health and safety plan will prevent worker exposure to hazardous substances and will minimize any risk to surrounding communities while activities are performed.

5.4.3.6 Implementability

Initial dewatering of the basin and placement of 0.6 m (2 ft) of fill material over the contaminated sediments is administratively feasible in that the only permits required would be a non-discharge permit for the land application of basin water. Non-discharge permits have been granted for past remedial activities at SRS involving the land application of water. Alternative A-3 is also considered to be technically feasible in that ~~De-watering~~ dewatering and earth work can be achieved with standard, readily available equipment. There is ample forested area adjacent to the basin to receive irrigation from the dewatering effort. SRS has extensive experience in dewatering and earth moving activities. ~~It is anticipated that a non-discharge permit will be required to allow land application of the water.~~ Approximately 466 m^3 (610 yd^3) of clean fill will be required to be hauled from a borrow area and placed at the bottom of the basin. Because soil compaction is not required to prevent settling, this alternative can be completed relatively quickly and with less equipment.

5.4.3.7 Cost

Construction costs for Alternative A-3 would include clearing ~~and grubbing~~, erosion control, dewatering, temporary excavation of the berms for access, and testing, hauling, and placing of clean fill. The O&M cost includes LUCs and sampling of accumulated rainwater to ensure long term effectiveness. For estimating purposes, sampling of accumulated rainwater was assumed to occur once per year for a period of 5 years. A cost estimate for construction, construction management, safety, and O&M is presented in Appendix H.

Total Present-Worth Cost: ~~$1,357,012~~3,072,000

5.4.4 Alternative A-4 Backfill Basin and Manage Surface Water

Alternative A-4 was also carried forward for a detailed analysis. This alternative proposes to backfill the basin with clean and construction of a vegetative cover. This alternative will require site clearing for equipment staging, temporary erosion control, and road improvements to accommodate the high volume of truck traffic for hauling in soil backfill. For the purpose of developing a cost estimate, de-watering of the basin is assumed to be by pumping and spray irrigating.

Access for Alternative A-4 (Figure 5-1) will be via the gravel road off of SRS Road C. Approximately 0.27 ha (0.67 ac) of the GOSB OU will be cleared ~~and grubbed~~. For the purpose of developing a cost estimate, de-watering of the ~1,567,160.48 L (414,000 gal) of rainwater in the basin is assumed to be accomplished by pumping and spray irrigating (Figure 5-2). The area that will receive the rainwater is a pine forest downgradient and east of the basin. The irrigation will promote tree growth and mitigate runoff.

After the basin is de-watered, a portion of the basin side wall will be removed for access to the basin floor for backfill and compaction of the clean soils. The backfill will be a combination of 255 m^3 (334 yd^3) of stockpiled former berm and basin sidewall soils along with ~3,976 m^3 (5,200 yd^3) of clean soil to fill the basin and 229 m^3 (300 yd^3) of top soil required for the vegetative cover. The clean fill will be hauled to the site from a borrow area on SRS. The clean fill will be placed in 0.203-m (8-in.) lifts and compacted to 95% of the standard proctor in order to provide

for a solid foundation for the construction of the vegetative cover. Figures 5-5 and 5-6 show the limits of disturbance and the proposed construction elements.

5.4.4.1 Protection of Human Health and the Environment

De-watering and backfilling of the basin sediments provides complete protection of human health and the environment and would achieve RAOs in a short period (several months) of time.

5.4.4.2 Compliance with ARARs

Chemical-Specific ARARs: None.

Location-Specific ARARs: None.

Action-Specific ARARs: In order to minimize erosion of sediment and manage storm water runoff that may occur during the remedial actions, best management practices will be employed.

5.4.4.3 Long-Term Effectiveness

Backfilling the basin and construction of a vegetated soil cover will provide long-term effectiveness with no associated long-term O&M requirements. Residual risks will be mitigated by the placement of a clean soil layer ranging in thickness from ~3.05 m to 4.90 m (10 ft to 16 ft). The thickness of the clean fill layer will ensure that exposure to contaminated sediments will be eliminated with no requirement to monitor and maintain. Additionally, this alternative eliminates the physical hazards associated with an open basin with steep slopes and eliminates the need for LUCs and five-year remedy reviews.

5.4.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not employ any treatment to reduce the toxicity, mobility, or volume of the contaminated media.

5.4.4.5 Short-Term Effectiveness

This alternative can be completed in a short timeframe while posing no ~~significant~~ risk to the community ~~or workers~~. Initial protection against the threats associated with exposure to

contaminated sediments and achievement of the RAOs would be achieved in less than 6 months from the commencement of construction activities. Remedial workers will have the greatest risk of exposure during construction activities. Use of best management practices during construction and strict adherence to the project-specific health and safety plan will prevent worker exposure to hazardous substances and will minimize risk to surrounding communities while activities are performed.

5.4.4.6 Implementability

Initial dewatering of the basin and backfilling the basin is administratively feasible in that the only permits required would be a non-discharge permit for the land application of the basin water. Non-discharge permits have been granted for past remedial activities at SRS involving the land application of water. Alternative A-4 is also considered to be technically feasible in that de~~De~~watering can be achieved with standard equipment and~~.~~ ~~It is anticipated that a non-discharge permit will be required to allow land application of the water. Backfilling is~~backfilling can be implemented with standard earth-moving equipment, materials, and conventional construction methods. There is ample forested area adjacent to the basin to receive irrigation from the dewatering effort. SRS as extensive experience in dewatering and earth moving activities. Because this alternative requires a total of 4,205 m^3 (5,500 yd^3) of clean fill and top soil, and placement of sod, this alternative will require road improvements to accommodate the increased construction traffic.

5.4.4.7 Cost

Construction costs for Alternative A-4 would include clearing ~~and grubbing~~, erosion control, dewatering, excavation of the berms, testing/hauling ~~and~~/placing of clean fill and top soil, and sod installation. A cost estimate for construction is presented in Appendix H.

Total Present-Worth Cost: ~~$1,719,441~~1,827,100

5.4.5 Alternative A-5 Excavate and Manage Surface Water

Alternative A-5 was carried forward for a detailed analysis. This alternative proposes to excavate the contaminated sediments, hauling and off-site disposal of the excavated waste, and confirmation

sampling at the base of the excavation. This alternative will require clearing for equipment staging and access, erosion control, improvements to the access road to the GOSB OU to accommodate truck traffic for waste disposal staging and hauling, and de-watering of the basin by pumping and spray irrigation.

Access (Figure 5-1) will be via the 1 kilometer (km) (3,200 ft) un-named gravel road off of SRS Road C. The limit of disturbance will be ~0.27 ha (0.67 ac) of the GOSB OU to be cleared ~~and grubbed accordance with the site Erosion Control Permit~~. For the purposes of estimating cost, de-watering of the ~1,567,160.48 L (414,000 gal) of rainwater in the basin is assumed to be accomplished by pumping and spray irrigating. The area that will receive the rainwater is a pine forest downgradient and east of the basin. The irrigation will promote tree growth and mitigate runoff.

Excavation will be completed using standard earth moving equipment. Initially a portion of the basin side wall will be removed for access to the basin floor. An estimated 566 m^3 (740 yd^3) of waste will be generated during excavation and directly loaded into roll-off containers and staged at the site. This volume includes the 0 to 0.3 m (1 ft) of basin-bottom sediments and an additional 0.9 m (3 ft) of sub-basin soil. Representative soil samples will be collected and analyzed for waste characterization and post-excavation confirmation sampling. This alternative assumes that the wastes will ultimately be hauled to the Three Rivers Landfill following the proposed route (Figure 5-1). Figures 5-7 and 5-8 show the limit of disturbance, and excavation depths.

5.4.5.1 Protection of Human Health and the Environment

De-watering and excavation of the basin sediments provides complete protection of human health and the environment and would be protective of human health and achieve RAOs during a short period (several months) of time.

5.4.5.2 Compliance with ARARs

Chemical-Specific ARARs: None.

Location-Specific ARARs: None.

Action-Specific ARARs: Disposal and transportation of solid waste generated from Alternative A-5 would be handled in accordance with ~~Federal and State regulations (40 CFR 262.11(b) and SCDHEC 61-107.5(D)(3))~~ Regulation 61-107.5 SWM: Collection, Temporary Storage and Transportation of Municipal Solid Waste and Regulation 61-107.19 SWM: Solid Waste Landfills and Structural Fill. Disposal of the solid waste will also trigger South Carolina SC R-61-107 requirements, which requires disposal in a properly constructed and permitted disposal facility. This requirement can be achieved through use of an existing and approved on-site SRS facility or transporting the contaminated media to an approved off-site SRS facility such as Three Rivers Landfill.

5.4.5.3 Long-Term Effectiveness

This alternative permanently removes and safely disposes of the contaminated surface water and sediments and, therefore, offers long-term protection. No contaminants would be left in place, therefore, there would be no remaining risk and LUCs would not be required.

5.4.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative does not employ any treatment to reduce the toxicity, mobility, or volume of the contaminated media.

5.4.5.5 Short-Term Effectiveness

This alternative can be completed in a short timeframe while posing no ~~significant~~ risk to the community. Initial protection against the threats associated with exposure to contaminated sediments and achievement of the RAOs would be achieved in less than 6 months from the commencement of construction activities. Use of best management practices during construction and transportation of contaminated media off-site will minimize any risk to surrounding communities. Remedial workers will have the greatest risk of exposure during excavation and hauling activities. Strict adherence to the project-specific health and safety plan will mitigate worker exposure to hazardous while activities are performed.

5.4.5.6 Implementability

Initial dewatering of the basin and backfilling the basin is considered to be administratively feasible in that the only permits required would be a non-discharge permit for the land application of the basin water. Non-discharge permits have been granted for past remedial activities at SRS involving the land application of water. Alternative A-5 is also considered to be technically feasible in that de~~De~~watering can be achieved with standard equipment. ~~It is~~and ~~anticipated that a non-discharge permit will be required to allow land application of the water.~~ E~~e~~xcavation and disposal are implemented with standard earth-moving equipment, materials, and conventional construction methods. There is ample forested area adjacent to the basin to receive irrigation from the dewatering effort. SRS as extensive experience in dewatering and earth moving activities. This alternative will require improvements to the access road to the GOSB OU to accommodate truck traffic for waste disposal staging and hauling. An estimated 566 m^3 (740 yd^3) of excavated soil and sediment will be generated during excavation, sampled for waste acceptance criteria, managed on-site pending laboratory results, and ultimately hauled to the Three Rivers Landfill for disposal.

5.4.5.7 Cost

Construction costs for Alternative A-5 would include clearing ~~and grubbing~~, temporary erosion control, de-watering, excavation, transportation and disposal of contaminated sediments, and sampling and analysis. For estimating purposes, 10 post-excavation samples are assumed with analyses for pesticides and metals, and 10 waste characterization samples are assumed with analysis for TCLP. A cost estimate is presented in Appendix H.

Total Present-Worth Cost: ~~$1,626,117~~1,716,000

5.5 Summary of the Analysis

This section identifies key advantages and disadvantages of each alternative in relation to the evaluation criteria. Table 5-2 provides a summary of the comparative ranking analysis. Each alternative is ranked with respect to the other alternatives for the evaluation criteria.

Overall Protection of Human Health and the Environment

With the exception of Alternative A-1, all alternatives are protective of human health and the environment. Alternatives A-3 and A-4 break the exposure pathway by placing clean fill over the contaminated basin sediments. Alternative A-5 physically removes the source of contamination via excavation and offsite disposal.

Compliance with ARARs

There are no ARARs associated with Alternative A-1, A-3 or A-4. Action specific ARARs for Alternative A-5, associated with disposal and transportation of solid waste, are achievable through the use of existing approved on-site disposal facility such as Three Rivers Landfill.

Long-term Effectiveness

Alternative A-1 has no long-term effectiveness and was ranked lowest of all the alternatives. Alternative A-5 was considered to rank best on long-term effectiveness, as this alternative includes excavation of contaminated sediments and leaves no contamination in place. Alternative A-3 was ranked below A-4 due to the uncertainty associated with the potential for accumulation of rainwater to reduce the effectiveness of the 0.6-m (2-ft) soil cover and the requirement to sample the accumulated rainwater.

Reduction of Toxicity, Mobility, or Volume Through Treatment

None of the alternatives employ any treatment to reduce the toxicity, mobility, or volume of the contaminated media. As such, all alternatives were given an equally low ranking.

Short-term Effectiveness

Although there is no short-term impact to remedial workers, A-1was scored lowest because the RAOs/RGOs would not be met could not be considered as being effective in the short term. Consequently, A-5 was also considered to rank lowest because the risk to remedial workers is greatest for this alternative due to remedial worker exposure to the contaminated sediments during excavation. Short-term effectiveness was deemed slightly higher for A-4 than A-3 because the

berms would be pushed in under A-4 and would provide temporary cover over the contaminated sediments to protect workers during the backfilling operation.

Implementability

Alternative A-5 was ranked the lowest regarding implementability due to the fact that it would require excavation, transportation, and disposal of ~566 m^3 (740yd^3) of soil. Additionally, due to the depth (~3.3 m [10 ft]) and the remote location of the GOSB, alternative A-5 would require significant access improvements to allow for excavation equipment operation and an increased construction equipment (haul trucks) traffic. Alternative A-3 was judged to be slightly better than A-4 in terms of implementability based on the smaller volume of clean fill and the fact that soil compaction is not required for the 6-m (2-ft) soil cover. There is no implementation of A-1; therefore, this alternative was ranked highest.

Cost

The total present-worth cost for each of the alternatives is provided below:

Alternative A-1	No Action	*$0*
Alternative A-3	Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water	*~~$1,357,012~~3,072,000*
Alternative A-4	Backfill Basin and Manage Surface Water	*~~$1,719,441~~1,827,100*
Alternative A-5	Excavate and Manage Surface Water	*~~$1,626,117~~1,716,000*

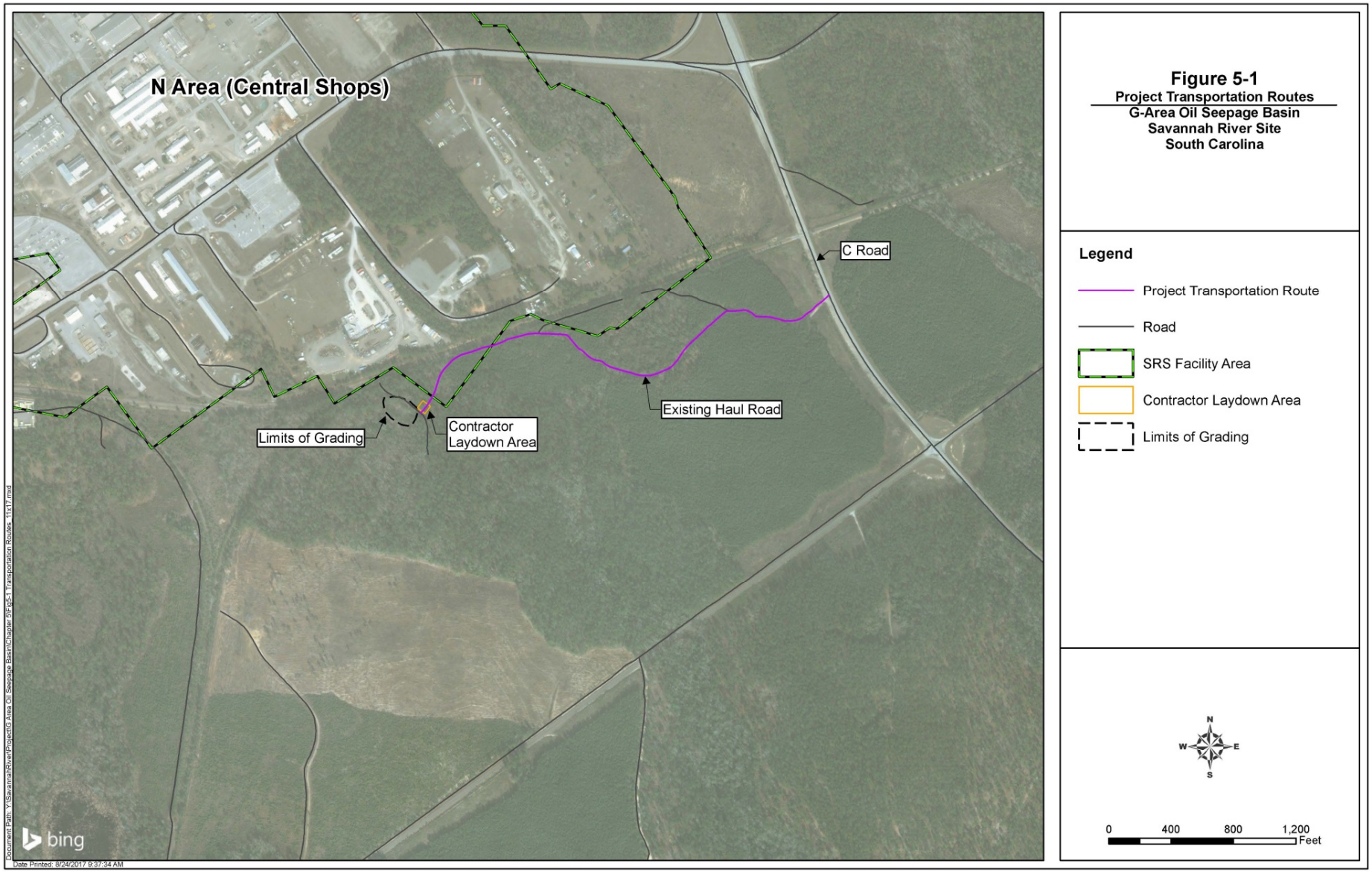


Figure 5-1. Transportation Routes to Clean Soil and Solid Waste Disposal Facilities

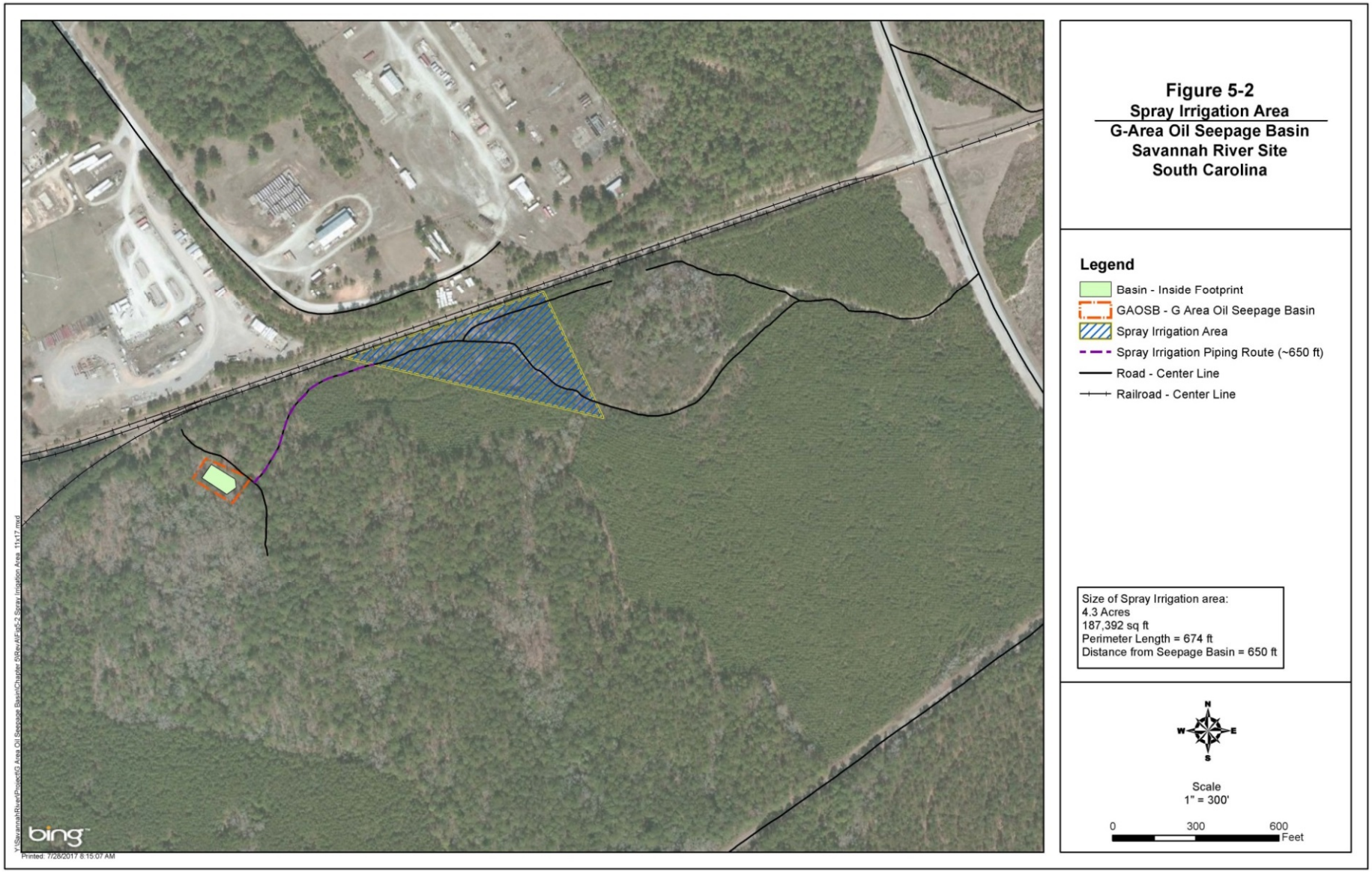


Figure 5-2. Spray Irrigation Area

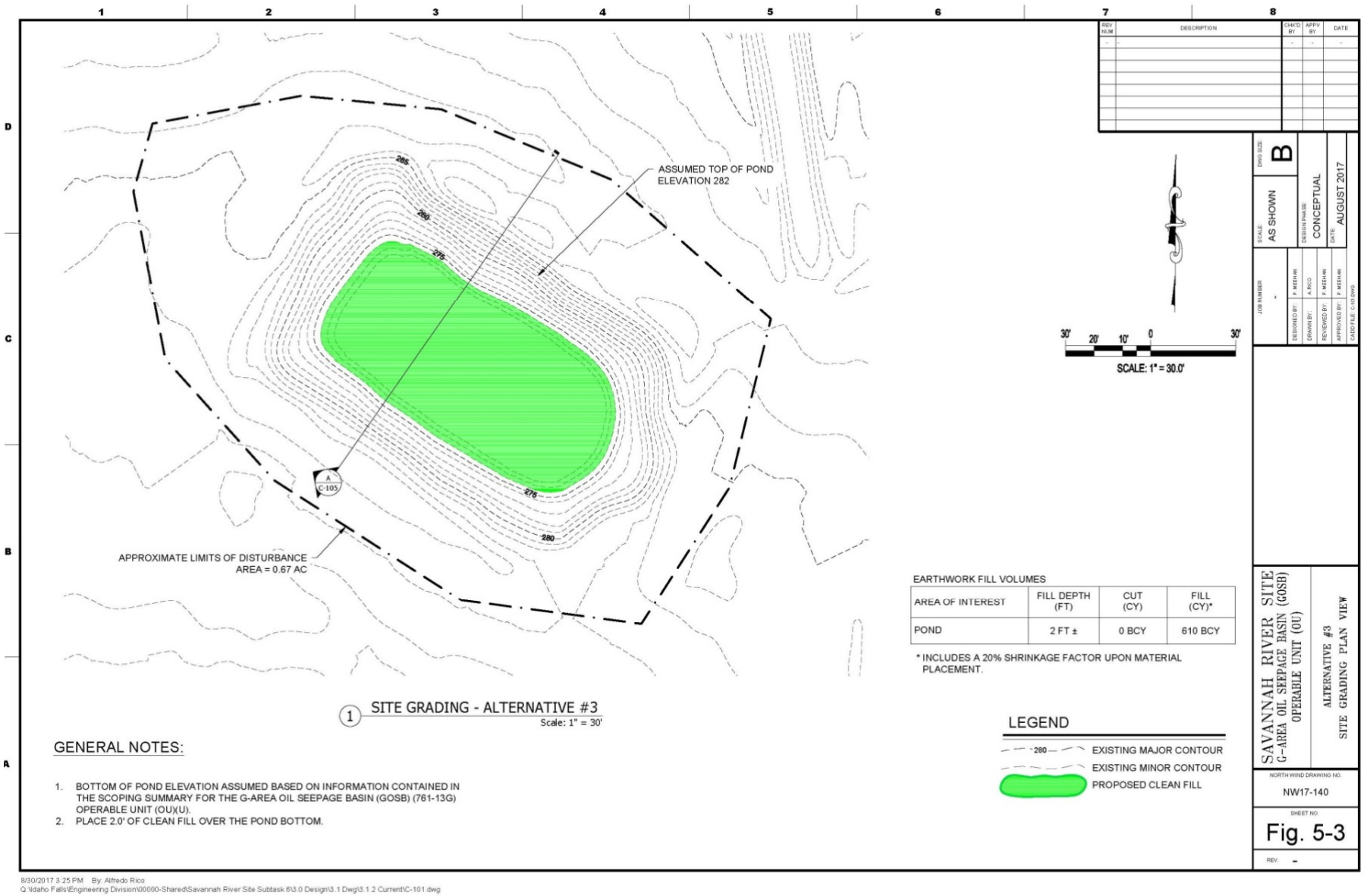


Figure 5-3. Site Grading – Alternative #3

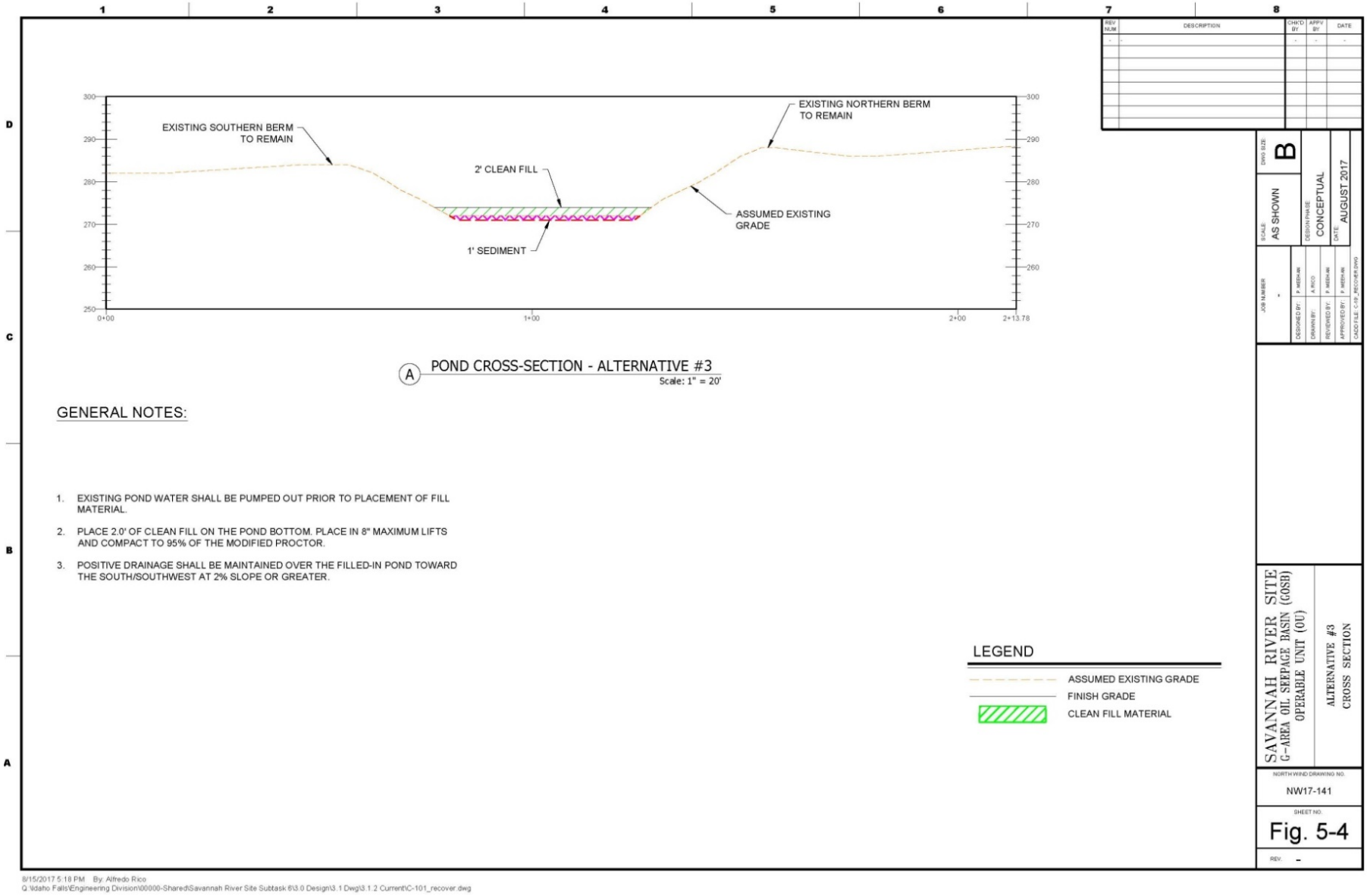


Figure 5-4. ~~Pond~~Basin Cross-Section – Alternative #3

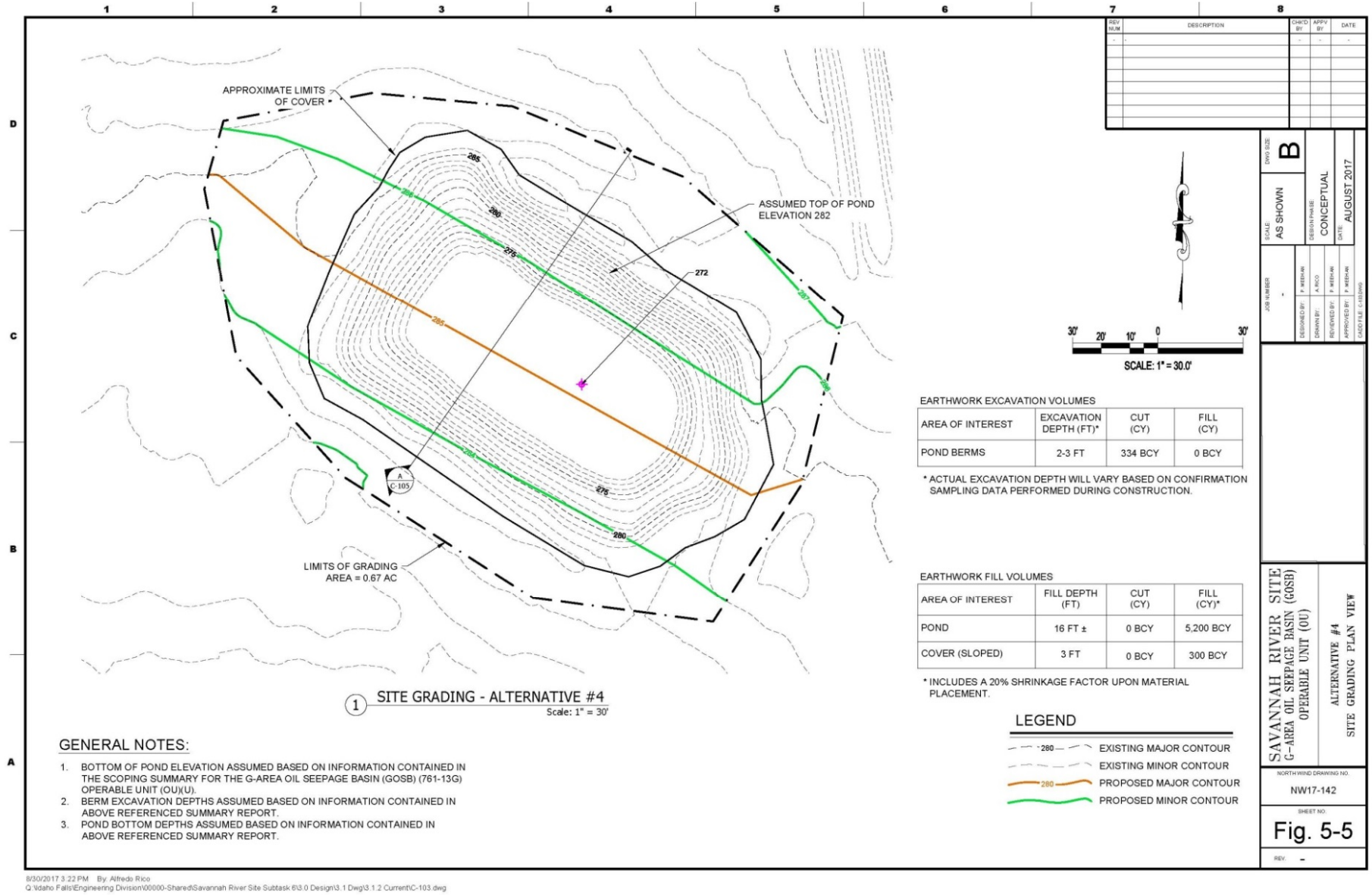


Figure 5-5. Site Grading – Alternative #4

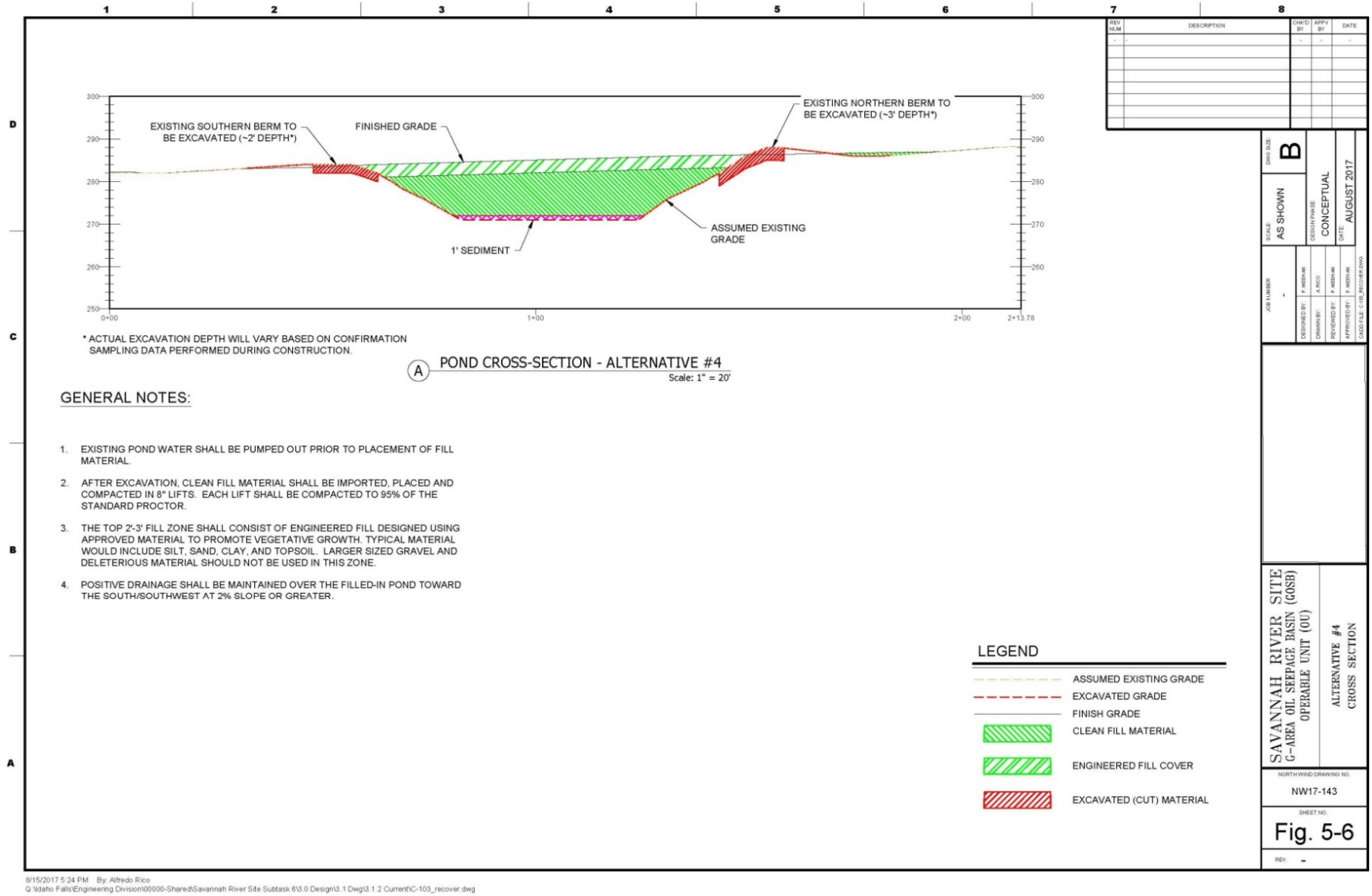


Figure 5-6. ~~Pond~~Basin Cross-Section – Alternative #4

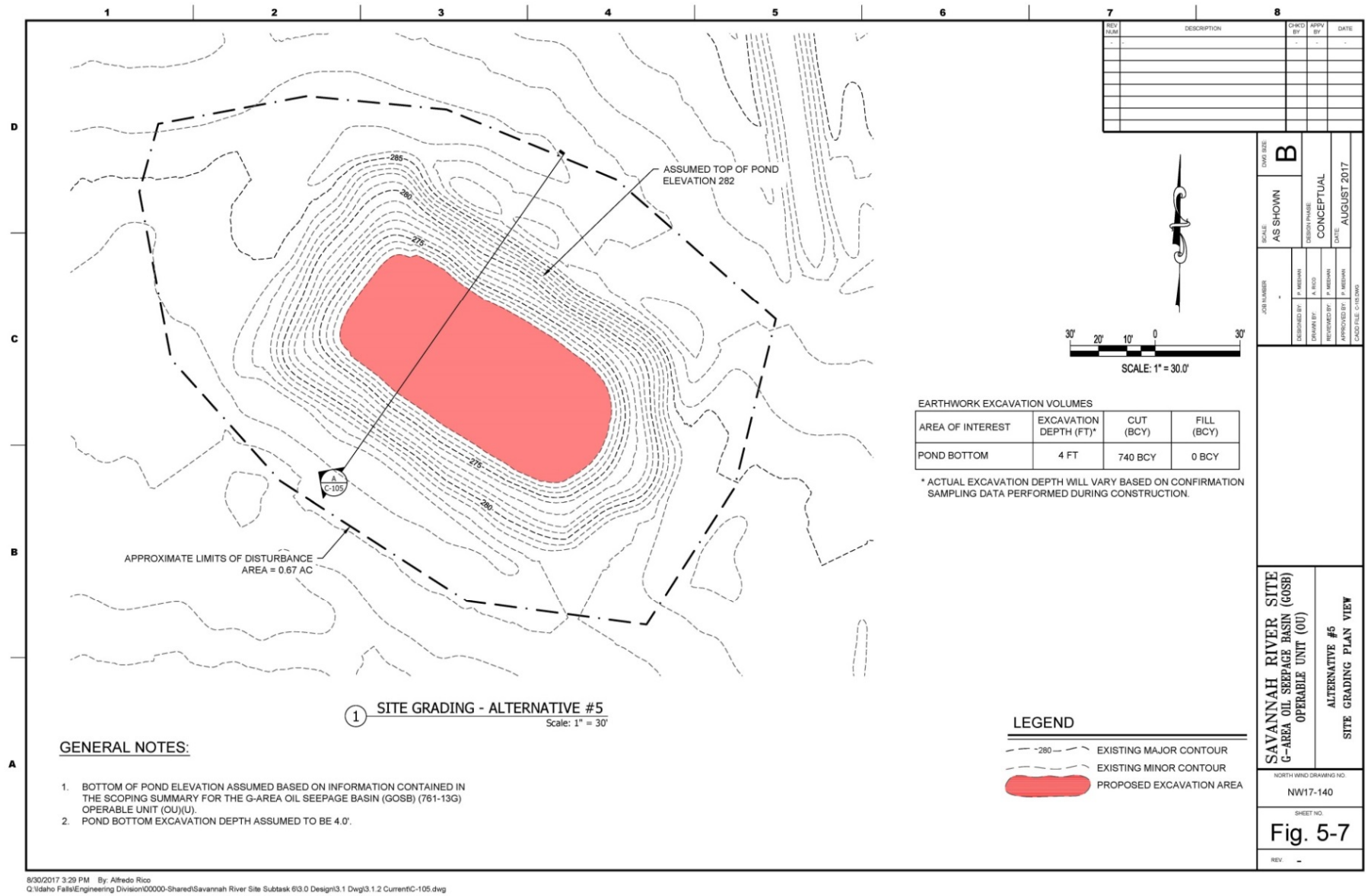


Figure 5-7. Site Grading – Alternative #5

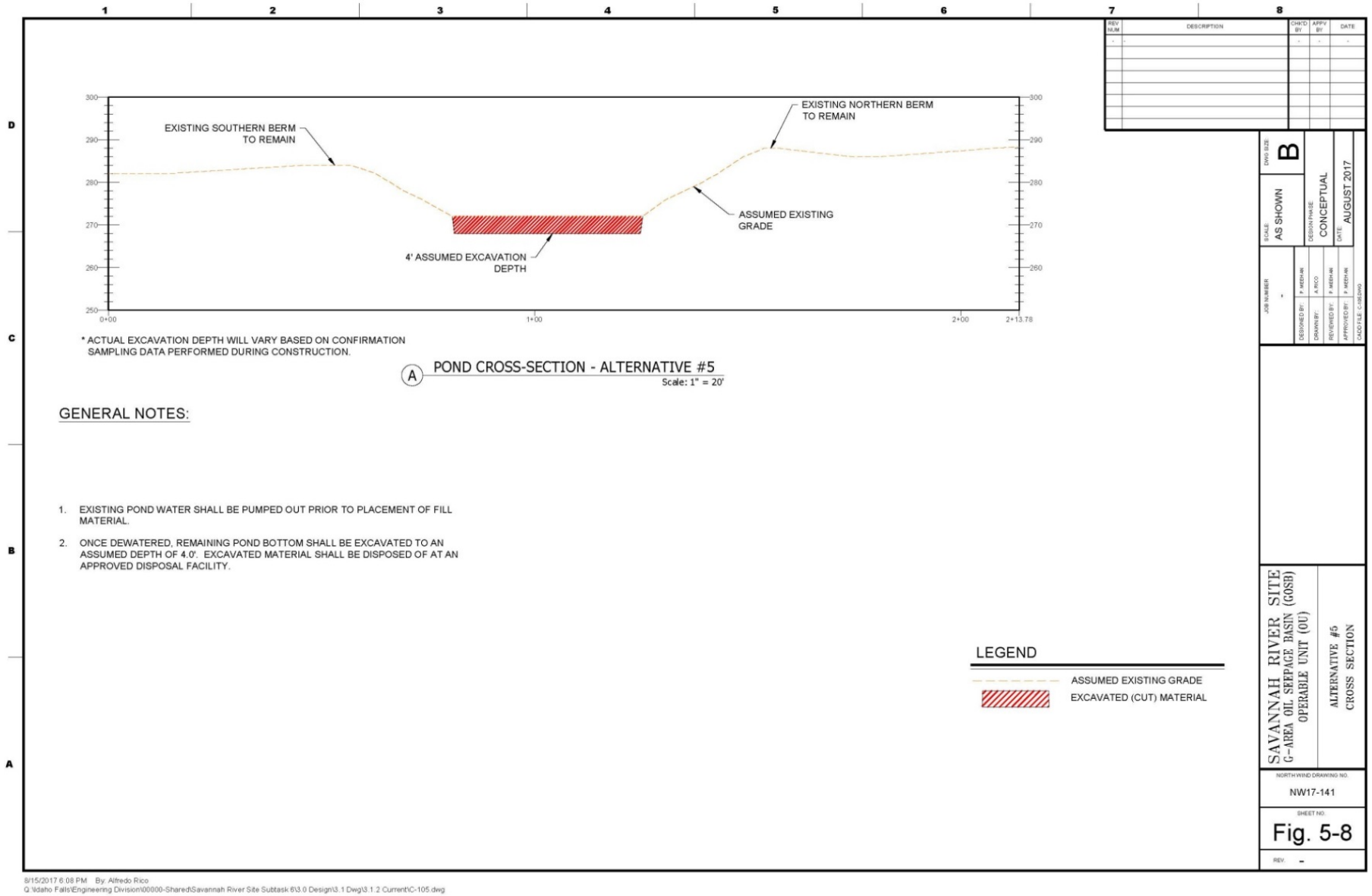


Figure 5-8. ~~Pond~~Basin Cross-Section – Alternative #5

Table 5-1. Summary of Alternative Screening for GOSB OU- Basin Interior Subunit (Sediment and Surface Water)

Alternative	Effectiveness	Implementability	Cost	Status	Comment
A-1 No Action	Not effective in reducing exposure of contaminated media to human or ecological receptors. Alternative does not treat or remove waste.	Not applicable	None	Required	Alternative is required by NCP. Influenced by risk management decision to consider impact of removal/backfill alternatives on ecosystem.
A-2 Land Use Controls	Effective in reducing exposure of contaminated media to human receptors but not ecological receptors. Alternative does not treat or remove waste.	Installation of warning signs postings and site inspections.	Low	Remove	Action would allow contaminated media to remain in place. Influenced by risk management decision to consider impact of removal/backfill alternatives on ecosystem. Requires 5-year remedy reviews.
A-3 Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water	Effective in reducing exposure of contaminated media to human and ecological receptors. Alternative may require treatment of surface water.	Involves management of surface water, backfill basin to break exposure pathway with clean soil, as needed, from onsite borrow pit using standard earth moving equipment.	Med	Retained	~~Does not~~Includes LUCs and requires 5-year remedy review.
A-4 Backfill Basin and Manage Surface Water	Effective in reducing exposure of contaminated media to human and ecological receptors. Alternative may require treatment of surface water.	Involves management of surface water, hauling and placing backfill, final grading and vegetative cover	High	Retained	Remedial workers managing surface water would be exposed to contaminated media. Does not require LUCs or 5-year remedy reviews.
A-5 Excavate and Manage Surface Water	Effective in reducing exposure of contaminated media to human and ecological receptors. Alternative may require treatment of surface water.	Involves management of surface water, excavation of contaminated sediment, and disposal at offsite facility.	High	Retained	Remedial workers removing sediment and managing surface water would be exposed to contaminated media. Does not require LUCs or 5-year remedy reviews.

Table 5-2. Comparative Alternative Analysis for GOSB OU-Basin Interior Subunit (Sediment and Surface Water)

Response Action	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Performance	Reduction of Toxicity, Mobility or Volume Through Treatment	Short-Term Effectiveness	Implement anility	Cost	Overall Ranking (4 - 16)
A-1 No Action	No	No	1	1	1	4	($0)	7
A-3 Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water	Yes	Yes	2	1	3	3	($~~1.4~~3.1M)	9
A-4 Backfill Basin and Manage Surface Water	Yes	Yes	3	1	4	2	($~~1.7~~1.8M)	10
A-5 Excavate and Manage Surface Water	Yes	Yes	4	1	1	1	($~~1.6~~1.7M)	7

Note: Numeric range 1 through 4, where 1 = worst and 4 = best

6.0 RFI/RI/BRA/CMS/FS SUMMARY/CONCLUSIONS

The GOSB Interior Subunit is the only subunit at the GOSB OU that presents unacceptable risks to human health and the environment. There are no problems warranting action for the GOSB Berm, Pipeline, or Effluent Discharge Subunits.

The problems warranting action for the GOSB Interior Subunit are:

1. Alpha-chlordane, gamma-chlordane, dichlorodiphenyldichloroethylene (DDE), dieldrin, and heptachlor epoxide are present in sediment at levels that exceed a 1E-06 risk for the hypothetical resident receptor (total cumulative risk [TCR] = 3.0E-05).
2. Gamma-chlordane, dieldrin, and heptachlor epoxide are present in sediment at levels that exceed a 1E-06 risk for the industrial worker (TCR = 5.7E-06).
3. Alpha-chlordane, gamma-chlordane, dichlorodiphenyldichloroethane (DDD), DDE, dieldrin, heptachlor epoxide and silver are present in sediment at levels that pose a risk to benthic organisms.
4. Alpha-chlordane and gamma-chlordane and silver are present in surface water at levels that pose a risk to aquatic organisms.

The Remedial Action Objectives are:

1. Protect a hypothetical resident receptor from exposure to alpha-chlordane, gamma-chlordane, DDE, dieldrin, and heptachlor epoxide in sediment within the 0- to 0.30-m (0- to 1-ft) interval that exceeds 1E-06 risk based threshold level. The primary route of exposure is the incidental ingestion pathway.
2. Protect an industrial worker receptor from exposure to gamma-chlordane, dieldrin, and heptachlor epoxide in sediment within the 0- to 0.30-m (0- to 1-ft) interval that exceeds 1E-06 risk based threshold level. The primary route of exposure is the incidental ingestion pathway.
3. Protect benthic organisms from exposure alpha-chlordane, gamma-chlordane, DDD, DDE, dieldrin, heptachlor epoxide, and silver in sediment.

4. Protect aquatic organisms from exposure to alpha-chlordane, gamma-chlordane, and silver in surface water.

Five remedial alternatives were ~~evaluated~~ considered in the Corrective Measures/Feasibility Study. These are identified as Alternatives A-1 – A-5.

- A-1. No Action. Required
- A-2. Land Use Controls. ~~Rejected and not considered in detail because it does not address ecological risks~~
- A-3. Place ~~a~~ 0.6 m (2 ft) ~~layer of clean fill over the contaminated sediments in the bottom of the basin to break the exposure pathway and manage surface water~~Clean Fill Layer and Manage Surface Water (includes LUCs)
- A-4. Backfill ~~the basin to ground surface to break the exposure pathway and eliminate the basin, and manage surface water~~Basin and Manage Surface Water
- A-5. Excavate ~~and dispose of the contaminated sediment, and manage surface water~~and Manage Surface Water

These alternatives were ranked relative to each other using the nine criteria established by USEPA~~Relative ranking of alternatives indicates that alternative A-4 (Backfill Basin and Manage Surface Water) may be the most favorable~~. The preferred alternative will be determined in the development of the Statement of Basis/Proposed Plan based on information contained in this report and comments received from the USEPA, South Carolina Department of Health and Environmental Control (SCDHEC), and the public prior to finalization in the Record of Decision (ROD).

6.1 Implementation Schedule

A summary of the key deliverables and submittal dates for the GOSB OU project are shown below. These dates are listed in the USEPA and SCDHEC approved GOSB OU implementation schedule and are included in the Federal Facility Agreement.

Deliverable	Submittal Date
Submit Rev. 0, RFI/RI/BRA/CMS/FS	September 29, 2017
Submit Rev. 0, Statement of Basis/Proposed Plan	June 11, 2018
Submit Rev. 0, Record of Decision	January 28, 2019
Issuance of the Record of Decision	September 30, 2019
Submit Rev. 0, Corrective Measures Implementation/Remedial Action Implementation Plan	September 5, 2019
Submit Rev. 0, Land Use Control Implementation Plan	September 5, 2019
Remedial Action Start	September 30, 2020

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7.0 REFERENCES

Aadland, R.K., J.A. Gellici, and P.A. Thayer, 1995. *Hydrogeologic Framework of West-central South Carolina*; South Carolina Department of Natural Resources – Water Resources Division Report 5

Bumpus, D. and J. Garner, 1994. *Threatened, Endangered & Sensitive Species Listing 1994 Savannah River Forest Station Site 19, Central Shops Burning Rubble Pit (Waste Site # (90)*, U.S Department of Agriculture – Forest Service, Savannah River Site, Aiken, SC

Fallaw, W. and V. Price, 1995. "Stratigraphy of the Savannah River Site and Vicinity," *Southeastern Geology*, volume 35, no. 1, p. 21-58

FFA, 1993. *Federal Facility Agreement for the Savannah River Site*, Administrative Docket No. 89-05-FF, WSRC-OS-94-52, Effective Date: August 16, 1993

LANL, 2015. *Ecorisk Database*, Release 3.3, Los Alamos National Laboratory, Los Alamos, NM

NRMRL, 1999. *Superfund Innovative Technology Evaluation Program (SITE) Technology Profiles*, Tenth Edition, EPA/540/R-99/500B (NTIS PB2000-102922), National Risk Management Research Laboratory, Cincinnati, OH

SRNS, 2010. *Scoping Summary for the G-Area Oil Seepage Basin (761-13G)*, ERD-EN-2010-0023, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2011. *Savannah River Site Federal Facility Agreement Community Involvement Plan*, WSRC-RP-96-120, Revision 7, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2012. *Environmental Compliance and Area Completion Projects Regulatory Document Handbook*, ERD-AG-003, Revision 17, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015a. *Environmental Requirements and Program Documents: Soil Boring Investigations*, SRS Manual 3Q1, Procedure 9006, Revision 3, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015b. *Environmental Requirements and Program Documents: Sampling Groundwater Monitoring Wells, Tanks/Vessels (Sample Ports or Spigots), and Surface Water*, SRS Manual 3Q1, Procedure 9015, Revision 4, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2016. *Sampling and Analysis Plan for the G-Area Oil Seepage Basin (GOSB) 761-13G Operable Unit (OU)(U)*, SRNS-RP-2015-01036, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2017. *G-Area Oil Seepage Basin (761-13G) Data Usability Report (U)*, SRNS-2017-RP-00405, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC

Stieve, A. and D. Stephenson, 1995. "Geophysical Evidence for Post Last Cretaceous Reactivation of Basement Structures in the Central Savannah River Area," *Southeastern Geology*, vol. 35, no. 1

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*, EPA/540/G-89/004 (OSWER Directive 9355.3-01), Interim Final, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC

USEPA, 1991. *A Guide to Principal Threat and Low-Level Threat Wastes*, Superfund Publication 9380.3-06FS, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC

USEPA, 1996. CLU-IN. U.S. Environmental Protection Agency, Technology Innovation and Field Services Division, https://clu-in.org/default.cfm, Accessed 17 Aug. 2017

USEPA, 2003. "Region 5 Ecological Screening Levels" (Archived document) https://www3.epa.gov/region5/waste/cars/esl.htm

USEPA, 2015. *Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft*, U.S. Environmental Protection Agency, Scientific Support Section, Superfund Division, Atlanta, GA

USEPA, 2016. "USEPA Regional Screening Levels," https://www.epa.gov/risk/regional-screening-levels-rsls (May 2016)

USEPA, 2017. "USEPA Radionuclide Preliminary Remediation Goals for Superfund," https://epa-prgs.ornl.gov/radionuclides (May 2017)

WSRC, 1991. *RCRA Facility Investigation/Remedial Investigation Plan for the G-Area Oil Seepage Basin (U)*, WRSC-RP-91-200, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Background Soils Statistical Summary Report for the Savannah River Site*, ERD-EN-2005-0223, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

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APPENDIX A

INVESTIGATION DATA

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Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
1,3-Dichlorobenzene	mg/kg	5	1	4	1	X	5	0.002941	0.00605	0.00824	ND	0.00605	GOSB-51		11/06/2009
1,4-Dichlorobenzene	mg/kg	5	1	4	0	X	5	0.012612	0.02748	0.0344	ND	0.02748	GOSB-53		11/12/2009
2-Methylnaphthalene	mg/kg	5	1	4	1	X	2	0.553256	14.581	2.58	ND	2.58	GOSB-51		11/06/2009
Acetone	mg/kg	5	0	5	0	N	12	0.02266	0.02892	0.0284	0.0115	0.0284	GOSB-52		11/13/2009
Alpha-Chlordane	mg/kg	5	0	5	0	X	11	1.6946	4.494	7.32	0.14	4.494	GOSB-51		11/06/2009
Aluminum	mg/kg	5	0	5	0	N	12	4154	5358.33	5720	2620	5358.33	GOSB-53		11/12/2009
Anthracene	mg/kg	5	4	1	1			0.026554		0.0185	ND	0.0185	GOSB-49	J	11/13/2009
Antimony	mg/kg	5	4	1	0			0.7538		2.93	ND	2.93	GOSB-49		11/13/2009
Arsenic	mg/kg	5	3	2	2			1.0664		2.9	ND	2.9	GOSB-49	J	11/13/2009
Barium	mg/kg	5	0	5	0	X	2	32.07	164.424	92	9.95	92	GOSB-49		11/13/2009
Benzo(g,h,I)Perylene	mg/kg	5	4	1	0			0.04773		0.067	ND	0.067	GOSB-49		11/13/2009
Benzo[a]Anthracene	mg/kg	5	4	1	0			0.07333		0.195	ND	0.195	GOSB-49		11/13/2009
Benzo[a]Pyrene	mg/kg	5	4	1	0			0.06193		0.138	ND	0.138	GOSB-49		11/13/2009
Benzo[b]Fluoranthene	mg/kg	5	4	1	0			0.08373		0.247	ND	0.247	GOSB-49		11/13/2009
Cadmium	mg/kg	5	0	5	2	N	12	1.82	3.26	4.19	0.45	3.26	GOSB-50		11/12/2009
Calcium	mg/kg	5	0	5	0	N	12	4853.4	10990.2	15700	780	10990.2	GOSB-49		11/13/2009
Caprolactam	mg/kg	5	4	1	0			2.8785		14.2	ND	14.2	GOSB-51		11/06/2009
Carbon Disulfide	mg/kg	5	4	1	1			0.001042		0.00162	ND	0.00162	GOSB-51	J	11/06/2009
Chlorobenzene	mg/kg	5	0	5	0	N	12	0.007914	0.0158	0.0218	0.0015	0.0158	GOSB-53		11/12/2009
Chromium	mg/kg	5	0	5	0	N	12	29.66	42.483	51.2	17.3	42.483	GOSB-49		11/13/2009
Chrysene	mg/kg	5	4	1	0			0.06773		0.167	ND	0.167	GOSB-49		11/13/2009
Cobalt	mg/kg	5	0	5	3	G	1	0.9848	6.571	2.98	0.24	2.98	GOSB-49		11/13/2009
Copper	mg/kg	5	0	5	0	N	12	31.986	49.476	48.1	9.23	48.1	GOSB-49		11/13/2009
Cumene (Isopropylbenzene)	mg/kg	5	4	1	1			0.000253		0.0004	ND	0.0004	GOSB-51	J	11/06/2009
Cyanide	mg/kg	5	4	1	1			0.19985		0.81	ND	0.81	GOSB-51	J	11/06/2009
DDD	mg/kg	5	1	4	2	G	1	0.390666	10.171	1.8	ND	1.8	GOSB-51		11/06/2009
DDE	mg/kg	5	0	5	0	G	1	1.03684	20.1	4.5	0.0503	4.5	GOSB-51		11/06/2009
Dieldrin	mg/kg	5	2	3	3	X	5	0.112443	0.3398	0.5	ND	0.3398	GOSB-51	J	11/06/2009
Ethylbenzene	mg/kg	5	4	1	1			0.000275		0.00051	ND	0.00051	GOSB-51	J	11/06/2009
Fluoranthene	mg/kg	5	0	5	2	G	1	0.29636	3.105	0.993	0.0257	0.993	GOSB-51	J	11/06/2009
Fluorene	mg/kg	5	3	2	0			0.33407		1.59	ND	1.59	GOSB-51		11/06/2009
Gamma-Chlordane	mg/kg	5	0	5	0	X	3	2.5112	23.402	10.9	0.175	10.9	GOSB-51		11/06/2009
Heptachlor	mg/kg	5	2	3	3	X	5	0.021075	0.00835	0.00897	ND	0.00835	GOSB-50	J	11/12/2009
Heptachlor Epoxide	mg/kg	5	2	3	1	X	5	0.198417	0.6348	0.945	ND	0.6348	GOSB-51		11/06/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	5	4	1	0			0.04727		0.0647	ND	0.0647	GOSB-49		11/13/2009
Iron	mg/kg	5	0	5	0	N	12	6094	8672.84	9070	3050	8672.84	GOSB-52		11/13/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Lead	mg/kg	5	0	5	0	N	12	26.74	43.073	52	14.2	43.073	GOSB-50		11/12/2009
M,P-Xylene	mg/kg	5	3	2	2			0.000356		0.00064	ND	0.00064	GOSB-51	J	11/06/2009
Magnesium	mg/kg	5	0	5	0	G	1	148.84	535.109	368	61.8	368	GOSB-49		11/13/2009
Manganese	mg/kg	5	0	5	0	N	12	16.48	22.706	27.7	11.8	22.706	GOSB-49		11/13/2009
Mercury	mg/kg	5	0	5	1	X	3	0.2591	0.7841	0.578	0.0612	0.578	GOSB-49		11/13/2009
Methyl Ethyl Ketone	mg/Kg	5	4	1	1			0.00104		0.00161	ND	0.00161	GOSB-51	J	11/06/2009
Methylcyclohexane	mg/Kg	5	4	1	1			0.000261		0.00044	ND	0.00044	GOSB-51	J	11/06/2009
Nickel	mg/Kg	5	0	5	0	N	12	9.036	18.241	24.9	1.12	18.241	GOSB-49		11/13/2009
Phenanthrene	mg/Kg	5	0	5	2	G	1	0.87472	19.178	3.91	0.0291	3.91	GOSB-51		11/06/2009
Potassium	mg/Kg	5	0	5	1	N	12	90.72	129.563	140	30	129.563	GOSB-53		11/12/2009
Pyrene	mg/Kg	5	0	5	3	N	12	0.20032	0.4642	0.683	0.0183	0.4642	GOSB-51	J	11/06/2009
Silver	mg/Kg	5	0	5	1	G	1	87.146	1360.98	314	4.06	314	GOSB-49		11/13/2009
Sodium	mg/Kg	5	0	5	3	N	12	30.86	37.644	38.8	22.4	37.644	GOSB-49		11/13/2009
Thallium	mg/Kg	5	4	1	0			1.1823		4.64	ND	4.64	GOSB-49		11/13/2009
Toluene	mg/Kg	5	4	1	1			0.000353		0.001	ND	0.001	GOSB-50	J	11/12/2009
Vanadium	mg/Kg	5	0	5	0	N	12	21.944	35.791	38	8.45	35.791	GOSB-52		11/13/2009
Zinc	mg/Kg	5	0	5	1	N	12	288.36	430.959	449	63.8	430.959	GOSB-49		11/13/2009
Radionuclides															
Actinium-228	pCi/g	5	0	5	0	N	12	1.0984	1.437	1.38	0.482	1.38	GOSB-52		11/13/2009
Bismuth-214	pCi/g	5	0	5	0	N	12	0.6954	0.809	0.882	0.571	0.809	GOSB-52		11/13/2009
Cesium-137	pCi/g	5	4	1	1			0.02243		0.0499	ND	0.0499	GOSB-51	J	11/06/2009
Gross Alpha	pCi/g	5	0	5	5	N	12	9.638	12.4	12.5	5.97	12.4	GOSB-50	J	11/12/2009
Lead-212	pCi/g	5	0	5	0	X	3	1.122	1.911	1.33	0.4	1.33	GOSB-52		11/13/2009
Lead-214	pCi/g	5	0	5	0	N	12	0.8072	0.934	1.01	0.636	0.934	GOSB-52		11/13/2009
Nonvolatile Beta	pCi/g	5	0	5	4	N	12	7.026	10.15	12.5	3.97	10.15	GOSB-52		11/13/2009
Potassium-40	pCi/g	5	0	5	0	N	12	2.526	3.206	2.96	1.26	2.96	GOSB-52		11/13/2009
Thallium-208	pCi/g	5	0	5	0	N	12	0.3664	0.482	0.431	0.15	0.431	GOSB-50		11/12/2009

J = Estimated Value
ND = Non-Detect

UCL Method Code:
(as determined by ProUCL)

1 95% Adjusted Gamma UCL
2 95% Adjusted KM-UCL
3 95% Chebyshev UCL
4 95% KM (Chebyshev) UCL
5 95% KM (t) UCL
6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Distribution Code:

N Normal
G Gamma
X Non-Parametric

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Acetone	µg/L	6	5	1	1			1.295		4.02	ND	4.02	GOSB-64	J	11/30/2016
Alpha-Benzene Hexachloride	µg/L	11	10	1	1			0.003765909		0.0123	ND	0.0123	GOSB-63	J	11/30/2016
Alpha-Chlordane	µg/L	11	5	6	1	X	5	0.070356818	0.115	0.222	ND	0.115	GOSB-64	J	11/30/2016
Aluminum	µg/L	11	0	11	2	X	3	7439.181818	24064	33200	160	24064	GOSB-50		11/12/2009
Antimony	µg/L	11	10	1	1			1.806363636		3.62	ND	3.62	GOSB-64	J	11/30/2016
Barium	µg/L	11	0	11	0	G	1	80.97	203.9	305	7.87	203.9	GOSB-53		11/12/2009
Beryllium	µg/L	11	9	2	2			0.652727273		1.4	ND	1.4	GOSB-53	J	11/12/2009
Beta-Benzene Hexachloride	µg/L	11	10	1	0			0.006038636		0.0348	ND	0.0348	GOSB-68		11/30/2016
Cadmium	µg/L	11	8	3	0	X	5	4.760909091	10.34	23.1	ND	10.34	GOSB-53		11/12/2009
Calcium	µg/L	11	0	11	0	N	12	7412.727273	9316	13500	3900	9316	GOSB-53		11/12/2009
Caprolactam	µg/L	11	7	4	1	X	5	12.60909091	20.98	36.4	ND	20.98	GOSB-53	J	11/12/2009
Chromium	µg/L	11	3	8	5	X	7	29.82818182	56.36	147	ND	56.36	GOSB-50		11/12/2009
Cobalt	µg/L	11	8	3	1	X	5	3.094545455	6.624	13.6	ND	6.624	GOSB-50		11/12/2009
Copper	µg/L	11	1	10	10	X	3	171.8	591.6	805	ND	591.6	GOSB-50	J	11/12/2009
Cyanide	µg/L	11	8	3	3	X	5	1.506363636	2.822	5.27	ND	2.822	GOSB-53	J	11/12/2009
DDD	µg/L	11	8	3	2	X	5	0.010136364	0.0198	0.0408	ND	0.0198	GOSB-51		11/13/2009
DDE	µg/L	11	6	5	3	X	5	0.023218182	0.0406	0.0804	ND	0.0406	GOSB-51		11/13/2009
DDT	µg/L	11	9	2	2			0.007145455		0.0228	ND	0.0228	GOSB-51	J	11/13/2009
Dieldrin	µg/L	11	10	1	1			0.0056		0.0116	ND	0.0116	GOSB-51	J	11/13/2009
Gamma-Chlordane	µg/L	11	4	7	2	X	5	0.083422727	0.136	0.234	ND	0.136	GOSB-51		11/13/2009
Iron	µg/L	11	0	11	0	G	1	8299.090909	16260	25500	1780	16260	GOSB-53		11/12/2009
Lead	µg/L	11	6	5	2	X	5	28.70272727	58.67	131	ND	58.67	GOSB-53		11/12/2009
Magnesium	µg/L	11	0	11	0	N	12	952.6363636	1238	2080	459	1238	GOSB-50		11/12/2009
Manganese	µg/L	11	0	11	0	N	12	202.4636364	247.4	340	99.5	247.4	GOSB-63		11/30/2016
Mercury	µg/L	11	9	2	1			0.059681818		0.237	ND	0.237	GOSB-64		11/30/2016
Nickel	µg/L	11	5	6	3	X	5	27.44363636	56.56	128	ND	56.56	GOSB-50		11/12/2009
Potassium	µg/L	11	0	11	0	N	12	3949.090909	4443	5530	2580	4443	GOSB-50		11/12/2009
Silver	µg/L	11	2	9	6	X	7	60.15363636	114.3	299	ND	114.3	GOSB-50		11/12/2009
Sodium	µg/L	11	0	11	0	N	12	7010	7342	8700	6510	7342	GOSB-49		11/13/2009
Toluene	µg/L	11	6	5	2	X	5	1.159227273	2.185	5.06	ND	2.185	GOSB-66		11/30/2016

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Vanadium	µg/L	11	0	11	7	X	3	16.84727273	48.74	68.8	1.82	48.74	GOSB-53		11/12/2009
Zinc	µg/L	11	0	11	0	X	3	746.2454545	4844	3800	17.3	3800	GOSB-53		11/12/2009
Radionuclides															
Tritium	pCi/L	5	2	3	3	X	5	4949.7	1390	1370	ND	1370	GOSB-52	J	11/13/2009
Bismuth-214	pCi/L	4	1	3	3	X	5	15.04875	24.52	23	ND	23	GOSB-50	J	11/12/2009
Gross Alpha	pCi/L	11	7	4	1	X	5	40.15181818	103.2	349	ND	103.2	GOSB-50		11/12/2009
Lead-214	pCi/L	3	1	2	2	X	5	10.18	20.47	16.1	ND	16.1	GOSB-50	J	11/12/2009
Nonvolatile Beta	pCi/L	11	0	11	7	X	3	34.83181818	139.7	270	2.15	139.7	GOSB-50		11/12/2009

J = Estimated Value
ND = Non-Detect

Distribution Code:
N Normal
G Gamma
X Non-Parametric

UCL Method Code:
(as determined by ProUCL)

1 95% Adjusted Gamma UCL
2 95% Adjusted KM-UCL
3 95% Chebyshev UCL
4 95% KM (Chebyshev) UCL
5 95% KM (t) UCL
6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
1,2-Dichlorobenzene	mg/kg	10	9	1	1	0.00023435	0.000592	ND	GOSB-49	J	11/13/2009
1,3-Dichlorobenzene	mg/kg	10	3	7	2	0.00306505	0.00842	ND	GOSB-52		11/13/2009
1,4-Dichlorobenzene	mg/kg	10	3	7	0	0.01101035	0.0344	ND	GOSB-53		11/12/2009
2-Methylnaphthalene	mg/kg	10	4	6	3	0.2880105	2.58	ND	GOSB-51		11/06/2009
Acetone	mg/kg	10	0	10	0	0.02438	0.0324	0.0115	GOSB-50		11/12/2009
Aldrin	mg/kg	10	8	2	2	0.0208505	0.0149	ND	GOSB-53	J	11/12/2009
Alpha-Chlordane	mg/kg	10	0	10	0	1.09842	7.32	0.0982	GOSB-51		11/06/2009
Aluminum	mg/kg	10	0	10	0	3999	5720	2620	GOSB-53		11/12/2009
Anthracene	mg/kg	10	9	1	1	0.0183415	0.0185	ND	GOSB-49	J	11/13/2009
Antimony	mg/kg	10	8	2	0	0.6071	2.93	ND	GOSB-49		11/13/2009
Arsenic	mg/kg	10	6	4	4	1.0045	2.9	ND	GOSB-49	J	11/13/2009
Barium	mg/kg	10	0	10	0	20.93	92	2.99	GOSB-49		11/13/2009
Benzo(g,h,I)Perylene	mg/kg	10	8	2	1	0.03249	0.067	ND	GOSB-49		11/13/2009
Benzo[a]Anthracene	mg/kg	10	9	1	0	0.044265	0.195	ND	GOSB-49		11/13/2009
Benzo[a]Pyrene	mg/kg	10	8	2	1	0.03958	0.138	ND	GOSB-49		11/13/2009
Benzo[b]Fluoranthene	mg/kg	10	8	2	1	0.0514	0.247	ND	GOSB-49		11/13/2009
Cadmium	mg/kg	10	0	10	6	1.1302	4.19	0.149	GOSB-50		11/12/2009
Calcium	mg/kg	10	0	10	0	3593.1	15700	519	GOSB-49		11/13/2009
Caprolactam	mg/kg	10	9	1	0	1.489895	14.2	ND	GOSB-51		11/06/2009
Carbon Disulfide	mg/kg	10	8	2	2	0.001161	0.00334	ND	GOSB-52	J	11/13/2009
Chlorobenzene	mg/kg	10	1	9	0	0.0053725	0.0218	ND	GOSB-53		11/12/2009
Chloroform	mg/kg	10	9	1	1	0.00026255	0.000874	ND	GOSB-49	J	11/13/2009
Chromium	mg/kg	10	0	10	0	19.551	51.2	5.94	GOSB-49		11/13/2009
Chrysene	mg/kg	10	9	1	0	0.041465	0.167	ND	GOSB-49		11/13/2009
Cobalt	mg/kg	10	2	8	5	0.7777	2.98	ND	GOSB-49		11/13/2009
Copper	mg/kg	10	0	10	1	22.071	48.1	5.01	GOSB-49		11/13/2009
Cumene (Isopropylbenzene)	mg/kg	10	9	1	1	0.00021945	0.0004	ND	GOSB-51	J	11/06/2009
Cyanide	mg/kg	10	7	3	3	0.148425	0.81	ND	GOSB-51	J	11/06/2009
DDD	mg/kg	10	1	9	7	0.236023	1.8	ND	GOSB-51		11/06/2009
DDE	mg/kg	10	1	9	0	0.56673	4.5	ND	GOSB-51		11/06/2009
DDT	mg/kg	10	9	1	0	0.0402675	0.0383	ND	GOSB-53		11/12/2009
Dieldrin	mg/kg	10	7	3	3	0.0745695	0.5	ND	GOSB-51	J	11/06/2009
Ethylbenzene	mg/kg	10	9	1	1	0.00023045	0.00051	ND	GOSB-51	J	11/06/2009
Fluoranthene	mg/kg	10	2	8	5	0.16048	0.993	ND	GOSB-51	J	11/06/2009
Fluorene	mg/kg	10	8	2	0	0.174635	1.59	ND	GOSB-51		11/06/2009
Gamma-Chlordane	mg/kg	10	0	10	0	1.73	10.9	0.134	GOSB-51		11/06/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Heptachlor	mg/kg	10	7	3	3	0.0197115	0.00897	ND	GOSB-50	J	11/12/2009
Heptachlor Epoxide	mg/kg	10	7	3	1	0.1107005	0.945	ND	GOSB-51		11/06/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	10	8	2	1	0.03236	0.0647	ND	GOSB-49		11/13/2009
Iron	mg/kg	10	0	10	0	5058	9070	1950	GOSB-52		11/13/2009
Lead	mg/kg	10	0	10	0	18.59	52	7.23	GOSB-50		11/12/2009
M,P-Xylene	mg/kg	10	7	3	3	0.0003224	0.000708	ND	GOSB-53	J	11/12/2009
Magnesium	mg/kg	10	0	10	0	116.19	368	46.7	GOSB-49		11/13/2009
Manganese	mg/kg	10	0	10	0	15.812	55.7	3.94	GOSB-49		11/13/2009
Mercury	mg/kg	10	0	10	2	0.18258	0.578	0.0127	GOSB-49		11/13/2009
Methyl Ethyl Ketone	mg/kg	10	5	5	5	0.001737	0.0036	ND	GOSB-50	J	11/12/2009
Methylcyclohexane	mg/kg	10	9	1	1	0.00022345	0.00044	ND	GOSB-51	J	11/06/2009
Nickel	mg/kg	10	0	10	1	7.0549	24.9	0.669	GOSB-49		11/13/2009
Phenanthrene	mg/kg	10	1	9	4	0.468285	3.91	ND	GOSB-51		11/06/2009
Potassium	mg/kg	10	0	10	1	97.27	175	30	GOSB-52		11/13/2009
Pyrene	mg/kg	10	4	6	4	0.10925	0.683	ND	GOSB-51	J	11/06/2009
Silver	mg/kg	10	0	10	1	53.343	314	4.06	GOSB-49		11/13/2009
Sodium	mg/kg	10	0	10	8	25.78	38.8	15	GOSB-49		11/13/2009
Thallium	mg/kg	10	8	2	0	0.9851	4.64	ND	GOSB-49		11/13/2009
Toluene	mg/kg	10	6	4	3	0.00043915	0.00132	ND	GOSB-52		11/13/2009
Vanadium	mg/kg	10	0	10	0	18.502	38	8.45	GOSB-52		11/13/2009
Zinc	mg/kg	10	0	10	1	223.84	460	23.2	GOSB-49		11/13/2009
Radionuclides											
Actinium-228	pCi/g	10	0	10	0	1.0503	1.38	0.479	GOSB-52		11/13/2009
Bismuth-214	pCi/g	10	0	10	0	0.6272	0.882	0.471	GOSB-52		11/13/2009
Cesium-137	pCi/g	10	9	1	1	0.018255	0.0499	ND	GOSB-51	J	11/06/2009
Gross Alpha	pCi/g	10	0	10	10	9.654	12.5	5.24	GOSB-50	J	11/12/2009
Lead-212	pCi/g	10	0	10	0	1.0495	1.33	0.4	GOSB-52		11/13/2009
Lead-214	pCi/g	10	0	10	0	0.7033	1.01	0.505	GOSB-52		11/13/2009
Nonvolatile Beta	pCi/g	10	0	10	8	8.943	20.3	3.97	GOSB-49		11/13/2009
Potassium-40	pCi/g	10	0	10	0	2.4083	3.42	0.833	GOSB-52		11/13/2009
Thallium-208	pCi/g	10	0	10	0	0.3488	0.433	0.15	GOSB-51		11/06/2009

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Acenaphthene	mg/kg	13	12	1	1			0.0072		0.0178	ND	0.0178	GOSB-40	J	11/02/2009
Acetone	mg/kg	13	3	10	3	X	5	0.0279	0.03852	0.0702	ND	0.03852	GOSB-45		11/02/2009
Alpha-Chlordane	mg/kg	13	9	4	0	X	5	0.0021	0.004305	0.0123	ND	0.004305	GOSB-33		10/26/2009
Aluminum	mg/kg	13	0	13	0	N	12	7466.9	8696.333	11500	1010	8696.333	GOSB-37		10/30/2009
Anthracene	mg/kg	13	12	1	1			0.0057		0.028	ND	0.028	GOSB-40	J	11/02/2009
Aroclor 1254	mg/kg	13	12	1	0			0.0022		0.0206	ND	0.0206	GOSB-40		11/02/2009
Aroclor 1260	mg/kg	13	12	1	0			0.0016		0.0136	ND	0.0136	GOSB-40		11/02/2009
Arsenic	mg/kg	13	3	10	5	G	6	3.4461	7.415	15.8	ND	7.415	GOSB-39		08/27/2009
Barium	mg/kg	13	0	13	0	N	12	13.558	16.358	22.3	1.27	16.358	GOSB-45		11/02/2009
Benzo(g,h,i)Perylene	mg/kg	13	12	1	0			0.0097		0.0579	ND	0.0579	GOSB-40		11/02/2009
Benzo[a]Anthracene	mg/kg	13	12	1	0			0.0131		0.101	ND	0.101	GOSB-40		11/02/2009
Benzo[a]Pyrene	mg/kg	13	12	1	0			0.0123		0.0915	ND	0.0915	GOSB-40		11/02/2009
Benzo[b]Fluoranthene	mg/kg	13	11	2	1			0.0211		0.187	ND	0.187	GOSB-40		11/02/2009
Beryllium	mg/kg	13	6	7	7	X	5	0.1154	0.1564	0.194	ND	0.1564	GOSB-34	J	10/26/2009
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/kg	13	12	1	1			0.0413		0.0768	ND	0.0768	GOSB-35	J	10/30/2009
Cadmium	mg/kg	13	8	5	5	X	5	0.0864	0.1276	0.168	ND	0.1276	GOSB-44	J	11/02/2009
Calcium	mg/kg	13	0	13	1	G	6	147.27	251.952	482	32.3	251.952	GOSB-43		11/02/2009
Carbazole	mg/kg	13	12	1	1			0.0073		0.0264	ND	0.0264	GOSB-40	J	11/02/2009
Chromium	mg/kg	13	0	13	0	N	12	17.374	21.441	32.7	2.73	21.441	GOSB-35		10/30/2009
Chrysene	mg/kg	13	11	2	1			0.0144		0.112	ND	0.112	GOSB-40		11/02/2009
Cobalt	mg/kg	13	0	13	10	N	12	0.4628	0.5315	0.73	0.201	0.5315	GOSB-44	J	11/02/2009
Copper	mg/kg	13	0	13	9	N	12	5.5677	7.423	17.1	3.04	7.423	GOSB-40		11/02/2009
Cyanide	mg/kg	13	10	3	3	X	5	0.0554	0.09526	0.167	ND	0.09526	GOSB-40	J	11/02/2009
DDD	mg/kg	13	11	2	0			0.0009		0.00532	ND	0.00532	GOSB-35		10/30/2009
DDE	mg/kg	13	6	7	2	X	7	0.0043	0.02491	0.0285	ND	0.02491	GOSB-33		10/26/2009
DDT	mg/kg	13	4	9	4	X	7	0.0042	0.01151	0.0194	ND	0.01151	GOSB-33		10/26/2009
Dieldrin	mg/kg	13	11	2	1			0.0004		0.0017	ND	0.0017	GOSB-34		10/26/2009
Endosulfan Sulfate	mg/kg	13	12	1	1			0.0002		0.000713	ND	0.000713	GOSB-34	J	10/26/2009
Endrin	mg/kg	13	11	2	2			0.0003		0.00145	ND	0.00145	GOSB-40	J	11/02/2009
Endrin Ketone	mg/kg	13	12	1	0			0.0003		0.00161	ND	0.00161	GOSB-41		11/02/2009
Fluoranthene	mg/kg	13	11	2	1			0.0256		0.245	ND	0.245	GOSB-40		11/02/2009
Gamma-Chlordane	mg/kg	13	8	5	2	X	5	0.0009	0.001846	0.0048	ND	0.001846	GOSB-35		10/30/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	13	12	1	0			0.0092		0.0506	ND	0.0506	GOSB-40		11/02/2009
Iron	mg/kg	13	0	13	0	N	12	17593	208333.8	27100	2010	27100	GOSB-44		11/02/2009
Lead	mg/kg	13	0	13	2	X	3	18.858	45.328	72.9	0.95	45.328	GOSB-35		10/30/2009
Magnesium	mg/kg	13	1	12	0	X	10	101.53	122.964	356	ND	122.964	GOSB-38		10/30/2009
Manganese	mg/kg	13	0	13	0	N	12	34.925	47.278	85.5	1.23	47.278	GOSB-43		11/02/2009
Mercury	mg/kg	13	0	13	1	N	12	0.027	0.03211	0.047	0.00665	0.03211	GOSB-37		10/30/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Methyl Acetate	mg/kg	13	11	2	1			0.0026		0.013	ND	0.013	GOSB-40		11/02/2009
Methyl Ethyl Ketone	mg/kg	13	10	3	3	X	5	0.0011	0.0019	0.0026	ND	0.0019	GOSB-44	J	11/02/2009
Nickel	mg/kg	13	1	12	3	X	5	0.9381	1.305	2.55	ND	1.305	GOSB-40		11/02/2009
Phenanthrene	mg/kg	13	11	2	1			0.0161		0.132	ND	0.132	GOSB-40		11/02/2009
Potassium	mg/kg	13	1	12	0	X	9	104.47	207.888	380	ND	207.888	GOSB-38		10/30/2009
Pyrene	mg/kg	13	11	2	1			0.0202		0.179	ND	0.179	GOSB-40		11/02/2009
Silver	mg/kg	13	12	1	1			0.0902		0.496	ND	0.496	GOSB-39	J	08/27/2009
Sodium	mg/kg	13	7	6	5	X	8	10.954	31.81	61.9	ND	31.81	GOSB-44		11/02/2009
Styrene	mg/kg	13	12	1	1			0.0003		0.00173	ND	0.00173	GOSB-41	J	11/02/2009
Thallium	mg/kg	13	12	1	1			0.3591		1.3	ND	1.3	GOSB-41	J	11/02/2009
Toluene	mg/kg	13	11	2	2			0.0002		0.00039	ND	0.00039	GOSB-43	J	11/02/2009
Vanadium	mg/kg	13	0	13	0	N	12	46.231	53.775	66.9	8.9	53.775	GOSB-40		11/02/2009
Zinc	mg/kg	13	0	13	2	N	12	5.4708	7.02	13.9	1.14	7.02	GOSB-40		11/02/2009
Radionuclides															
Actinium-228	pCi/g	13	0	13	0	N	12	1.3462	1.431	1.62	1.12	1.431	GOSB-38		10/30/2009
Bismuth-214	pCi/g	13	0	13	0	N	12	0.8445	0.893	0.992	0.643	0.893	GOSB-42		11/02/2009
Cesium-137	pCi/g	13	6	7	1	X	5	0.0825	0.127	0.278	ND	0.127	GOSB-40		11/02/2009
Gross Alpha	pCi/g	13	0	13	8	N	12	10.708	12.37	17	6.11	12.37	GOSB-33		10/26/2009
Lead-212	pCi/g	13	0	13	0	N	12	1.3508	1.429	1.68	1.15	1.429	GOSB-38		10/30/2009
Lead-214	pCi/g	13	0	13	0	N	12	0.9044	0.953	1.02	0.737	0.953	GOSB-42		11/02/2009
Nonvolatile Beta	pCi/g	13	1	12	9	X	5	8.7415	10.8	17.1	ND	10.8	GOSB-33	J	10/26/2009
Potassium-40	pCi/g	13	0	13	0	N	12	1.9877	2.213	3.25	1.43	2.213	GOSB-42		11/02/2009
Thallium-208	pCi/g	13	0	13	0	N	12	0.4287	0.459	0.542	0.354	0.459	GOSB-38		10/30/2009

J = Estimated Value
ND = Non-Detect

Distribution Code:

N Normal
G Gamma
X Non-Parametric

UCL Method Code:
(as determined by ProUCL)

1 95% Adjusted Gamma UCL
2 95% Adjusted KM-UCL
3 95% Chebyshev UCL
4 95% KM (Chebyshev) UCL
5 95% KM (t) UCL
6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Acetone	mg/Kg	13	5	8	2	X	5	0.01885	0.02835	0.062	ND	0.02835	GOSB-33	J	10/26/2009
Alpha-Chlordane	mg/Kg	13	9	4	3	X	5	0.000264577	0.000475	0.001	ND	0.000475	GOSB-36		10/30/2009
Aluminum	mg/Kg	13	0	13	0	G	1	8115.384615	10783.877	18900	4290	10783.877	GOSB-37		10/30/2009
Arsenic	mg/Kg	13	4	9	5	G	1	2.568076923	6.618	14.1	ND	6.618	GOSB-39		08/27/2009
Barium	mg/Kg	13	0	13	0	N	12	22.83846154	25.87	34.9	14.7	25.87	GOSB-45		11/02/2009
Beryllium	mg/Kg	13	1	12	12	X	5	0.161730769	0.1908	0.264	ND	0.1908	GOSB-34	J	10/26/2009
Calcium	mg/Kg	13	0	13	1	N	12	113.8076923	144.072	235	29.9	144.072	GOSB-37		10/30/2009
Caprolactam	mg/Kg	13	11	2	2			0.042573077		0.0757	ND	0.0757	GOSB-40	J	11/02/2009
Carbon Disulfide	mg/Kg	13	12	1	1			0.000803462		0.00227	ND	0.00227	GOSB-37	J	10/30/2009
Chromium	mg/Kg	13	0	13	0	N	12	12.40230769	16.548	33	5.5	16.548	GOSB-37		10/30/2009
Cobalt	mg/Kg	13	0	13	8	N	12	0.582	0.6722	0.888	0.323	0.6722	GOSB-34		10/26/2009
Copper	mg/Kg	13	0	13	10	N	12	3.02	3.616	5.51	1.79	3.616	GOSB-37	J	10/30/2009
DDD	mg/Kg	13	12	1	1			0.000271808		0.00134	ND	0.00134	GOSB-35	J	10/30/2009
DDE	mg/Kg	13	9	4	2	X	5	0.001219423	0.002775	0.00975	ND	0.002775	GOSB-41		11/02/2009
DDT	mg/Kg	13	11	2	1			0.000386038		0.00163	ND	0.00163	GOSB-41		11/02/2009
Gamma-Chlordane	mg/Kg	13	10	3	2	X	5	0.000222885	0.000455	0.0012	ND	0.000455	GOSB-36		10/30/2009
Iron	mg/Kg	13	0	13	0	N	12	10560.76923	14676.961	30400	1320	14676.961	GOSB-37		10/30/2009
Lead	mg/Kg	13	0	13	2	N	12	8.462307692	9.556	14.3	5.62	9.556	GOSB-35		10/30/2009
Magnesium	mg/Kg	13	0	13	0	N	12	89.25384615	102.977	139	54.4	102.977	GOSB-38		10/30/2009
Manganese	mg/Kg	13	0	13	0	N	12	64.42615385	89.451	142	6.99	89.451	GOSB-44		11/02/2009
Mercury	mg/Kg	13	0	13	2	G	1	0.023713846	0.03386	0.0618	0.00784	0.03386	GOSB-38		10/30/2009
Methyl Acetate	mg/Kg	13	10	3	3	X	5	0.003563846	0.007401	0.0204	ND	0.007401	GOSB-33	J	10/26/2009
Methyl Ethyl Ketone	mg/Kg	13	12	1	1			0.000830769		0.00257	ND	0.00257	GOSB-33	J	10/26/2009
Nickel	mg/Kg	13	0	13	0	N	12	1.485923077	1.736	2.82	0.813	1.736	GOSB-34		10/26/2009
Potassium	mg/Kg	13	0	13	1	N	12	78.91538462	90.609	134	49	90.609	GOSB-45		11/02/2009
Silver	mg/Kg	13	10	3	3	X	5	0.097076923	0.1879	0.425	ND	0.1879	GOSB-39	J	08/27/2009
Sodium	mg/Kg	13	3	10	3	X	5	49.99076923	77.65	165	ND	77.65	GOSB-40		11/02/2009
Vanadium	mg/Kg	13	0	13	0	N	12	28.54615385	38.841	78.3	10.7	38.841	GOSB-37		10/30/2009
Zinc	mg/Kg	13	0	13	2	N	12	3.734615385	4.233	5.27	1.98	4.233	GOSB-38		10/30/2009
Radionuclides															
Actinium-228	pCi/g	13	0	13	0	N	12	1.164230769	1.342	1.94	0.719	1.342	GOSB-37		10/30/2009
Barium-133	pCi/g	13	12	1	1			0.013126923		0.0247	ND	0.0247	GOSB-45	J	11/02/2009
Bismuth-214	pCi/g	13	0	13	0	N	12	0.818846154	0.898	1.11	0.6	0.898	GOSB-38		10/30/2009
Cesium-137	pCi/g	13	11	2	2			0.015103846		0.0596	ND	0.0596	GOSB-38	J	10/30/2009
Gross Alpha	pCi/g	13	0	13	9	N	12	10.96307692	12.2	16.1	7.12	12.2	GOSB-33		10/26/2009
Lead-212	pCi/g	13	0	13	0	N	12	1.166538462	1.348	2	0.756	1.348	GOSB-37		10/30/2009
Lead-214	pCi/g	13	0	13	0	N	12	0.937461538	1.028	1.27	0.661	1.028	GOSB-37		10/30/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Nonvolatile Beta	pCi/g	13	2	11	9	X	5	8.587692308	10.84	15.2	ND	10.84	GOSB-42		11/02/2009
Potassium-40	pCi/g	13	0	13	2	N	12	1.186	1.318	1.67	0.749	1.318	GOSB-39		08/27/2009
Thallium-208	pCi/g	13	0	13	0	N	12	0.374076923	0.426	0.593	0.26	0.426	GOSB-37		10/30/2009

J = Estimated Value
ND = Non-Detect

Distribution Code:

N Normal
G Gamma
X Non-Parametric

UCL Method Code:
(as determined by ProUCL)

1 95% Adjusted Gamma UCL
2 95% Adjusted KM-UCL
3 95% Chebyshev UCL
4 95% KM (Chebyshev) UCL
5 95% KM (t) UCL
6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acenaphthene	mg/kg	39	38	1	1	0.006584615	0.0178	ND	GOSB-40	J	11/02/2009
Acetone	mg/kg	39	19	20	5	0.017665769	0.0702	ND	GOSB-45		11/02/2009
Alpha-Benzene Hexachloride	mg/kg	39	38	1	0	0.000144167	0.00112	ND	GOSB-44		11/02/2009
Alpha-Chlordane	mg/kg	39	26	13	5	0.001817692	0.029	ND	GOSB-44		11/02/2009
Aluminum	mg/kg	39	0	39	0	7708.974359	18900	1010	GOSB-37		10/30/2009
Anthracene	mg/kg	39	38	1	1	0.004430769	0.028	ND	GOSB-40	J	11/02/2009
Aroclor 1254	mg/kg	39	38	1	0	0.00114641	0.0206	ND	GOSB-40		11/02/2009
Aroclor 1260	mg/kg	39	38	1	0	0.000966923	0.0136	ND	GOSB-40		11/02/2009
Arsenic	mg/kg	39	12	27	15	3.949717949	48.1	ND	GOSB-39		08/27/2009
Barium	mg/kg	39	0	39	0	14.87307692	34.9	1.27	GOSB-45		11/02/2009
Benzo(g,h,I)Perylene	mg/kg	39	38	1	0	0.007057692	0.0579	ND	GOSB-40		11/02/2009
Benzo[a]Anthracene	mg/kg	39	38	1	0	0.008162821	0.101	ND	GOSB-40		11/02/2009
Benzo[a]Pyrene	mg/kg	39	38	1	0	0.007919231	0.0915	ND	GOSB-40		11/02/2009
Benzo[b]Fluoranthene	mg/kg	39	37	2	1	0.010839744	0.187	ND	GOSB-40		11/02/2009
Beryllium	mg/kg	39	19	20	20	0.114294872	0.264	ND	GOSB-34	J	10/26/2009
Beta-Benzene Hexachloride	mg/kg	39	38	1	0	0.000227756	0.00438	ND	GOSB-44		11/02/2009
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/kg	39	37	2	2	0.040258974	0.0831	ND	GOSB-38	J	10/30/2009
Cadmium	mg/kg	39	31	8	8	0.092358974	0.185	ND	GOSB-39	J	08/27/2009
Calcium	mg/kg	39	1	38	4	138.4584615	482	ND	GOSB-43		11/02/2009
Caprolactam	mg/kg	39	37	2	2	0.040167949	0.0757	ND	GOSB-40	J	11/02/2009
Carbazole	mg/kg	39	38	1	1	0.00625	0.0264	ND	GOSB-40	J	11/02/2009
Carbon Disulfide	mg/kg	39	38	1	1	0.000755256	0.00227	ND	GOSB-37	J	10/30/2009
Chromium	mg/kg	39	0	39	0	20.38435897	86.7	2.73	GOSB-36		10/30/2009
Chrysene	mg/kg	39	37	2	1	0.008608974	0.112	ND	GOSB-40		11/02/2009
Cobalt	mg/kg	39	4	35	26	0.420897436	0.888	ND	GOSB-34		10/26/2009
Copper	mg/kg	39	0	39	28	5.154871795	17.1	1.79	GOSB-40		11/02/2009
Cyanide	mg/kg	39	36	3	3	0.042411538	0.167	ND	GOSB-40	J	11/02/2009
DDD	mg/kg	39	35	4	1	0.000597718	0.00532	ND	GOSB-35		10/30/2009
DDE	mg/kg	39	27	12	5	0.001975487	0.0285	ND	GOSB-33		10/26/2009
DDT	mg/kg	39	28	11	5	0.001633974	0.0194	ND	GOSB-33		10/26/2009
Dieldrin	mg/kg	39	36	3	2	0.000326141	0.0017	ND	GOSB-34		10/26/2009
Endosulfan Sulfate	mg/kg	39	38	1	1	0.000249551	0.000713	ND	GOSB-34	J	10/26/2009
Endrin	mg/kg	39	37	2	2	0.000280718	0.00145	ND	GOSB-40	J	11/02/2009
Endrin Ketone	mg/kg	39	38	1	0	0.000272385	0.00161	ND	GOSB-41		11/02/2009
Fluoranthene	mg/kg	39	37	2	1	0.012339744	0.245	ND	GOSB-40		11/02/2009
Gamma-Chlordane	mg/kg	39	26	13	6	0.001211833	0.0269	ND	GOSB-44		11/02/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	39	38	1	0	0.006870513	0.0506	ND	GOSB-40		11/02/2009
Iron	mg/kg	39	0	39	0	21641.53846	85200	1320	GOSB-45		11/02/2009
Lead	mg/kg	39	0	39	6	13.30461538	72.9	0.95	GOSB-35		10/30/2009
Magnesium	mg/kg	39	2	37	3	83.97294872	356	ND	GOSB-38		10/30/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Manganese	mg/kg	39	1	38	5	35.99576923	142	ND	GOSB-44		11/02/2009
Mercury	mg/kg	39	2	37	7	0.021792051	0.0618	ND	GOSB-38		10/30/2009
Methyl Acetate	mg/kg	39	34	5	4	0.002398718	0.0204	ND	GOSB-33	J	10/26/2009
Methyl Ethyl Ketone	mg/kg	39	35	4	4	0.000897564	0.0026	ND	GOSB-44	J	11/02/2009
Nickel	mg/kg	39	8	31	7	1.071538462	4.86	ND	GOSB-42		11/02/2009
Phenanthrene	mg/kg	39	37	2	1	0.009162821	0.132	ND	GOSB-40		11/02/2009
Potassium	mg/kg	39	1	38	1	103.8833333	380	ND	GOSB-38		10/30/2009
Pyrene	mg/kg	39	37	2	1	0.010542308	0.179	ND	GOSB-40		11/02/2009
Silver	mg/kg	39	31	8	7	0.150384615	1.74	ND	GOSB-39		08/27/2009
Sodium	mg/kg	39	12	27	9	69.27474359	311	ND	GOSB-33		10/26/2009
Styrene	mg/kg	39	38	1	1	0.000211821	0.00173	ND	GOSB-41	J	11/02/2009
Thallium	mg/kg	39	38	1	1	0.337153846	1.3	ND	GOSB-41	J	11/02/2009
Toluene	mg/kg	39	37	2	2	0.000182295	0.00039	ND	GOSB-43	J	11/02/2009
Vanadium	mg/kg	39	0	39	1	62.70512821	198	8.9	GOSB-36		10/30/2009
Zinc	mg/kg	39	0	39	11	3.932307692	13.9	1.14	GOSB-40		11/02/2009
Radionuclides											
Actinium-228	pCi/g	39	0	39	0	1.337820513	2.11	0.719	GOSB-36		10/30/2009
Barium-133	pCi/g	37	36	1	1	0.01272973	0.0247	ND	GOSB-45	J	11/02/2009
Bismuth-214	pCi/g	39	0	39	0	0.844333333	1.23	0.6	GOSB-36		10/30/2009
Cesium-137	pCi/g	39	30	9	3	0.036426923	0.278	ND	GOSB-40		11/02/2009
Gross Alpha	pCi/g	39	0	39	27	11.10692308	20.1	6.11	GOSB-33		10/26/2009
Lead-212	pCi/g	39	0	39	0	1.345384615	2.17	0.756	GOSB-36		10/30/2009
Lead-214	pCi/g	39	0	39	0	0.938512821	1.39	0.661	GOSB-36		10/30/2009
Nonvolatile Beta	pCi/g	39	4	35	25	9.237179487	21	ND	GOSB-42		11/02/2009
Potassium-40	pCi/g	39	0	39	2	1.945846154	4.21	0.749	GOSB-45		11/02/2009
Thallium-208	pCi/g	39	0	39	0	0.426205128	0.627	0.26	GOSB-36		10/30/2009

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acetone	mg/kg	29	17	12	6	0.006906207	0.0387	ND	GOSB-4		10/28/2009
Alpha-Benzene Hexachloride	mg/kg	29	28	1	1	0.000115069	0.000646	ND	GOSB-7	J	10/26/2009
Alpha-Chlordane	mg/kg	29	27	2	1	0.000186483	0.00232	ND	GOSB-9		10/29/2009
Aluminum	mg/kg	29	0	29	0	7785.172414	11700	4880	GOSB-21		10/21/2009
Arsenic	mg/kg	29	3	26	9	9.857689655	39.8	ND	GOSB-22		10/21/2009
Barium	mg/kg	29	0	29	1	8.989310345	19.3	2.47	GOSB-14		08/27/2009
Benzene	mg/kg	29	26	3	3	0.000197103	0.000478	ND	GOSB-19	J	10/20/2009
Beryllium	mg/kg	29	23	6	6	0.074689655	0.171	ND	GOSB-8	J	10/29/2009
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/kg	29	28	1	1	0.041113793	0.114	ND	GOSB-9	J	10/29/2009
Cadmium	mg/kg	29	27	2	2	0.078413793	0.331	ND	GOSB-8	J	10/29/2009
Calcium	mg/kg	29	1	28	10	142.6018966	733	ND	GOSB-5		10/28/2009
Chloroform	mg/kg	29	28	1	1	0.000205569	0.00109	ND	GOSB-2	J	10/28/2009
Chromium	mg/kg	29	0	29	0	18.64172414	41.4	2.01	GOSB-22		10/21/2009
Cobalt	mg/kg	29	6	23	23	0.256396552	0.528	ND	GOSB-14	J	08/27/2009
Copper	mg/kg	29	0	29	6	4.383448276	9.54	1.19	GOSB-5		10/28/2009
Cyanide	mg/kg	29	27	2	2	0.041182759	0.103	ND	GOSB-13	J	08/27/2009
DDE	mg/kg	29	28	1	1	0.000215828	0.000873	ND	GOSB-7	J	10/26/2009
DDT	mg/kg	29	28	1	0	0.000300897	0.00334	ND	GOSB-7		10/26/2009
Iron	mg/kg	29	0	29	0	20689.31034	42300	3870	GOSB-3		10/28/2009
Lead	mg/kg	29	0	29	0	8.270689655	16.7	4.87	GOSB-3		10/28/2009
Magnesium	mg/kg	29	0	29	2	86.35862069	166	23.4	GOSB-28		10/22/2009
Manganese	mg/kg	29	3	26	11	6.501293103	32.9	ND	GOSB-8		10/29/2009
Mercury	mg/kg	29	7	22	8	0.013476207	0.0524	ND	GOSB-8		10/29/2009
Nickel	mg/kg	29	1	28	12	1.350086207	5.48	ND	GOSB-25		10/21/2009
Potassium	mg/kg	29	0	29	15	70.63793103	224	23.1	GOSB-8		10/29/2009
Selenium	mg/kg	29	28	1	1	0.380655172	3.1	ND	GOSB-3	J	10/28/2009
Silver	mg/kg	29	19	10	9	0.214103448	1.76	ND	GOSB-7		10/26/2009
Sodium	mg/kg	29	13	16	8	32.84465517	160	ND	GOSB-8		10/29/2009
Toluene	mg/kg	29	24	5	5	0.000216569	0.00051	ND	GOSB-13	J	08/27/2009
Vanadium	mg/kg	29	0	29	1	71.6	156	17	GOSB-3		10/28/2009
Zinc	mg/kg	29	0	29	5	3.680689655	15.4	1.18	GOSB-7		10/26/2009
Radionuclides											
Actinium-228	pCi/g	29	0	29	0	1.473793103	1.94	1.04	GOSB-6		10/28/2009
Bismuth-214	pCi/g	29	0	29	0	0.759862069	1.02	0.532	GOSB-8		10/29/2009
Gross Alpha	pCi/g	29	0	29	19	13.37551724	22.8	6.41	GOSB-21		10/21/2009
Lead-212	pCi/g	29	0	29	0	1.517241379	1.85	1.13	GOSB-21		10/21/2009
Lead-214	pCi/g	29	0	29	0	0.867655172	1.14	0.608	GOSB-8		10/29/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Nonvolatile Beta	pCi/g	29	1	28	22	9.757758621	19.2	ND	GOSB-5		10/28/2009
Potassium-40	pCi/g	29	0	29	1	1.791448276	2.94	0.758	GOSB-2		10/28/2009
Thallium-208	pCi/g	29	0	29	0	0.487275862	0.644	0.36	GOSB-21		10/21/2009

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Acetone	mg/kg	6	1	5	3	X	5	0.09828	0.1547	0.173	ND	0.1547	GOSB-55	J	12/05/2016
Alpha-Chlordane	mg/kg	6	2	4	1	X	5	0.117965333	0.2534	0.386	ND	0.2534	GOSB-54		12/05/2016
Aluminum	mg/kg	6	0	6	0	N	12	9073.333333	12174.229	15300	4680	12174.23	GOSB-30		10/22/2009
Aroclor 1254	mg/kg	6	4	2	1			0.019766667		0.0366	ND	0.0366	GOSB-32		10/23/2009
Aroclor 1260	mg/kg	6	4	2	1			0.0216375		0.0357	ND	0.0357	GOSB-32		10/23/2009
Arsenic	mg/kg	6	0	6	3	N	12	4.48	6.207	8.55	2.55	6.207	GOSB-30	J	10/22/2009
Barium	mg/kg	6	0	6	1	N	12	28.76666667	35.253	42	22.6	35.253	GOSB-56		12/05/2016
Benzo(g,h,i)Perylene	mg/kg	6	5	1	1			0.017583333		0.019	ND	0.019	GOSB-32	J	10/23/2009
Benzo[a]Pyrene	mg/kg	6	5	1	1			0.018966667		0.0273	ND	0.0273	GOSB-32	J	10/23/2009
Benzo[b]Fluoranthene	mg/kg	6	5	1	0			0.02145		0.0422	ND	0.0422	GOSB-32		10/23/2009
Benzo[k]Fluoranthene	mg/kg	6	5	1	1			0.017616667		0.0192	ND	0.0192	GOSB-32	J	10/23/2009
Beryllium	mg/kg	6	3	3	3	X	5	0.150083333	0.2483	0.295	ND	0.2483	GOSB-31	J	10/23/2009
Cadmium	mg/kg	6	4	2	2			0.078416667		0.134	ND	0.134	GOSB-54	J	12/05/2016
Calcium	mg/kg	6	0	6	0	N	12	441.8333333	599.132	684	237	599.132	GOSB-56		12/05/2016
Chromium	mg/kg	6	0	6	0	N	12	13.595	17.82	20.7	6.61	17.82	GOSB-30		10/22/2009
Chrysene	mg/kg	6	5	1	0			0.021333333		0.0415	ND	0.0415	GOSB-32		10/23/2009
Cobalt	mg/kg	6	0	6	0	G	1	1.146666667	2.269	2.48	0.636	2.269	GOSB-56		12/05/2016
Copper	mg/kg	6	0	6	1	N	12	8.676666667	14.36	20.6	2.21	14.36	GOSB-54		12/05/2016
Cumene (Isopropylbenzene)	mg/kg	6	5	1	1			0.000861583		0.00425	ND	0.00425	GOSB-56	J	12/05/2016
Cyanide	mg/kg	6	3	3	3	X	5	0.140191667	0.3112	0.496	ND	0.3112	GOSB-54	J	12/05/2016
DDE	mg/kg	6	4	2	1			0.003987083		0.0145	ND	0.0145	GOSB-32		10/23/2009
DDT	mg/kg	6	4	2	0			0.004430417		0.016	ND	0.016	GOSB-32		10/23/2009
Fluoranthene	mg/kg	6	5	1	0			0.024566667		0.0609	ND	0.0609	GOSB-32		10/23/2009
Gamma-Chlordane	mg/kg	6	2	4	1	X	5	0.070587	0.1657	0.277	ND	0.1657	GOSB-54		12/05/2016
Heptachlor Epoxide	mg/kg	6	5	1	1			0.000751583		0.00025	ND	0.00025	GOSB-32	J	10/23/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	6	5	1	1			0.017333333		0.0175	ND	0.0175	GOSB-32	J	10/23/2009
Iron	mg/kg	6	0	6	0	N	12	14716.66667	22279.571	30500	6070	22279.57	GOSB-30		10/22/2009
Lead	mg/kg	6	0	6	0	N	12	10.17	13.242	17.2	5.93	13.242	GOSB-32		10/23/2009
Magnesium	mg/kg	6	0	6	1	N	12	161.1666667	201.257	247	114	201.257	GOSB-56		12/05/2016
Manganese	mg/kg	6	0	6	0	N	12	68.41666667	102.699	115	12.4	102.699	GOSB-32		10/23/2009
Mercury	mg/kg	6	0	6	0	N	12	0.05235	0.07218	0.0764	0.023	0.07218	GOSB-54		12/05/2016
Methyl Acetate	mg/kg	6	5	1	1			0.009175		0.0503	ND	0.0503	GOSB-54	J	12/05/2016
Methyl Ethyl Ketone	mg/kg	6	1	5	5	X	4	0.013199167	0.05613	0.0613	ND	0.05613	GOSB-54	J	12/05/2016
Nickel	mg/kg	6	0	6	0	N	12	3.013333333	4.086	4.84	1.63	4.086	GOSB-56		12/05/2016
Phenanthrene	mg/kg	6	5	1	1			0.01985		0.0326	ND	0.0326	GOSB-32	J	10/23/2009
Potassium	mg/kg	6	0	6	1	N	12	121.7666667	147.013	178	88.6	147.013	GOSB-56		12/05/2016
Pyrene	mg/kg	6	5	1	0			0.021533333		0.0427	ND	0.0427	GOSB-32		10/23/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Selenium	mg/kg	6	2	4	4	X	5	1.46975	2.465	3.27	ND	2.465	GOSB-32	J	10/23/2009
Silver	mg/kg	6	2	4	1	X	5	3.918083333	8.016	11.9	ND	8.016	GOSB-54		12/05/2016
Sodium	mg/kg	6	0	6	6	N	12	28.90166667	45.046	59.7	9.91	45.046	GOSB-56	J	12/05/2016
Styrene	mg/kg	6	4	2	2			0.001316667		0.00622	ND	0.00622	GOSB-56	J	12/05/2016
Vanadium	mg/kg	6	0	6	1	N	12	35.21666667	53.84	76.1	13	53.84	GOSB-30		10/22/2009
Zinc	mg/kg	6	0	6	0	N	12	17.91	28.471	36.5	3.72	28.471	GOSB-56		12/05/2016
Radionuclides															
Actinium-228	pCi/g	3	0	3	0	N	12	1.663333333	2.238	1.86	1.27	1.86	GOSB-30		10/22/2009
Bismuth-214	pCi/g	3	0	3	0	N	12	0.932	1.247	1.1	0.731	1.1	GOSB-31		10/23/2009
Cesium-137	pCi/g	3	0	3	0	N	12	0.196	0.326	0.284	0.139	0.284	GOSB-32		10/23/2009
Gross Alpha	pCi/g	6	0	6	0	N	12	19.08333333	23.32	27.4	13.6	23.32	GOSB-56		12/05/2016
Lead-212	pCi/g	3	0	3	0	N	12	1.676666667	2.095	1.88	1.4	1.88	GOSB-30		10/22/2009
Lead-214	pCi/g	3	0	3	0	N	12	1.084666667	1.359	1.22	0.904	1.22	GOSB-31		10/23/2009
Nonvolatile Beta	pCi/g	6	0	6	2	G	1	15.66833333	35.07	36.6	7.23	35.07	GOSB-54		12/05/2016
Potassium-40	pCi/g	3	0	3	0	N	12	1.52	2.149	1.95	1.28	1.95	GOSB-32		10/23/2009
Radium-226	pCi/g	2	0	2	0			1.0835		1.37	0.797	1.37	GOSB-56		12/05/2016
Radium-228	pCi/g	2	0	2	0			1.885		2.47	1.3	2.47	GOSB-56		12/05/2016
Thallium-208	pCi/g	3	0	3	0	N	12	0.519666667	0.659	0.59	0.429	0.59	GOSB-30		10/22/2009
Thorium-228	pCi/g	2	0	2	0			2.535		2.75	2.32	2.75	GOSB-56		12/05/2016
Thorium-230	pCi/g	2	0	2	0			1.39		1.47	1.31	1.47	GOSB-56		12/05/2016
Thorium-232	pCi/g	2	0	2	1			2.385		2.4	2.37	2.4	GOSB-56	J	12/05/2016
Uranium-233/234	pCi/g	2	0	2	1			1.016		1.19	0.842	1.19	GOSB-56		12/05/2016
Uranium-238	pCi/g	2	0	2	1			0.8765		1.01	0.743	1.01	GOSB-56		12/05/2016

J = Estimated Value
ND = Non-Detect

Distribution Code:
N Normal
G Gamma
X Non-Parametric

UCL Method Code:
(as determined by ProUCL)

1 95% Adjusted Gamma UCL
2 95% Adjusted KM-UCL
3 95% Chebyshev UCL
4 95% KM (Chebyshev) UCL
5 95% KM (t) UCL
6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Acetone	mg/kg	6	1	5	2	X	2	0.015822	0.1801	0.0687	ND	0.0687	GOSB-32		10/23/2009
Alpha-Chlordane	mg/kg	6	3	3	1	X	5	0.021164	0.05461	0.0914	ND	0.05461	GOSB-54		12/05/2016
Aluminum	mg/kg	6	0	6	0	N	12	9831.667	13258.444	14700	2430	13258.44	GOSB-32		10/23/2009
Aroclor 1242	mg/kg	6	5	1	0			0.007546		0.0302	ND	0.0302	GOSB-31		10/23/2009
Aroclor 1254	mg/kg	6	5	1	0			0.007013		0.027	ND	0.027	GOSB-31		10/23/2009
Aroclor 1260	mg/kg	6	5	1	0			0.003479		0.0058	ND	0.0058	GOSB-31		10/23/2009
Arsenic	mg/kg	6	0	6	1	N	12	5.908	8.506	9.84	0.918	8.506	GOSB-32		10/23/2009
Barium	mg/kg	6	0	6	0	G	1	19.88333	63.703	60.6	7.28	60.6	GOSB-32		10/23/2009
Beryllium	mg/kg	6	4	2	1			0.215492		0.811	ND	0.811	GOSB-32		10/23/2009
Calcium	mg/kg	6	0	6	1	N	12	342.75	562.116	780	71	562.116	GOSB-54		12/05/2016
Chloromethane (Methyl Chloride)	mg/kg	6	5	1	1			0.000234		0.00053	ND	0.00053	GOSB-30	J	10/22/2009
Chromium	mg/kg	6	0	6	0	N	12	15.95	19.19	21.3	12	19.19	GOSB-31		10/23/2009
Cobalt	mg/kg	6	0	6	3	X	3	1.415167	4.111	3.96	0.378	3.96	GOSB-56		12/05/2016
Copper	mg/kg	6	0	6	0	N	12	3.865	5.004	5.4	1.74	5.004	GOSB-32		10/23/2009
DDE	mg/kg	6	5	1	1			0.000555		0.000505	ND	0.000505	GOSB-32	J	10/23/2009
Gamma-Chlordane	mg/kg	6	3	3	1	X	5	0.013749	0.03728	0.0643	ND	0.03728	GOSB-54		12/05/2016
Iron	mg/kg	6	0	6	0	N	12	17500	25636.571	34300	4500	25636.57	GOSB-54		12/05/2016
Lead	mg/kg	6	0	6	0	N	12	9.926667	14.024	15.5	3.14	14.024	GOSB-54		12/05/2016
M,P-Xylene	mg/kg	6	5	1	1			0.000341		0.000634	ND	0.000634	GOSB-30	J	10/22/2009
Magnesium	mg/kg	6	0	6	0	N	12	145.1	214.425	250	32.8	214.425	GOSB-32		10/23/2009
Manganese	mg/kg	6	0	6	0	G	1	118.7	1263.717	537	6.2	537	GOSB-32		10/23/2009
Mercury	mg/kg	6	0	6	1	N	12	0.02226	0.03198	0.0367	0.00576	0.03198	GOSB-32		10/23/2009
Methyl Acetate	mg/kg	6	5	1	0			0.003099		0.014	ND	0.014	GOSB-32		10/23/2009
Methyl Ethyl Ketone	mg/kg	6	5	1	1			0.001153		0.00279	ND	0.00279	GOSB-32	J	10/23/2009
Nickel	mg/kg	6	0	6	0	N	12	2.68	3.92	5.4	1.04	3.92	GOSB-32		10/23/2009
Potassium	mg/kg	6	0	6	0	N	12	110.6	165.267	217	27.9	165.267	GOSB-32		10/23/2009
Selenium	mg/kg	6	3	3	2	X	5	1.077667	2.379	3.72	ND	2.379	GOSB-54		12/05/2016
Silver	mg/kg	6	3	3	0	X	5	0.812667	1.456	1.72	ND	1.456	GOSB-55		12/05/2016
Sodium	mg/kg	6	0	6	6	N	12	28.57	43.702	54.2	8.32	43.702	GOSB-54	J	12/05/2016
Vanadium	mg/kg	6	0	6	0	N	12	39.5	53.168	57.1	10.9	53.168	GOSB-54		12/05/2016
Zinc	mg/kg	6	0	6	2	N	12	6.275	8.834	10.7	2.24	8.834	GOSB-32		10/23/2009
Radionuclides															
Actinium-228	pCi/g	3	0	3	0	N	12	1.626667	2.083	1.86	1.33	1.86	GOSB-31		10/23/2009
Bismuth-214	pCi/g	3	0	3	0	N	12	0.877667	0.939	0.905	0.836	0.905	GOSB-31		10/23/2009
Gross Alpha	pCi/g	6	0	6	3	N	12	14.89833	20.22	23.3	9.79	20.22	GOSB-54		12/05/2016
Lead-212	pCi/g	3	0	3	0	N	12	1.536667	1.914	1.69	1.28	1.69	GOSB-31		10/23/2009
Lead-214	pCi/g	3	0	3	0	N	12	0.994	1.078	1.05	0.954	1.05	GOSB-31		10/23/2009
Nonvolatile Beta	pCi/g	6	0	6	2	N	12	9.578333	12.36	13.6	5.76	12.36	GOSB-56		12/05/2016
Potassium-40	pCi/g	3	0	3	0	N	12	1.7	2.3	2.07	1.36	2.07	GOSB-31		10/23/2009
Radium-226	pCi/g	2	0	2	0			0.856		1.05	0.662	1.05	GOSB-56		12/05/2016

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Max	Min	RME	Max Location	Qualifier of Max	Max Date
Radium-228	pCi/g	2	0	2	0			1.42		1.74	1.1	1.74	GOSB-56		12/05/2016
Thallium-208	pCi/g	3	0	3	0	N	12	0.486667	0.609	0.549	0.407	0.549	GOSB-31		10/23/2009
Thorium-228	pCi/g	2	0	2	0			1.38		1.51	1.25	1.51	GOSB-56		12/05/2016
Thorium-230	pCi/g	2	0	2	0			0.8325		0.835	0.83	0.835	GOSB-56		12/05/2016
Thorium-232	pCi/g	2	0	2	2			1.505		1.54	1.47	1.54	GOSB-54	J	12/05/2016
Tritium	pCi/g	3	1	2	2			6.896667		11.1	ND	11.1	GOSB-31	J	10/23/2009
Uranium-233/234	pCi/g	2	0	2	0			0.8825		0.952	0.813	0.952	GOSB-56		12/05/2016
Uranium-235	pCi/g	2	1	1	0			0.08955		0.169	ND	0.169	GOSB-54		12/05/2016
Uranium-238	pCi/g	2	0	2	2			0.7645		0.81	0.719	0.81	GOSB-56	J	12/05/2016

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UCL Method Code:
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1 95% Adjusted Gamma UCL
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6 95% KM Adjusted Gamma UCL
7 95% KM Bootstrap t UCL
7 KM Bootstrap-t UCL
8 95% KM Chebyshev UCL
9 95% KM H-UCL
10 95% KM Student's-t UCL
11 95% Percentile Bootstrap UCL
12 95% Student's-t UCL

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acetone	mg/kg	12	2	10	5	0.057050833	0.173	ND	GOSB-55	J	12/05/2016
Alpha-Chlordane	mg/kg	12	5	7	2	0.069564792	0.386	ND	GOSB-54		12/05/2016
Aluminum	mg/kg	12	0	12	0	9452.5	15300	2430	GOSB-30		10/22/2009
Aroclor 1242	mg/kg	12	11	1	0	0.01057	0.0302	ND	GOSB-31		10/23/2009
Aroclor 1254	mg/kg	12	9	3	1	0.013389583	0.0366	ND	GOSB-32		10/23/2009
Aroclor 1260	mg/kg	12	9	3	1	0.012558333	0.0357	ND	GOSB-32		10/23/2009
Arsenic	mg/kg	12	0	12	4	5.194	9.84	0.918	GOSB-32		10/23/2009
Barium	mg/kg	12	0	12	1	24.325	60.6	7.28	GOSB-32		10/23/2009
Benzo(g,h,i)Perylene	mg/kg	12	11	1	1	0.011579167	0.019	ND	GOSB-32	J	10/23/2009
Benzo[a]Pyrene	mg/kg	12	11	1	1	0.012270833	0.0273	ND	GOSB-32	J	10/23/2009
Benzo[b]Fluoranthene	mg/kg	12	11	1	0	0.0135125	0.0422	ND	GOSB-32		10/23/2009
Benzo[k]Fluoranthene	mg/kg	12	11	1	1	0.011595833	0.0192	ND	GOSB-32	J	10/23/2009
Beryllium	mg/kg	12	7	5	4	0.1827875	0.811	ND	GOSB-32		10/23/2009
Cadmium	mg/kg	12	10	2	2	0.0660375	0.134	ND	GOSB-54	J	12/05/2016
Calcium	mg/kg	12	0	12	1	392.2916667	780	71	GOSB-54		12/05/2016
Chloromethane (Methyl Chloride)	mg/kg	12	11	1	1	0.00020975	0.00053	ND	GOSB-30	J	10/22/2009
Chromium	mg/kg	12	0	12	0	14.7725	21.3	6.61	GOSB-31		10/23/2009
Chrysene	mg/kg	12	11	1	0	0.013454167	0.0415	ND	GOSB-32		10/23/2009
Cobalt	mg/kg	12	0	12	3	1.280916667	3.96	0.378	GOSB-56		12/05/2016
Copper	mg/kg	12	0	12	1	6.270833333	20.6	1.74	GOSB-54		12/05/2016
Cumene (Isopropylbenzene)	mg/kg	12	11	1	1	0.000517875	0.00425	ND	GOSB-56	J	12/05/2016
Cyanide	mg/kg	12	9	3	3	0.0880125	0.496	ND	GOSB-54	J	12/05/2016
DDE	mg/kg	12	9	3	2	0.002271083	0.0145	ND	GOSB-32		10/23/2009
DDT	mg/kg	12	10	2	0	0.002466042	0.016	ND	GOSB-32		10/23/2009
Fluoranthene	mg/kg	12	11	1	0	0.015070833	0.0609	ND	GOSB-32		10/23/2009
Gamma-Chlordane	mg/kg	12	5	7	2	0.042168125	0.277	ND	GOSB-54		12/05/2016
Heptachlor Epoxide	mg/kg	12	11	1	1	0.000507125	0.00025	ND	GOSB-32	J	10/23/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	12	11	1	1	0.011454167	0.0175	ND	GOSB-32	J	10/23/2009
Iron	mg/kg	12	0	12	0	16108.33333	34300	4500	GOSB-54		12/05/2016
Lead	mg/kg	12	0	12	0	10.04833333	17.2	3.14	GOSB-32		10/23/2009
M,P-Xylene	mg/kg	12	11	1	1	0.000313333	0.000634	ND	GOSB-30	J	10/22/2009
Magnesium	mg/kg	12	0	12	1	153.1333333	250	32.8	GOSB-32		10/23/2009
Manganese	mg/kg	12	0	12	0	93.55833333	537	6.2	GOSB-32		10/23/2009
Mercury	mg/kg	12	0	12	1	0.037305	0.0764	0.00576	GOSB-54		12/05/2016
Methyl Acetate	mg/kg	12	10	2	1	0.006137083	0.0503	ND	GOSB-54	J	12/05/2016
Methyl Ethyl Ketone	mg/kg	12	6	6	6	0.007175833	0.0613	ND	GOSB-54	J	12/05/2016
Nickel	mg/kg	12	0	12	0	2.846666667	5.4	1.04	GOSB-32		10/23/2009
Phenanthrene	mg/kg	12	11	1	1	0.0127125	0.0326	ND	GOSB-32	J	10/23/2009
Potassium	mg/kg	12	0	12	1	116.1833333	217	27.9	GOSB-32		10/23/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Pyrene	mg/kg	12	11	1	0	0.013554167	0.0427	ND	GOSB-32		10/23/2009
Selenium	mg/kg	12	5	7	6	1.273708333	3.72	ND	GOSB-54		12/05/2016
Silver	mg/kg	12	5	7	1	2.365375	11.9	ND	GOSB-54		12/05/2016
Sodium	mg/kg	12	0	12	12	28.73583333	59.7	8.32	GOSB-56	J	12/05/2016
Styrene	mg/kg	12	10	2	2	0.000745417	0.00622	ND	GOSB-56	J	12/05/2016
Vanadium	mg/kg	12	0	12	1	37.35833333	76.1	10.9	GOSB-30		10/22/2009
Zinc	mg/kg	12	0	12	2	12.0925	36.5	2.24	GOSB-56		12/05/2016
Radionuclides											
Actinium-228	pCi/g	6	0	6	0	1.645	1.86	1.27	GOSB-30		10/22/2009
Bismuth-214	pCi/g	6	0	6	0	0.904833333	1.1	0.731	GOSB-31		10/23/2009
Cesium-137	pCi/g	6	3	3	0	0.105708333	0.284	ND	GOSB-32		10/23/2009
Gross Alpha	pCi/g	12	0	12	3	16.99083333	27.4	9.79	GOSB-56		12/05/2016
Lead-212	pCi/g	6	0	6	0	1.606666667	1.88	1.28	GOSB-30		10/22/2009
Lead-214	pCi/g	6	0	6	0	1.039333333	1.22	0.904	GOSB-31		10/23/2009
Nonvolatile Beta	pCi/g	12	0	12	4	12.62333333	36.6	5.76	GOSB-54		12/05/2016
Potassium-40	pCi/g	6	0	6	0	1.61	2.07	1.28	GOSB-31		10/23/2009
Radium-226	pCi/g	4	0	4	0	0.96975	1.37	0.662	GOSB-56		12/05/2016
Radium-228	pCi/g	4	0	4	0	1.6525	2.47	1.1	GOSB-56		12/05/2016
Thallium-208	pCi/g	6	0	6	0	0.503166667	0.59	0.407	GOSB-30		10/22/2009
Thorium-228	pCi/g	4	0	4	0	1.9575	2.75	1.25	GOSB-56		12/05/2016
Thorium-230	pCi/g	4	0	4	0	1.11125	1.47	0.83	GOSB-56		12/05/2016
Thorium-232	pCi/g	4	0	4	3	1.945	2.4	1.47	GOSB-56	J	12/05/2016
Tritium	pCi/g	6	4	2	2	4.690833333	11.1	ND	GOSB-31	J	10/23/2009
Uranium-233/234	pCi/g	4	0	4	1	0.94925	1.19	0.813	GOSB-56		12/05/2016
Uranium-235	pCi/g	4	3	1	0	0.053175	0.169	ND	GOSB-54		12/05/2016
Uranium-238	pCi/g	4	0	4	3	0.8205	1.01	0.719	GOSB-56		12/05/2016

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
1,2-Dichlorobenzene	mg/kg	90	89	1	1	0.000180622	0.000592	ND	GOSB-49	J	11/13/2009
1,3-Dichlorobenzene	mg/kg	90	83	7	2	0.000495144	0.00842	ND	GOSB-52		11/13/2009
1,4-Dichlorobenzene	mg/kg	90	83	7	0	0.001377956	0.0344	ND	GOSB-53		11/12/2009
2-Methylnaphthalene	mg/kg	90	84	6	3	0.036163944	2.58	ND	GOSB-51		11/06/2009
Acenaphthene	mg/kg	90	89	1	1	0.009436111	0.0178	ND	GOSB-40	J	11/02/2009
Acetone	mg/kg	90	38	52	16	0.020196167	0.173	ND	GOSB-55	J	12/05/2016
Aldrin	mg/kg	90	88	2	2	0.002463456	0.0149	ND	GOSB-53	J	11/12/2009
Alpha-Benzene Hexachloride	mg/kg	90	88	2	1	0.002212589	0.00112	ND	GOSB-44		11/02/2009
Alpha-Chlordane	mg/kg	90	58	32	8	0.132169728	7.32	ND	GOSB-51		11/06/2009
Aluminum	mg/kg	90	0	90	0	7553.777778	18900	1010	GOSB-37		10/30/2009
Anthracene	mg/kg	90	88	2	2	0.006467389	0.028	ND	GOSB-40	J	11/02/2009
Antimony	mg/kg	90	88	2	0	0.348205556	2.93	ND	GOSB-49		11/13/2009
Aroclor 1242	mg/kg	90	89	1	0	0.033340833	0.0302	ND	GOSB-31		10/23/2009
Aroclor 1254	mg/kg	90	86	4	1	0.033938222	0.0366	ND	GOSB-32		10/23/2009
Aroclor 1260	mg/kg	90	86	4	1	0.033749611	0.0357	ND	GOSB-32		10/23/2009
Arsenic	mg/kg	90	21	69	32	5.692055556	48.1	ND	GOSB-39		08/27/2009
Barium	mg/kg	90	0	90	2	14.91044444	92	1.27	GOSB-49		11/13/2009
Benzene	mg/kg	90	87	3	3	0.0001836	0.000478	ND	GOSB-19	J	10/20/2009
Benzo(g,h,i)Perylene	mg/kg	90	86	4	2	0.010071111	0.067	ND	GOSB-49		11/13/2009
Benzo[a]Anthracene	mg/kg	90	88	2	0	0.011711111	0.195	ND	GOSB-49		11/13/2009
Benzo[a]Pyrene	mg/kg	90	86	4	2	0.011324444	0.138	ND	GOSB-49		11/13/2009
Benzo[b]Fluoranthene	mg/kg	90	85	5	2	0.014068889	0.247	ND	GOSB-49		11/13/2009
Benzo[k]Fluoranthene	mg/kg	90	89	1	1	0.008712778	0.0192	ND	GOSB-32	J	10/23/2009
Beryllium	mg/kg	90	59	31	30	0.104862222	0.811	ND	GOSB-32		10/23/2009
Beta-Benzene Hexachloride	mg/kg	90	89	1	0	0.002242728	0.00438	ND	GOSB-44		11/02/2009
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/kg	90	87	3	3	0.062211111	0.114	ND	GOSB-9	J	10/29/2009
Cadmium	mg/kg	90	68	22	18	0.199671667	4.19	ND	GOSB-50		11/12/2009
Calcium	mg/kg	90	2	88	15	557.4870556	15700	ND	GOSB-49		11/13/2009
Caprolactam	mg/kg	90	87	3	2	0.208044444	14.2	ND	GOSB-51		11/06/2009
Carbazole	mg/kg	90	89	1	1	0.00879	0.0264	ND	GOSB-40	J	11/02/2009
Carbon Disulfide	mg/kg	90	87	3	3	0.000800778	0.00334	ND	GOSB-52	J	11/13/2009
Chlorobenzene	mg/kg	90	81	9	0	0.000751528	0.0218	ND	GOSB-53		11/12/2009
Chloroform	mg/kg	90	88	2	2	0.000193894	0.00109	ND	GOSB-2	J	10/28/2009
Chloromethane (Methyl Chloride)	mg/kg	90	89	1	1	0.000180156	0.00053	ND	GOSB-30	J	10/22/2009
Chromium	mg/kg	90	0	90	0	18.982	86.7	2.01	GOSB-36		10/30/2009
Chrysene	mg/kg	90	86	4	1	0.011990556	0.167	ND	GOSB-49		11/13/2009
Cobalt	mg/kg	90	12	78	57	0.522205556	3.96	ND	GOSB-56		12/05/2016
Copper	mg/kg	90	0	90	36	6.934666667	48.1	1.19	GOSB-49		11/13/2009
Cumene (Isopropylbenzene)	mg/kg	90	88	2	2	0.000224017	0.00425	ND	GOSB-56	J	12/05/2016

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Cyanide	mg/kg	90	79	11	11	0.059875	0.81	ND	GOSB-51	J	11/06/2009
DDD	mg/kg	90	77	13	8	0.02667505	1.8	ND	GOSB-51		11/06/2009
DDE	mg/kg	90	65	25	8	0.0641984	4.5	ND	GOSB-51		11/06/2009
DDT	mg/kg	90	75	15	5	0.005607983	0.0383	ND	GOSB-53		11/12/2009
Dieldrin	mg/kg	90	84	6	5	0.008618089	0.5	ND	GOSB-51	J	11/06/2009
Endosulfan Sulfate	mg/kg	90	89	1	1	0.0043964	0.000713	ND	GOSB-34	J	10/26/2009
Endrin	mg/kg	90	88	2	2	0.004409906	0.00145	ND	GOSB-40	J	11/02/2009
Endrin Ketone	mg/kg	90	89	1	0	0.004406294	0.00161	ND	GOSB-41		11/02/2009
Ethylbenzene	mg/kg	90	89	1	1	0.000180189	0.00051	ND	GOSB-51	J	11/06/2009
Fluoranthene	mg/kg	90	79	11	6	0.027046667	0.993	ND	GOSB-51	J	11/06/2009
Fluorene	mg/kg	90	88	2	0	0.025141111	1.59	ND	GOSB-51		11/06/2009
Gamma-Chlordane	mg/kg	90	60	30	8	0.198400761	10.9	ND	GOSB-51		11/06/2009
Heptachlor	mg/kg	90	87	3	3	0.0023369	0.00897	ND	GOSB-50	J	11/12/2009
Heptachlor Epoxide	mg/kg	90	86	4	2	0.012470356	0.945	ND	GOSB-51		11/06/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	90	86	4	2	0.009958889	0.0647	ND	GOSB-49		11/13/2009
Iron	mg/kg	90	0	90	0	18754.33333	85200	1320	GOSB-45		11/02/2009
Lead	mg/kg	90	0	90	6	11.83566667	72.9	0.95	GOSB-35		10/30/2009
M,P-Xylene	mg/kg	90	86	4	4	0.000208183	0.000708	ND	GOSB-53	J	11/12/2009
Magnesium	mg/kg	90	2	88	6	97.54272222	368	ND	GOSB-49		11/13/2009
Manganese	mg/kg	90	4	86	16	31.92436111	537	ND	GOSB-32		10/23/2009
Mercury	mg/kg	90	9	81	18	0.039046222	0.578	ND	GOSB-49		11/13/2009
Methyl Acetate	mg/kg	90	83	7	5	0.002287833	0.0503	ND	GOSB-54	J	12/05/2016
Methyl Ethyl Ketone	mg/kg	90	75	15	15	0.001772556	0.0613	ND	GOSB-54	J	12/05/2016
Methylcyclohexane	mg/kg	90	89	1	1	0.000179411	0.00044	ND	GOSB-51	J	11/06/2009
Nickel	mg/kg	90	9	81	20	2.062794444	24.9	ND	GOSB-49		11/13/2009
Phenanthrene	mg/kg	90	78	12	6	0.059556111	3.91	ND	GOSB-51		11/06/2009
Potassium	mg/kg	90	1	89	18	94.07611111	380	ND	GOSB-38		10/30/2009
Pyrene	mg/kg	90	81	9	5	0.020373333	0.683	ND	GOSB-51	J	11/06/2009
Selenium	mg/kg	90	82	8	7	0.487622222	3.72	ND	GOSB-54		12/05/2016
Silver	mg/kg	90	55	35	18	6.376538889	314	ND	GOSB-49		11/13/2009
Sodium	mg/kg	90	25	65	37	47.29822222	311	ND	GOSB-33		10/26/2009
Styrene	mg/kg	90	87	3	3	0.000268883	0.00622	ND	GOSB-56	J	12/05/2016
Thallium	mg/kg	90	87	3	1	0.407988889	4.64	ND	GOSB-49		11/13/2009
Toluene	mg/kg	90	79	11	10	0.000221572	0.00132	ND	GOSB-52		11/13/2009
Vanadium	mg/kg	90	0	90	3	57.28022222	198	8.45	GOSB-36		10/30/2009
Zinc	mg/kg	90	0	90	19	29.37344444	460	1.14	GOSB-49		11/13/2009
Radionuclides											
Actinium-228	pCi/g	84	0	84	0	1.37247619	2.11	0.479	GOSB-36		10/30/2009
Barium-133	pCi/g	82	81	1	1	0.01470122	0.0247	ND	GOSB-45	J	11/02/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Bismuth-214	pCi/g	84	0	84	0	0.793642857	1.23	0.471	GOSB-36		10/30/2009
Cesium-137	pCi/g	84	71	13	4	0.031714881	0.284	ND	GOSB-32		10/23/2009
Gross Alpha	pCi/g	90	0	90	59	12.461	27.4	5.24	GOSB-56		12/05/2016
Lead-212	pCi/g	84	0	84	0	1.388154762	2.17	0.4	GOSB-36		10/30/2009
Lead-214	pCi/g	84	0	84	0	0.89325	1.39	0.505	GOSB-36		10/30/2009
Nonvolatile Beta	pCi/g	90	5	85	59	9.823722222	36.6	ND	GOSB-54		12/05/2016
Potassium-40	pCi/g	84	0	84	3	1.923607143	4.21	0.749	GOSB-45		11/02/2009
Radium-226	pCi/g	4	0	4	0	0.96975	1.37	0.662	GOSB-56		12/05/2016
Radium-228	pCi/g	4	0	4	0	1.6525	2.47	1.1	GOSB-56		12/05/2016
Thallium-208	pCi/g	84	0	84	0	0.443571429	0.644	0.15	GOSB-21		10/21/2009
Thorium-228	pCi/g	4	0	4	0	1.9575	2.75	1.25	GOSB-56		12/05/2016
Thorium-230	pCi/g	4	0	4	0	1.11125	1.47	0.83	GOSB-56		12/05/2016
Thorium-232	pCi/g	4	0	4	3	1.945	2.4	1.47	GOSB-56	J	12/05/2016
Tritium	pCi/g	84	82	2	2	2.434583333	11.1	ND	GOSB-31	J	10/23/2009
Uranium-233/234	pCi/g	4	0	4	1	0.94925	1.19	0.813	GOSB-56		12/05/2016
Uranium-235	pCi/g	4	3	1	0	0.053175	0.169	ND	GOSB-54		12/05/2016
Uranium-238	pCi/g	4	0	4	3	0.8205	1.01	0.719	GOSB-56		12/05/2016

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2 X Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acenaphthylene	mg/kg	3	2	1	0	0.022766667	0.045533333	0.0568	ND	GOSB-46		10/29/2009
Acetone	mg/kg	3	0	3	0	0.046666667	0.093333333	0.0496	0.0441	GOSB-48		10/29/2009
Aluminum	mg/kg	3	0	3	0	10763.33333	21526.66667	12100	9190	GOSB-48		10/29/2009
Anthracene	mg/kg	3	2	1	0	0.018613333	0.037226667	0.0482	ND	GOSB-46		10/29/2009
Arsenic	mg/kg	3	2	1	1	0.613166667	1.226333333	1.27	ND	GOSB-46	J	10/29/2009
Barium	mg/kg	3	0	3	0	21.3	42.6	34	14.5	GOSB-48		10/29/2009
Benzo(g,h,I)Perylene	mg/kg	3	2	1	0	0.035166667	0.070333333	0.094	ND	GOSB-46		10/29/2009
Benzo[b]Fluoranthene	mg/kg	3	2	1	1	0.186166667	0.372333333	0.547	ND	GOSB-46	J	10/29/2009
Beryllium	mg/kg	3	0	3	3	0.197666667	0.395333333	0.328	0.13	GOSB-48	J	10/29/2009
Cadmium	mg/kg	3	2	1	1	0.090833333	0.181666667	0.157	ND	GOSB-47	J	10/29/2009
Calcium	mg/kg	3	0	3	0	237.6666667	475.3333333	372	156	GOSB-46		10/29/2009
Carbazole	mg/kg	3	2	1	1	0.010033333	0.020066667	0.0186	ND	GOSB-46	J	10/29/2009
Chloromethane (Methyl Chloride)	mg/kg	3	2	1	1	0.0002765	0.000553	0.000474	ND	GOSB-48	J	10/29/2009
Chromium	mg/kg	3	0	3	0	20.93333333	41.86666667	23.2	17.7	GOSB-46		10/29/2009
Chrysene	mg/kg	3	2	1	0	0.0815	0.163	0.233	ND	GOSB-46		10/29/2009
Cobalt	mg/kg	3	0	3	3	0.575666667	1.151333333	0.915	0.373	GOSB-48	J	10/29/2009
Copper	mg/kg	3	0	3	3	4.383333333	8.766666667	5.31	2.87	GOSB-46	J	10/29/2009
DDE	mg/kg	3	2	1	1	0.000401333	0.000802667	0.000823	ND	GOSB-46	J	10/29/2009
Fluoranthene	mg/kg	3	2	1	0	0.094833333	0.189666667	0.273	ND	GOSB-46		10/29/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	3	2	1	0	0.0362	0.0724	0.0971	ND	GOSB-46		10/29/2009
Iron	mg/kg	3	0	3	0	20700	41400	24500	14100	GOSB-46		10/29/2009
Lead	mg/kg	3	0	3	1	9.75	19.5	13.5	6.45	GOSB-48		10/29/2009
Magnesium	mg/kg	3	0	3	0	123.6666667	247.3333333	146	107	GOSB-48		10/29/2009
Manganese	mg/kg	3	0	3	0	32.76666667	65.53333333	54.6	18.5	GOSB-48		10/29/2009
Mercury	mg/kg	3	0	3	0	0.0305	0.061	0.0445	0.0192	GOSB-47		10/29/2009
Methyl Acetate	mg/kg	3	1	2	1	0.00713	0.01426	0.0181	ND	GOSB-47		10/29/2009
Methyl Ethyl Ketone	mg/kg	3	1	2	1	0.004803333	0.009606667	0.0109	ND	GOSB-48		10/29/2009
Nickel	mg/kg	3	0	3	1	1.273	2.546	2.26	0.429	GOSB-48		10/29/2009
Potassium	mg/kg	3	0	3	0	119.6666667	239.3333333	146	85	GOSB-46		10/29/2009
Pyrene	mg/kg	3	2	1	0	0.158833333	0.317666667	0.465	ND	GOSB-46		10/29/2009
Silver	mg/kg	3	1	2	2	0.113833333	0.227666667	0.159	ND	GOSB-47	J	10/29/2009
Sodium	mg/kg	3	1	2	2	7.175	14.35	9.03	ND	GOSB-47	J	10/29/2009
Toluene	mg/kg	3	2	1	1	0.000359167	0.000718333	0.000722	ND	GOSB-48	J	10/29/2009
Vanadium	mg/kg	3	0	3	0	56.1	112.2	68.3	35.6	GOSB-46		10/29/2009
Zinc	mg/kg	3	0	3	0	6.186666667	12.37333333	8.35	4.87	GOSB-47		10/29/2009
Radionuclides												
Actinium-228	pCi/g	3	0	3	0	1.44	2.88	1.69	1.29	GOSB-47		10/29/2009
Bismuth-214	pCi/g	3	0	3	0	0.999666667	1.999333333	1.09	0.829	GOSB-47		10/29/2009
Cesium-137	pCi/g	3	0	3	1	0.103866667	0.207733333	0.173	0.0569	GOSB-46		10/29/2009
Gross Alpha	pCi/g	3	0	3	3	8.923333333	17.84666667	11	7.83	GOSB-48	J	10/29/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2 X Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Lead-212	pCi/g	3	0	3	0	1.483333333	2.966666667	1.79	1.3	GOSB-47		10/29/2009
Lead-214	pCi/g	3	0	3	0	1.095	2.19	1.22	0.905	GOSB-48		10/29/2009
Nonvolatile Beta	pCi/g	3	0	3	3	6.98	13.96	8.32	5.08	GOSB-46	J	10/29/2009
Potassium-40	pCi/g	3	0	3	0	2.04	4.08	2.42	1.46	GOSB-47		10/29/2009
Thallium-208	pCi/g	3	0	3	0	0.462333333	0.924666667	0.533	0.424	GOSB-47		10/29/2009

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2 X Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acetone	mg/Kg	3	1	2	0	0.011798333	0.023596667	0.0177	ND	GOSB-46		10/29/2009
Aluminum	mg/Kg	3	0	3	0	13543.33333	27086.66667	18500	8730	GOSB-48		10/29/2009
Aroclor 1254	mg/Kg	3	2	1	1	0.001121667	0.002243333	0.0021	ND	GOSB-47	J	10/29/2009
Arsenic	mg/Kg	3	2	1	1	0.914166667	1.828333333	2.18	ND	GOSB-46	J	10/29/2009
Barium	mg/Kg	3	0	3	0	23.2	46.4	38.6	12.6	GOSB-46		10/29/2009
Benzo[B]Fluoranthene	mg/Kg	3	2	1	1	0.01195	0.0239	0.0245	ND	GOSB-46	J	10/29/2009
Beryllium	mg/Kg	3	1	2	2	0.175	0.35	0.341	ND	GOSB-46	J	10/29/2009
Cadmium	mg/Kg	3	2	1	1	0.081666667	0.163333333	0.136	ND	GOSB-48	J	10/29/2009
Calcium	mg/Kg	3	0	3	0	186	372	263	83	GOSB-48		10/29/2009
Chromium	mg/Kg	3	0	3	0	19.96666667	39.93333333	30.3	13.9	GOSB-48		10/29/2009
Cobalt	mg/Kg	3	0	3	2	0.654333333	1.308666667	1.18	0.328	GOSB-46		10/29/2009
Copper	mg/Kg	3	0	3	3	4.706666667	9.413333333	5.21	4.01	GOSB-46	J	10/29/2009
Dde	mg/Kg	3	2	1	1	0.0003085	0.000617	0.000546	ND	GOSB-47	J	10/29/2009
Fluoranthene	mg/Kg	3	2	1	1	0.007683333	0.015366667	0.0117	ND	GOSB-46	J	10/29/2009
Iron	mg/Kg	3	0	3	0	19933.33333	39866.66667	31600	13400	GOSB-48		10/29/2009
Lead	mg/Kg	3	0	3	2	7.813333333	15.62666667	11	5.69	GOSB-46		10/29/2009
Magnesium	mg/Kg	3	0	3	1	132.3333333	264.6666667	167	79	GOSB-46		10/29/2009
Manganese	mg/Kg	3	0	3	2	24.7	49.4	50.7	11.2	GOSB-46		10/29/2009
Mercury	mg/Kg	3	0	3	0	0.050033333	0.100066667	0.0674	0.0245	GOSB-48		10/29/2009
Nickel	mg/Kg	3	0	3	0	2.106666667	4.213333333	3.08	1.51	GOSB-46		10/29/2009
Potassium	mg/Kg	3	0	3	0	97.66666667	195.3333333	140	62.7	GOSB-46		10/29/2009
Pyrene	mg/Kg	3	2	1	1	0.00975	0.0195	0.0179	ND	GOSB-46	J	10/29/2009
Silver	mg/Kg	3	1	2	2	0.143333333	0.286666667	0.243	ND	GOSB-48	J	10/29/2009
Sodium	mg/Kg	3	0	3	3	8.983333333	17.96666667	9.95	8.27	GOSB-48	J	10/29/2009
Vanadium	mg/Kg	3	0	3	0	47.8	95.6	74.9	30.1	GOSB-48		10/29/2009
Zinc	mg/Kg	3	0	3	0	6.066666667	12.13333333	7.11	4.22	GOSB-48		10/29/2009
Radionuclides												
Actinium-228	pCi/g	3	0	3	0	1.51	3.02	1.89	1.15	GOSB-48		10/29/2009
Bismuth-214	pCi/g	3	0	3	0	1.051666667	2.103333333	1.22	0.945	GOSB-48		10/29/2009
Gross Alpha	pCi/g	3	0	3	1	13.20666667	26.41333333	19	7.22	GOSB-48		10/29/2009
Lead-212	pCi/g	3	0	3	0	1.523333333	3.046666667	1.86	1.18	GOSB-48		10/29/2009
Lead-214	pCi/g	3	0	3	0	1.163333333	2.326666667	1.3	1.08	GOSB-48		10/29/2009
Nonvolatile Beta	pCi/g	3	0	3	2	8.886666667	17.77333333	11.4	6.83	GOSB-48		10/29/2009
Potassium-40	pCi/g	3	0	3	0	1.576666667	3.153333333	2.06	1.22	GOSB-46		10/29/2009
Thallium-208	pCi/g	3	0	3	0	0.487333333	0.974666667	0.645	0.36	GOSB-48		10/29/2009

J = Estimated Value
N D = Non-Detect

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2 X Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Acenaphthylene	mg/kg	6	5	1	0	0.014191667	0.028383333	0.0568	ND	GOSB-46		10/29/2009
Acetone	mg/kg	6	1	5	0	0.0292325	0.058465	0.0496	ND	GOSB-48		10/29/2009
Aluminum	mg/kg	6	0	6	0	12153.33333	24306.66667	18500	8730	GOSB-48		10/29/2009
Anthracene	mg/kg	6	5	1	0	0.011178333	0.022356667	0.0482	ND	GOSB-46		10/29/2009
Aroclor 1254	mg/kg	6	5	1	1	0.000884167	0.001768333	0.0021	ND	GOSB-47	J	10/29/2009
Arsenic	mg/kg	6	4	2	2	0.763666667	1.527333333	2.18	ND	GOSB-46	J	10/29/2009
Barium	mg/kg	6	0	6	0	22.25	44.5	38.6	12.6	GOSB-46		10/29/2009
Benzo(g,h,i)Perylene	mg/kg	6	5	1	0	0.020391667	0.040783333	0.094	ND	GOSB-46		10/29/2009
Benzo[b]Fluoranthene	mg/kg	6	4	2	2	0.099058333	0.198116667	0.547	ND	GOSB-46	J	10/29/2009
Beryllium	mg/kg	6	1	5	5	0.186333333	0.372666667	0.341	ND	GOSB-46	J	10/29/2009
Cadmium	mg/kg	6	4	2	2	0.08625	0.1725	0.157	ND	GOSB-47	J	10/29/2009
Calcium	mg/kg	6	0	6	0	211.8333333	423.6666667	372	83	GOSB-46		10/29/2009
Carbazole	mg/kg	6	5	1	1	0.007825	0.01565	0.0186	ND	GOSB-46	J	10/29/2009
Chloromethane (Methyl Chloride)	mg/kg	6	5	1	1	0.000222667	0.000445333	0.000474	ND	GOSB-48	J	10/29/2009
Chromium	mg/kg	6	0	6	0	20.45	40.9	30.3	13.9	GOSB-48		10/29/2009
Chrysene	mg/kg	6	5	1	0	0.043558333	0.087116667	0.233	ND	GOSB-46		10/29/2009
Cobalt	mg/kg	6	0	6	5	0.615	1.23	1.18	0.328	GOSB-46		10/29/2009
Copper	mg/kg	6	0	6	6	4.545	9.09	5.31	2.87	GOSB-46	J	10/29/2009
DDE	mg/kg	6	4	2	2	0.000354917	0.000709833	0.000823	ND	GOSB-46	J	10/29/2009
Fluoranthene	mg/kg	6	4	2	1	0.051258333	0.102516667	0.273	ND	GOSB-46		10/29/2009
Indeno[1,2,3-cd]Pyrene	mg/kg	6	5	1	0	0.020908333	0.041816667	0.0971	ND	GOSB-46		10/29/2009
Iron	mg/kg	6	0	6	0	20316.66667	40633.33333	31600	13400	GOSB-48		10/29/2009
Lead	mg/kg	6	0	6	3	8.781666667	17.56333333	13.5	5.69	GOSB-48		10/29/2009
Magnesium	mg/kg	6	0	6	1	128	256	167	79	GOSB-46		10/29/2009
Manganese	mg/kg	6	0	6	2	28.73333333	57.46666667	54.6	11.2	GOSB-48		10/29/2009
Mercury	mg/kg	6	0	6	0	0.040266667	0.080533333	0.0674	0.0192	GOSB-48		10/29/2009
Methyl Acetate	mg/kg	6	4	2	1	0.0040325	0.008065	0.0181	ND	GOSB-47		10/29/2009
Methyl Ethyl Ketone	mg/kg	6	4	2	1	0.002753333	0.005506667	0.0109	ND	GOSB-48		10/29/2009
Nickel	mg/kg	6	0	6	1	1.689833333	3.379666667	3.08	0.429	GOSB-46		10/29/2009
Potassium	mg/kg	6	0	6	0	108.6666667	217.3333333	146	62.7	GOSB-46		10/29/2009
Pyrene	mg/kg	6	4	2	1	0.084291667	0.168583333	0.465	ND	GOSB-46		10/29/2009
Silver	mg/kg	6	2	4	4	0.128583333	0.257166667	0.243	ND	GOSB-48	J	10/29/2009
Sodium	mg/kg	6	1	5	5	8.079166667	16.15833333	9.95	ND	GOSB-48	J	10/29/2009
Toluene	mg/kg	6	5	1	1	0.000264	0.000528	0.000722	ND	GOSB-48	J	10/29/2009
Vanadium	mg/kg	6	0	6	0	51.95	103.9	74.9	30.1	GOSB-48		10/29/2009
Zinc	mg/kg	6	0	6	0	6.126666667	12.25333333	8.35	4.22	GOSB-47		10/29/2009
Radionuclides												
Actinium-228	pCi/g	6	0	6	0	1.475	2.95	1.89	1.15	GOSB-48		10/29/2009
Bismuth-214	pCi/g	6	0	6	0	1.025666667	2.051333333	1.22	0.829	GOSB-48		10/29/2009
Cesium-137	pCi/g	6	3	3	1	0.057683333	0.115366667	0.173	ND	GOSB-46		10/29/2009
Gross Alpha	pCi/g	6	0	6	4	11.065	22.13	19	7.22	GOSB-48		10/29/2009

Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2 X Mean	Max	Min	Max Location	Qualifier of Max	Max Date
Lead-212	pCi/g	6	0	6	0	1.503333333	3.006666667	1.86	1.18	GOSB-48		10/29/2009
Lead-214	pCi/g	6	0	6	0	1.129166667	2.258333333	1.3	0.905	GOSB-48		10/29/2009
Nonvolatile Beta	pCi/g	6	0	6	5	7.933333333	15.86666667	11.4	5.08	GOSB-48		10/29/2009
Potassium-40	pCi/g	6	0	6	0	1.808333333	3.616666667	2.42	1.22	GOSB-47		10/29/2009
Thallium-208	pCi/g	6	0	6	0	0.474833333	0.949666667	0.645	0.36	GOSB-48		10/29/2009

J = Estimated Value
N D = Non-Detect

Table A.2.1
USC Screen for GOSB Interior Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Inorganics								
Aluminum	mg/kg	5720	GOSB-53		0	1	13395	no
Antimony	mg/kg	2.93	GOSB-49		0	1	2.6528	**YES**
Arsenic	mg/kg	2.9	GOSB-49	J	0	1	4.4534	no
Barium	mg/kg	92	GOSB-49		0	1	33.1077	**YES**
Cadmium	mg/kg	4.19	GOSB-50		0	1	0.4436	**YES**
Calcium	mg/kg	15700	GOSB-49		0	1	334	**YES**
Chromium	mg/kg	51.2	GOSB-49		0	1	22.8683	**YES**
Cobalt	mg/kg	2.98	GOSB-49		0	1	1.3961	**YES**
Copper	mg/kg	48.1	GOSB-49		0	1	6.3517	**YES**
Iron	mg/kg	9070	GOSB-52		0	1	22001	no
Lead	mg/kg	52	GOSB-50		0	1	10.8252	**YES**
Magnesium	mg/kg	368	GOSB-49		0	1	245.69	**YES**
Manganese	mg/kg	55.7	GOSB-49		1	4	63.277	no
Mercury	mg/kg	0.578	GOSB-49		0	1	0.06681	**YES**
Nickel	mg/kg	24.9	GOSB-49		0	1	4.1537	**YES**
Potassium	mg/kg	175	GOSB-52		1	4	213.034	no
Silver	mg/kg	314	GOSB-49		0	1	0.6368	**YES**
Sodium	mg/kg	38.8	GOSB-49		0	1	43.555	no
Thallium	mg/kg	4.64	GOSB-49		0	1	2.9355	**YES**
Vanadium	mg/kg	38	GOSB-52		0	1	58.06	no
Zinc	mg/kg	460	GOSB-49		1	4	7.4404	**YES**
Pesticides								
Aldrin	mg/kg	0.0149	GOSB-53	J	1	4	NA	NA
Alpha−Chlordane	mg/kg	7.32	GOSB-51		0	1	NA	NA
DDD	mg/kg	1.8	GOSB-51		0	1	NA	NA
DDE	mg/kg	4.5	GOSB-51		0	1	NA	NA
DDT	mg/kg	0.0383	GOSB-53		1	4	NA	NA
Dieldrin	mg/kg	0.5	GOSB-51	J	0	1	NA	NA
Gamma−Chlordane	mg/kg	10.9	GOSB-51		0	1	NA	NA
Heptachlor	mg/kg	0.00897	GOSB-50	J	0	1	NA	NA
Heptachlor Epoxide	mg/kg	0.945	GOSB-51		0	1	NA	NA
Organics								
1,2-Dichlorobenzene	mg/kg	0.000592	GOSB-49	J	1	4	NA	NA
1,3-Dichlorobenzene	mg/kg	0.00842	GOSB-52		1	4	NA	NA
1,4-Dichlorobenzene	mg/kg	0.0344	GOSB-53		0	1	NA	NA
Acetone	mg/kg	0.0324	GOSB-50		1	4	NA	NA
Carbon Disulfide	mg/kg	0.00334	GOSB−52	J	1	4	NA	NA
Chlorobenzene	mg/kg	0.0218	GOSB−53		0	1	NA	NA
Chloroform	mg/kg	0.000874	GOSB−49	J	1	4	NA	NA

Table A.2.1
USC Screen for GOSB Interior Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Cumene (Isopropylbenzene)	mg/kg	0.0004	GOSB−51	J	0	1	NA	NA
Ethylbenzene	mg/kg	0.00051	GOSB−51	J	0	1	NA	NA
M,P−Xylene	mg/kg	0.000708	GOSB−53	J	1	4	NA	NA
Methyl Ethyl Ketone	mg/kg	0.0036	GOSB−50	J	1	4	NA	NA
Methylcyclohexane	mg/kg	0.00044	GOSB−51	J	0	1	NA	NA
Toluene	mg/kg	0.00132	GOSB−52		1	4	NA	NA
2−Methylnaphthalene	mg/kg	2.58	GOSB−51		0	1	NA	NA
Anthracene	mg/kg	0.0185	GOSB−49	J	0	1	NA	NA
Benzo(g,h,I)Perylene	mg/kg	0.067	GOSB−49		0	1	NA	NA
Benzo[a]Anthracene	mg/kg	0.195	GOSB−49		0	1	NA	NA
Benzo[a]Pyrene	mg/kg	0.138	GOSB−49		0	1	NA	NA
Benzo[b]Fluoranthene	mg/kg	0.247	GOSB−49		0	1	NA	NA
Caprolactam	mg/kg	14.2	GOSB−51		0	1	NA	NA
Chrysene	mg/kg	0.167	GOSB−49		0	1	NA	NA
Fluoranthene	mg/kg	0.993	GOSB−51	J	0	1	NA	NA
Fluorene	mg/kg	1.59	GOSB−51		0	1	NA	NA
Indeno[1,2,3−cd]Pyrene	mg/kg	0.0647	GOSB−49		0	1	NA	NA
Phenanthrene	mg/kg	3.91	GOSB−51		0	1	NA	NA
Pyrene	mg/kg	0.683	GOSB−51	J	0	1	NA	NA
Cyanide	mg/kg	0.81	GOSB−51	J	0	1	NA	NA
Radionuclides								
Actinium−228	pCi/g	1.38	GOSB−52		0	1	2.146	no
Bismuth−214	pCi/g	0.882	GOSB−52		0	1	2.115	no
Cesium−137	pCi/g	0.0499	GOSB−51	J	0	1	0.0931	no
Gross Alpha	pCi/g	12.5	GOSB−50	J	0	1	21.6392	no
Lead−212	pCi/g	1.33	GOSB−52		0	1	2.2408	no
Lead−214	pCi/g	1.01	GOSB−52		0	1	NA	NA
Nonvolatile Beta	pCi/g	20.3	GOSB−49		1	4	17.296	**YES**
Potassium−40	pCi/g	3.42	GOSB−52		1	4	2.5187	**YES**
Thallium−208	pCi/g	0.433	GOSB−51		1	4	NA	NA

J = estimated value NA = not available
1 = Max = maximum detected concentration from all depth intervals
2 = *Background Soils Statistical Summary Report for the Savannah River Site*, ERD‐EN‐2005‐0223, Appendix B‐2 (All Depth Intervals)

Table A.2.2
USC Screen for GOSB Berm Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Inorganics								
Aluminum	mg/Kg	18900	GOSB-37		1	4	13395	**YES**
Arsenic	mg/Kg	48.1	GOSB-39		8	10	4.4534	**YES**
Barium	mg/Kg	34.9	GOSB-45		1	4	33.1077	**YES**
Beryllium	mg/Kg	0.264	GOSB-34	J	1	4	0.3047	no
Cadmium	mg/Kg	0.185	GOSB-39	J	8	10	0.4436	no
Calcium	mg/Kg	482	GOSB-43		0	1	334	**YES**
Chromium	mg/Kg	86.7	GOSB-36		8	10	22.8683	**YES**
Cobalt	mg/Kg	0.888	GOSB-34		1	4	1.3961	no
Copper	mg/Kg	17.1	GOSB-40		0	1	6.3517	**YES**
Iron	mg/Kg	85200	GOSB-45		8	10	22001	**YES**
Lead	mg/Kg	72.9	GOSB-35		0	1	10.8252	**YES**
Magnesium	mg/Kg	356	GOSB-38		0	1	245.69	**YES**
Manganese	mg/Kg	142	GOSB-44		1	4	63.277	**YES**
Mercury	mg/Kg	0.0618	GOSB-38		1	4	0.06681	no
Nickel	mg/Kg	4.86	GOSB-42		8	10	4.1537	**YES**
Potassium	mg/Kg	380	GOSB-38		0	1	213.034	**YES**
Silver	mg/Kg	1.74	GOSB-39		8	10	0.6368	**YES**
Sodium	mg/Kg	311	GOSB-33		8	10	43.555	**YES**
Thallium	mg/Kg	1.3	GOSB-41	J	0	1	2.9355	no
Vanadium	mg/Kg	198	GOSB-36		8	10	58.06	**YES**
Zinc	mg/Kg	13.9	GOSB-40		0	1	7.4404	**YES**
Pesticides/PCBS								
Alpha-Benzene Hexachloride	mg/Kg	0.00112	GOSB-44		8	10	NA	NA
Alpha-Chlordane	mg/Kg	0.029	GOSB-44		8	10	NA	NA
Beta-Benzene Hexachloride	mg/Kg	0.00438	GOSB-44		8	10	NA	NA
DDD	mg/Kg	0.00532	GOSB-35		0	1	NA	NA
DDE	mg/Kg	0.0285	GOSB-33		0	1	NA	NA
DDT	mg/Kg	0.0194	GOSB-33		0	1	NA	NA
Dieldrin	mg/Kg	0.0017	GOSB-34		0	1	NA	NA
Endosulfan Sulfate	mg/Kg	0.000713	GOSB-34	J	0	1	NA	NA
Endrin	mg/Kg	0.00145	GOSB-40	J	0	1	NA	NA
Endrin Ketone	mg/Kg	0.00161	GOSB-41		0	1	NA	NA
Gamma-Chlordane	mg/Kg	0.0269	GOSB-44		8	10	NA	NA
Aroclor 1254	mg/Kg	0.0206	GOSB-40		0	1	NA	NA
Aroclor 1260	mg/Kg	0.0136	GOSB-40		0	1	NA	NA
Organics								
Acetone	mg/Kg	0.0702	GOSB-45		0	1	NA	NA
Carbon Disulfide	mg/Kg	0.00227	GOSB-37	J	1	4	NA	NA
Methyl Acetate	mg/Kg	0.0204	GOSB-33	J	1	4	NA	NA
Methyl Ethyl Ketone	mg/Kg	0.0026	GOSB-44	J	0	1	NA	NA

Table A.2.2
USC Screen for GOSB Berm Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Styrene	mg/Kg	0.00173	GOSB-41	J	0	1	NA	NA
Toluene	mg/Kg	0.00039	GOSB-43	J	0	1	NA	NA
Acenaphthene	mg/Kg	0.0178	GOSB-40	J	0	1	NA	NA
Anthracene	mg/Kg	0.028	GOSB-40	J	0	1	NA	NA
Benzo(g,h,I)Perylene	mg/Kg	0.0579	GOSB-40		0	1	NA	NA
Benzo[a]Anthracene	mg/Kg	0.101	GOSB-40		0	1	NA	NA
Benzo[a]Pyrene	mg/Kg	0.0915	GOSB-40		0	1	NA	NA
Benzo[b]Fluoranthene	mg/Kg	0.187	GOSB-40		0	1	NA	NA
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/Kg	0.0831	GOSB-38	J	8	10	NA	NA
Caprolactam	mg/Kg	0.0757	GOSB-40	J	1	4	NA	NA
Carbazole	mg/Kg	0.0264	GOSB-40	J	0	1	NA	NA
Chrysene	mg/Kg	0.112	GOSB-40		0	1	NA	NA
Fluoranthene	mg/Kg	0.245	GOSB-40		0	1	NA	NA
Indeno[1,2,3-Cd]Pyrene	mg/Kg	0.0506	GOSB-40		0	1	NA	NA
Phenanthrene	mg/Kg	0.132	GOSB-40		0	1	NA	NA
Pyrene	mg/Kg	0.179	GOSB-40		0	1	NA	NA
Cyanide	mg/Kg	0.167	GOSB-40	J	0	1	NA	NA
Radionuclides								
Actinium-228	pCi/g	2.11	GOSB-36		8	10	2.146	no
Barium-133	pCi/g	0.0247	GOSB-45	J	1	4	NA	NA
Bismuth-214	pCi/g	1.23	GOSB-36		8	10	2.115	no
Cesium-137	pCi/g	0.278	GOSB-40		0	1	0.0931	**YES**
Gross Alpha	pCi/g	20.1	GOSB-33		8	10	21.6392	no
Lead-212	pCi/g	2.17	GOSB-36		8	10	2.2408	no
Lead-214	pCi/g	1.39	GOSB-36		8	10	NA	NA
Nonvolatile Beta	pCi/g	21	GOSB-42		8	10	17.296	**YES**
Potassium-40	pCi/g	4.21	GOSB-45		8	10	2.5187	**YES**
Thallium-208	pCi/g	0.627	GOSB-36		8	10	NA	NA

J = estimated value NA = not available
1 = Max = maximum detected concentration from all depth intervals
2 = *Background Soils Statistical Summary Report for the Savannah River Site*, ERD - EN - 2005 - 0223, Appendix B - 2 (All Depth Intervals)

Table A.2.3
USC Screen for GOSB Pipeline Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Inorganics								
Aluminum	mg/Kg	11700	GOSB-21		8	10	13395	no
Arsenic	mg/Kg	39.8	GOSB-22		8	10	4.4534	**YES**
Barium	mg/Kg	19.3	GOSB-14		8	10	33.1077	no
Beryllium	mg/Kg	0.171	GOSB-8	J	8	10	0.3047	no
Cadmium	mg/Kg	0.331	GOSB-8	J	8	10	0.4436	no
Calcium	mg/Kg	733	GOSB-5		8	10	334	**YES**
Chromium	mg/Kg	41.4	GOSB-22		8	10	22.8683	**YES**
Cobalt	mg/Kg	0.528	GOSB-14	J	8	10	1.3961	no
Copper	mg/Kg	9.54	GOSB-5		8	10	6.3517	**YES**
Iron	mg/Kg	42300	GOSB-3		8	10	22001	**YES**
Lead	mg/Kg	16.7	GOSB-3		8	10	10.8252	**YES**
Magnesium	mg/Kg	166	GOSB-28		8	10	245.69	no
Manganese	mg/Kg	32.9	GOSB-8		8	10	63.277	no
Mercury	mg/Kg	0.0524	GOSB-8		8	10	0.06681	no
Nickel	mg/Kg	5.48	GOSB-25		8	10	4.1537	**YES**
Potassium	mg/Kg	224	GOSB-8		8	10	213.034	**YES**
Selenium	mg/Kg	3.1	GOSB-3	J	8	10	3.7058	no
Silver	mg/Kg	1.76	GOSB-7		8	10	0.6368	**YES**
Sodium	mg/Kg	160	GOSB-8		8	10	43.555	**YES**
Vanadium	mg/Kg	156	GOSB-3		8	10	58.06	**YES**
Zinc	mg/Kg	15.4	GOSB-7		8	10	7.4404	**YES**
Pesticides								
Alpha-Benzene Hexachloride	mg/Kg	0.000646	GOSB-7	J	8	10	NA	NA
Alpha-Chlordane	mg/Kg	0.00232	GOSB-9		8	10	NA	NA
DDE	mg/Kg	0.000873	GOSB-7	J	8	10	NA	NA
DDT	mg/Kg	0.00334	GOSB-7		8	10	NA	NA
Organics								
Acetone	mg/Kg	0.0387	GOSB-4		8	10	NA	NA
Benzene	mg/Kg	0.000478	GOSB-19	J	8	10	NA	NA
Chloroform	mg/Kg	0.00109	GOSB-2	J	8	10	NA	NA
Toluene	mg/Kg	0.00051	GOSB-13	J	8	10	NA	NA
Bis(2-Ethylhexyl)Phthalate (DEHP)	mg/Kg	0.114	GOSB-9	J	8	10	NA	NA
Cyanide	mg/Kg	0.103	GOSB-13	J	8	10	NA	NA
Radionuclides								
Actinium-228	pCi/g	1.94	GOSB-6		8	10	2.146	no
Bismuth-214	pCi/g	1.02	GOSB-8		8	10	2.115	no

Table A.2.3
USC Screen for GOSB Pipeline Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Gross Alpha	pCi/g	22.8	GOSB-21		8	10	21.6392	**YES**
Lead-212	pCi/g	1.85	GOSB-21		8	10	2.2408	no
Lead-214	pCi/g	1.14	GOSB-8		8	10	NA	NA
Nonvolatile Beta	pCi/g	19.2	GOSB-5		8	10	17.296	**YES**
Potassium-40	pCi/g	2.94	GOSB-2		8	10	2.5187	**YES**
Thallium-208	pCi/g	0.644	GOSB-21		8	10	NA	NA

J = estimated value
NA = not available
1 = Max = maximum detected concentration from all depth intervals
2 = *Background Soils Statistical Summary Report for the Savannah River Site*, ERD - EN - 2005 - 0223, Appendix B - 2 (All Depth Intervals)

Table A.2.4
USC Screen for GOSB Effluent Discharge Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Inorganics								
Aluminum	mg/Kg	15300	GOSB-30		0	1	13395	**YES**
Arsenic	mg/Kg	9.84	GOSB-32		1	4	4.4534	**YES**
Barium	mg/Kg	60.6	GOSB-32		1	4	33.1077	**YES**
Beryllium	mg/Kg	0.811	GOSB-32		1	4	0.3047	**YES**
Cadmium	mg/Kg	0.134	GOSB-54	J	0	1	0.4436	no
Calcium	mg/Kg	780	GOSB-54		1	4	334	**YES**
Chromium	mg/Kg	21.3	GOSB-31		1	4	22.8683	no
Cobalt	mg/Kg	3.96	GOSB-56		1	4	1.3961	**YES**
Copper	mg/Kg	20.6	GOSB-54		0	1	6.3517	**YES**
Iron	mg/Kg	34300	GOSB-54		1	4	22001	**YES**
Lead	mg/Kg	17.2	GOSB-32		0	1	10.8252	**YES**
Magnesium	mg/Kg	250	GOSB-32		1	4	245.69	**YES**
Manganese	mg/Kg	537	GOSB-32		1	4	63.277	**YES**
Mercury	mg/Kg	0.0764	GOSB-54		0	1	0.06681	**YES**
Nickel	mg/Kg	5.4	GOSB-32		1	4	4.1537	**YES**
Potassium	mg/Kg	217	GOSB-32		1	4	213.034	**YES**
Selenium	mg/Kg	3.72	GOSB-54		1	4	3.7058	**YES**
Silver	mg/Kg	11.9	GOSB-54		0	1	0.6368	**YES**
Sodium	mg/Kg	59.7	GOSB-56	J	0	1	43.555	**YES**
Vanadium	mg/Kg	76.1	GOSB-30		0	1	58.06	**YES**
Zinc	mg/Kg	36.5	GOSB-56		0	1	7.4404	**YES**
Pesticides/PCBS								
Alpha-Chlordane	mg/Kg	0.386	GOSB-54		0	1	NA	NA
DDE	mg/Kg	0.0145	GOSB-32		0	1	NA	NA
DDT	mg/Kg	0.016	GOSB-32		0	1	NA	NA
Gamma-Chlordane	mg/Kg	0.277	GOSB-54		0	1	NA	NA
Heptachlor Epoxide	mg/Kg	0.00025	GOSB-32	J	0	1	NA	NA
Aroclor 1242	mg/Kg	0.0302	GOSB-31		1	4	NA	NA
Aroclor 1254	mg/Kg	0.0366	GOSB-32		0	1	NA	NA
Aroclor 1260	mg/Kg	0.0357	GOSB-32		0	1	NA	NA
Organics								
Acetone	mg/Kg	0.173	GOSB-55	J	0	1	NA	NA
Chloromethane (Methyl Chloride)	mg/Kg	0.00053	GOSB-30	J	1	4	NA	NA
Cumene (Isopropylbenzene)	mg/Kg	0.00425	GOSB-56	J	0	1	NA	NA
M,P-Xylene	mg/Kg	0.000634	GOSB-30	J	1	4	NA	NA
Methyl Acetate	mg/Kg	0.0503	GOSB-54	J	0	1	NA	NA
Methyl Ethyl Ketone	mg/Kg	0.0613	GOSB-54	J	0	1	NA	NA
Styrene	mg/Kg	0.00622	GOSB-56	J	0	1	NA	NA

Table A.2.4
USC Screen for GOSB Effluent Discharge Subunit

Analyte	Units	Max[1]	Max Location	Qualifier of Max	Top Depth *(ft)*	Bottom Depth *(ft)*	SRS 2X Average Background[2]	Max Detect > SRS 2X Average Background?
Benzo(g,h,I)Perylene	mg/Kg	0.019	GOSB-32	J	0	1	NA	NA
Benzo[a]Pyrene	mg/Kg	0.0273	GOSB-32	J	0	1	NA	NA
Benzo[b]Fluoranthene	mg/Kg	0.0422	GOSB-32		0	1	NA	NA
Benzo[k]Fluoranthene	mg/Kg	0.0192	GOSB-32	J	0	1	NA	NA
Chrysene	mg/Kg	0.0415	GOSB-32		0	1	NA	NA
Fluoranthene	mg/Kg	0.0609	GOSB-32		0	1	NA	NA
Indeno[1,2,3-cd]Pyrene	mg/Kg	0.0175	GOSB-32	J	0	1	NA	NA
Phenanthrene	mg/Kg	0.0326	GOSB-32	J	0	1	NA	NA
Pyrene	mg/Kg	0.0427	GOSB-32		0	1	NA	NA
Cyanide	mg/Kg	0.496	GOSB-54	J	0	1	NA	NA
Radionuclides								
Actinium-228	pCi/g	1.86	GOSB-30		0	1	2.146	no
Bismuth-214	pCi/g	1.1	GOSB-31		0	1	2.115	no
Cesium-137	pCi/g	0.284	GOSB-32		0	1	0.0931	**YES**
Gross Alpha	pCi/g	27.4	GOSB-56		0	1	21.6392	**YES**
Lead-212	pCi/g	1.88	GOSB-30		0	1	2.2408	no
Lead-214	pCi/g	1.22	GOSB-31		0	1	NA	NA
Nonvolatile Beta	pCi/g	36.6	GOSB-54		0	1	17.296	**YES**
Potassium-40	pCi/g	2.07	GOSB-31		1	4	2.5187	no
Radium-226	pCi/g	1.37	GOSB-56		0	1	1.2807	**YES**
Radium-228	pCi/g	2.47	GOSB-56		0	1	2.1071	**YES**
Thallium-208	pCi/g	0.59	GOSB-30		0	1	NA	NA
Thorium-228	pCi/g	2.75	GOSB-56		0	1	2.2128	**YES**
Thorium-230	pCi/g	1.47	GOSB-56		0	1	1.3521	**YES**
Thorium-232	pCi/g	2.4	GOSB-56	J	0	1	2.0852	**YES**
Tritium	pCi/g	11.1	GOSB-31	J	1	4	NA	NA
Uranium-233/234	pCi/g	1.19	GOSB-56		0	1	1.2945	no
Uranium-235	pCi/g	0.169	GOSB-54		1	4	0.0942	**YES**
Uranium-238	pCi/g	1.01	GOSB-56		0	1	1.009	**YES**

J = estimated value
NA = not available
1 = Max = maximum detected concentration from all depth intervals
2 = *Background Soils Statistical Summary Report for the Savannah River Site*, ERD - EN - 2005 - 0223, Appendix B - 2 (All Depth Intervals)

APPENDIX B

CONTAMINANT FATE AND TRANSPORT

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LIST OF ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
CM	contaminant migration
COC	constituent of concern
COPC	constituent of potential concern
DAF	dilution attenuation factor
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
ft	feet
GOSB	G-Area Oil Seepage Basin (761-13G)
kg	kilogram
L	liter
µg	microgram
m	meter
MCL	maximum contaminant level
mg	milligram
MLSSL	mass-limited soil screening limit
NAPL	non-aqueous phase liquid
OU	operable unit
PCB	polychlorinated biphenyl
RCOC	refined constituent of concern
RGO	remedial goal objective
RSL	regional screening level
SRS	Savannah River Site
SSL	soil screening limit
SVOC	semivolatile organic compound
USEPA	U. S. Environmental Protection Agency
VOC	volatile organic compound

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B-1. CONTAMINANT FATE AND TRANSPORT

The purpose of this Appendix is to determine the fate and transport of contaminants associated with the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU). GOSB is divided into four subunits, including:

- GOSB Interior Subunit
- GOSB Berm Subunit
- Pipeline Subunit
- Effluent Discharge Subunit

The analysis was performed using the spreadsheet model VZCOMML© (V.4.2)[a], which accounts for decay processes, infiltration rate, soil properties, vadose zone thickness, and chemical behavior. Soil screening limits (SSLs) were calculated by the model and an exceedance of a SSL by a vadose zone constituent indicates that the resultant maximum groundwater concentration has the potential to exceed the regulatory limits (e.g., maximum contaminant levels [MCLs]).

As discussed in Chapter 3, the 2016-2017 sampling campaign included groundwater sampling at eight piezometers. Groundwater samples were taken upgradient, sidegradient and downgradient of the GOSB to confirm that there had not been a past release of contaminants from the basin and to corroborate the results of the fate and transport model. The groundwater sampling results are presented in Section B-2.6 of this appendix.

B-2. CONTAMINANT MIGRATION MODEL

B-2.1. Background

The GOSB OU is located southeast of N Area (Central Shops) in relatively flat terrain, approximately 54.86 meters (m) (180 feet [ft]) south of the railroad tracks, which run adjacent to Central Shops. The area surrounding the GOSB OU is wooded with heavy underbrush. It contains no stressed vegetation or other visual indications of contamination. The GOSB was initially used for liquid waste disposal during Savannah River Site (SRS) plant construction (1951-1956) and

[a] Vadose Zone Contaminant Migration Multi-Layered Model (VZCOMML©) Version 4.2, Copyright TXu 1-663-361, 2009, Savannah River Nuclear Services, LLC.

later for receipt of effluent from sanitary wastewater treatment plants in Central Shops. The basin may have received unknown liquid waste from the time of plant construction until the early 1960s. However, there are no records indicating that disposal of radioactive or hazardous materials at the GOSB occurred.

The basin also received effluent from the Central Shops sanitary wastewater treatment plant from 1983 until 1992. Prior to 1983, the basin received effluent from a smaller sanitary wastewater treatment facility. The designation of the basin as an oil seepage basin may be a misnomer, as there is no information available to support the specific use of the basin for management and disposal of waste oils. The basin is currently inactive; however, rainwater is typically retained in the basin.

B-2.2. Screening Methods

This section describes screening methods used for identifying contaminant migration (CM) constituents of potential concern (COPCs) and CM constituents of concern (COCs). The identification of CM COPCs and CM COCs is facilitated by the program VZCOMML© V4.2.

This CM evaluation follows the protocols and guidelines established in the *Environmental Compliance and Area Completion Projects Regulatory Document Handbook* (SRNS 2012). For the Tier I screening, each subunit was modeled under the most conservative assumptions including maximum constituent concentrations at the maximum sample depth (i.e., shortest travel time distance in the vadose zone to water table). Constituents predicted by the model to impact groundwater at concentrations exceeding action levels were retained as Tier I CM COPCs. A less conservative set of assumptions was used for the Tier II analysis to impact groundwater at concentrations exceeding action levels within the evaluation time of 1,000 years.

Both the Tier I and Tier II screens include infinite source mass and limited source mass calculations. In reality, the consideration of an infinite source mass is not reasonable, so the mass-limited calculations (default mass-limited SSLs and SRS site-specific mass-limited SSLs [MLSSL]) $T_{1/2}^{s}$ consider the entire release of the source mass within a 70-year exposure period. This prevents a source mass balance error (i.e., releasing more contaminant mass than actually contained in the source) in the calculation, which is likely with the infinite source scenario.

Equations used to calculate Tier I SSLs and MLSSLs, and Tier II SSL $_{T1/2}^{s}$ and MLSSL $_{T1/2}^{s}$ are provided below in the following Section.

The spreadsheet model VZCOMML© (V.4.2) was developed at SRS to facilitate SSL calculations and Tier I/Tier II soil data screens. VZCOMML© V4.2 simultaneously calculates SSLs for Target Analyte List and Target Compound List constituents, and for specified radionuclides (a total of 219 constituents). VZCOMML© compares user-entered soil concentrations to SSLs and identifies constituents that are Tier I CM COPCs and Tier II CM COCs. Chemical properties of analytes used by VZCOMML© (e.g., soil/water distribution coefficient, Henry's Law constant, etc.) are listed in Table B-1. VZCOMML© also contains assigned hydraulic functions for different types of soil layers (e.g., source layer, soil layer, or engineered barrier layer) and texture classifications (e.g., sand, loamy sand, clay, concrete) within the soil column. VZCOMML© calculates groundwater concentrations and migration times from input data and compares and evaluates user-entered concentrations to SSLs to identify constituents that are CM COPCs and CM COCs.

If CM COCs are identified, it is up to the user to evaluate results and apply professional judgment, other modeling approaches, and/or knowledge of site conditions and geochemistry to further refine the list of CM COCs. The CM refined COCs (RCOCs) include those constituents that are mobile at that waste unit and can leach to the aquifer within a 1,000-year travel time (per the Federal Facilities Agreement protocols) and exceed drinking water standards at a receptor well located adjacent to the edge of the waste unit.

B-2.3. Soil Screening Equations

Equations used by VZCOMML© are consistent with U.S. Environmental Protection Agency (USEPA) Soil Screening Guidance (USEPA 1996, 2000). A conceptual framework of the model and vadose zone and screening parameters for VZCOMML© is provided in Figure B-1. Model assumptions include:

1. A receptor drinking water well at the downgradient edge of the source zone with the well screen located in the plume

2. Linear equilibrium isotherms are used rather than exponential isotherms (this is typically a conservative estimate [i.e., likely transports more contaminant to water table] of partitioning into the aqueous phase of a moving front)

3. Uniformly distributed contamination in the subsurface (this is also typically a conservative estimate using the highest measured concentration value; however, limited soil sampling in an area with widely varying, heterogeneous contaminant distributions may lead to underprediction of localized contaminant transport)

4. Instantaneous equilibrium partitioning within soil, vapor, and liquid phases (this is typically a conservative estimate [i.e., likely transports more contaminant to water table] of partitioning into the aqueous phase of a moving front for compounds that have lower Henry's Law constants)

Generally, the source zone layer thickness represents the vertical extent of contamination. Layer 1 is the source zone and Layers 2 and 3 are the vadose zone beneath the source zone and was used to simulate soil heterogeneity in the soil column. These layers can accommodate different hydraulic functions, soil textures, properties, and layer thicknesses for up to five soil layers. The aquifer layer represents the shallowest water table aquifer. Following is a discussion of the equations used by VZCOMML© for the soil screening process.

B-2.3.1. Dilution Attenuation Factor

The dilution attenuation factor (DAF) represents leachate dilution in the water table aquifer. The DAF calculation assumes that the aquifer is unconfined, unconsolidated, isotropic and homogeneous. The minimum DAF is one, which indicates no dilution occurs in the aquifer. The USEPA recommends a default DAF of 20 for sites up to 0.2 hectares (0.5 acres) whenever site-specific data are not available (USEPA 1996). The DAF (dimensionless) is calculated as follows:

$$DAF = 1 + \frac{K_a \cdot i \cdot d}{I \cdot L}$$

where;

K_a = saturated zone (aquifer) hydraulic conductivity (ft/year)

i = saturated zone (aquifer) hydraulic gradient (ft/ft)

I = infiltration rate through vadose zone (ft/year)

L = length of the source (parallel to groundwater flow) (ft)

d_a = measured saturated zone (aquifer) thickness (ft)

d_i = calculated mixing zone depth (ft)

d = mixing zone depth (minimum of d_i and d_a) (ft)

If the input infiltration rate through the vadose zone is greater than any of the individual vadose zone layer saturated hydraulic conductivities, then the infiltration rate is adjusted to the maximum of the individual vadose zone layer saturated hydraulic conductivities. The mixing zone depth (d) is calculated as follows:

$$d_i = \sqrt{0.0112 \cdot L^2} + d_a\left(1 - e^{\left(-L \cdot I/(K_a \cdot i \cdot d_a)\right)}\right)$$

The d_i calculated value cannot exceed the actual aquifer thickness. Therefore, the mixing zone depth is the minimum of d_i or d_a. This can tend to underpredict localized contaminant concentrations in groundwater by immediately diluting the concentrations over the full aquifer extent when the contaminant reaches groundwater but is adjustable to accommodate mixing or lack thereof.

B-2.3.2. Soil Partitioning

The SSL soil concentration is back-calculated by two methods: 1) SSL (infinite source) and 2) MLSSL (finite source). The Tier I SSL assumes an infinite source and uses a linear equilibrium soil-water partitioning isotherm. The Tier I SSL is calculated for organic contaminants and mercury (with vapor phase) as follows:

$$Tier1SSL = \frac{MCL}{1000} \cdot DAF \cdot \left[K_d + \frac{(\theta_w + \theta_a \cdot H)}{\rho_b}\right]$$

where;

MCL = water-phase concentration limit standard (i.e., MCL or RSL) micrograms per liter (µg/L)

K_d = soil-water partitioning coefficient (L/kilogram [kg])

θ_w = water-filled soil porosity (fraction)

θ_a = air-filled soil porosity (fraction), $\theta_a = n_t - \theta_w$

n_t = total porosity (fraction)

H = Henry's Law constant (dimensionless)

ρ_b = dry soil bulk density (kg/L)

The Tier I SSL equation for inorganic contaminants (without vapor phase) is;

$$Tier1SSL = \frac{MCL}{1000} \times DAF \times \left(K_d + \frac{\theta_w}{\rho_b}\right)$$

And for radionuclides;

$$Tier1SSL = DefaultSSL \times \left(\frac{\lambda t}{1 - e^{(-\lambda t)}}\right)$$

where;

t = time of exposure (USEPA default value of 30 years)

λ = decay rate constant [$\ln(2)/t_{1/2}$ yr^{-1}]

t½ = half-life (years)

For organic constituents, the soil-water partitioning coefficient (K_d) (L/kg) is defined by:

$$K_d = f_{OC} \cdot K_{OC}$$

where;

f_{oc} = soil organic carbon content as mass fraction (fraction)

K_{oc} = organic carbon partitioning coefficient (L/kg)

For metals or radionuclides, the K_d is taken from literature and is dependent on the chemical form that exists and the geochemical environment at each site. Normally, the K_d is derived from laboratory column studies. The water-filled porosity (θ_w) is based on a weighted average for all vadose zone layers and calculated as follows:

$$\theta_w = \sum_{i=1}^{n} \left(\frac{T_{hi}}{T_c}\right) \theta_{wi}$$

where;

T_{hi} = layer *i* vertical thickness (ft)

T_c = total depth of soil column (ft), = (ds + Lv)

L_v = length from the bottom of the source zone to the top of the water table (ft)

θ_{wi} = layer *i* water-filled soil porosity (fraction)

The soil texture is determined for the different layers or soil types observed in the vadose zone, and the soil layer parameters are used to calculate the volumetric water content as follows:

$$\theta_{wi} = n_{ti} \left(\frac{I}{K_{si}}\right)^{\left[\frac{1}{(2b_i+3)}\right]}$$

where;

n_{ti} = layer *i* total porosity (fraction)

K_{si} = layer *i* Clapp and Hornberger "K" parameter based on soil texture (ft/year)

b_i = layer *i* Clapp and Hornberger "b" parameter based on soil texture (dimensionless)

The vadose zone total porosity (n_t, fraction) and vadose zone effective porosity (n_e, fraction) are both based on a weighted average for all vadose zone layers and calculated as follows:

$$n_t = \sum_{i=1}^{n} \left(\frac{T_{hi}}{T_c}\right) \times n_{ti}$$

$$n_e = \sum_{i=1}^{n} \left(\frac{T_{hi}}{T_c}\right) \times n_{ei}$$

where;

n_{ei} = layer *i* effective porosity (fraction)

The effective moisture content θ_e (fraction) is a weighted average for all vadose zone layers as follows;

$$\theta_e = \sum_{i=1}^{n} \left(\frac{T_{hi}}{T_c}\right) \times \theta_{ei}$$

where;

θ_{ei} = layer *i* effective moisture content (fraction)

To solve the mass-balance violations inherent in the infinite source equation, USEPA developed the MLSSL (Tier I, milligram/kilogram [mg/kg]) for organics and metals as follows:

$$Tier1MLSSL = \frac{MCL}{1000} \cdot DAF \cdot \frac{I \times ED}{(\rho_b \times d_s)}$$

where;

ED = exposure duration in years (USEPA default value of 70 years)

ds = average source thickness (ft)

The MLSSL equation for radionuclides is:

$$Tier1MLSSL = DefaultMLSSL \cdot \left(\frac{\lambda t}{1 - e^{(-\lambda t)}}\right)$$

B-2.3.3. Mean Travel Time

The mean travel time (T_{Mean} or T_t, years) through the vadose zone layers below the source is calculated in VZCOMML© as follows:

$$T_{Mean} = \frac{L_v \cdot R}{V_s}$$

The retardation coefficient (R, dimensionless) is calculated as:

$$R = 1 + \frac{(K_d \cdot \rho_\beta)}{\theta_e}$$

The mean pore water velocity in the vadose zone (V_s, ft/year) is a weighted average calculated by:

$$V_s = \sum_{i=1}^{n} \left(\frac{T_{ti}}{T_t}\right) \cdot V_{si}$$

where;

V_{si} = layer *i* mean pore water velocity (ft/year)

T_{ti} = layer *i* mean travel time (years)

T_t = Travel Time (years)

By applying Darcy's Law in the unsaturated zone and assuming steady-state conditions;

$$V_{si} = \frac{\mathrm{I}}{\theta_{wi}}$$

Darcy's Law is not applicable to unstable vadose zone flow, which typically exhibits fingering and other nonlinear behavior, however over most areas this method will typically be a conservative one (i.e., likely transports more contaminant on average to the water table) assuming appropriate hydraulic conductivity values are selected. One pitfall is that preferential pathways are not uncommon and can rapidly transport water (and contaminant) faster than Darcy derived flow in small, localized areas.

B-2.3.4. Incorporating Decay

To account for the radioactive decay, chemical degradation, hydrolysis, or biodegradation of constituents and for redistribution of mass in the vadose zone, the Tier I SSLs and Tier I MLSSLs are adjusted using first-order equations in the Tier II SSL $_{T1/2}$ and Tier II MLSSL$_{T1/2}$ as follows:

$$TierIISSL_{T1/2} = \left(\frac{TierISSL}{e^{(-\lambda T_{mean})}}\right) \cdot \left(\frac{T_c}{d_s}\right)$$

$$TierIIMLSSL_{T1/2} = \frac{TierIMLSSL}{e^{(-\lambda ED)}}$$

A half-life for a chemical compound is largely determined from literature sources. Because there is usually variability of the reported half-life of a chemical compound (e.g., aerobic and anaerobic rates), the most conservative (longest) half-life is selected as the rate constant in the equations. The rate constants used in the VZCOMML© model are primarily derived from the publications of P. H. Howard, et al and D. McKay, et al, but other references were also used such as USEPA's Estimation Program Interface Suite software and USEPA's Human Health Risk Assessment Parameters database.

VZCOMML© assumes equilibration, mass redistribution, and conservation of mass in the source zone between phases (i.e., volatilized, dissolved, or sorbed) and throughout the entire vadose zone volume. This results in 'more realistic' SSLs, which accounts for vadose zone thickness, travel time, and chemical behavior in the subsurface.

The VZCOMML© screening decision logic for a constituent 'fails' if; 1) the mean travel time (TMean) through the vadose zone is less than 1,000 years, and 2) the source concentration exceeds the Tier II MLSSL and 3) the groundwater concentration exceeds an action level (i.e., the calculated concentration in groundwater would exceed the regulatory limit; MCLs or RSLs). In this case, the constituent would be retained as a CM COC and subject to further CM COC refinement steps.

B-2.3.5. Saturation Concentration

For organic (non-radioactive) constituents, the saturation concentration (C_{sat}) (mg/kg) is calculated from the solubility constant in water (S) (mg/L) as follows:

$$C_{sat=}\frac{S}{\rho_b}\cdot(K_d+\rho_b+\theta_w+H\cdot\theta_a)$$

The C_{sat} is a theoretical concentration that represents a pure non-aqueous phase liquid (NAPL) or solid threshold concentration in soil. The C_{sat} is compared to the detected concentration to predict if a NAPL phase compound is present in the soil.

B-2.3.6. Groundwater Concentration

The concentration of constituents in groundwater in the water table aquifer is directly calculated by VZCOMML© for comparison to groundwater regulatory limits. The groundwater concentration (C_{gw}, µg/L) is calculated as follows (Rucker 2011):

For organic contaminants (including mercury with vapor phase);

$$C_{gw}=\frac{\left(\frac{C_t\cdot 1000}{DAF}\right)\times e^{(-\lambda T_{Mean})}}{\left(K_d+\frac{(\theta_w+H\cdot\theta_a)}{\rho_b}\right)\times\left(\frac{\lambda t}{1-e^{(-\lambda t)}}\right)}\cdot\left(\frac{d_s}{T_c}\right)$$

where;

T_c = Thickness of soil column (ft)

For inorganic contaminants (including metals [note: metals use an infinite half-life] and radionuclides and excluding mercury with vapor phase);

$$C_{gw}=\frac{\left(\frac{C_t\cdot 1000}{DAF}\right)\cdot e^{(-\lambda T_{Mean})}}{\left(K_d+\frac{\theta_w}{\rho_b}\right)\cdot\left(\frac{\lambda t}{1-e^{(-\lambda t)}}\right)}\cdot\left(\frac{d_s}{T_c}\right)$$

VZCOMML© assumes equilibration, redistribution, and conservation of mass of the source between phases (i.e., volatilized, dissolved, or sorbed) and distribution throughout the entire vadose zone volume. The concentration of constituents in groundwater in the water table aquifer is directly calculated by VZCOMML© for comparison to groundwater regulatory limits or standards.

B-2.4. G-Area Oil Seepage Basin Modeling Parameters

Vadose zone contaminant migration simulations are presented in this section, using the VZCOMML© spreadsheet, for the four GOSB subunits. The vadose zone at the various GOSB subunits was modeled as a three-layer system based on the 2017 soil boring program:

- Layer 1 is the source layer, consisting of silty clay
- Layer 2 is also a silty clay and extends down to 6.1 m (20 ft) below ground surface (bgs)
- Layer 3 is a sandy clay loam, which extends from the base of Layer 2 down to the water table

These steps are used to perform the CM analysis, for each subunit:

1. Analytical soil data are compiled and evaluated. The data are processed to purge all quality assurance data and rejected (R qualified) data. The data were further processed to select the maximum detected concentration for each analyte.

2. A conceptual site model is developed for the waste unit, which includes depth of contamination (source zone; Layer 1), vadose zone thickness below the source (Layer 2/3), and assigned values for several hydrogeological parameters.

3. VZCOMML© Tier I screening is performed, using two conservative assumptions: a) for each analyte, the maximum detected soil concentration is used to represent the soil concentration (C_t), and b) the thickness of the source zone is assumed to be equal to the depth of the deepest available soil sample. ~~Analytes predicted to impact groundwater at concentrations exceeding action levels, under the conservative conditions simulated, are retained as Tier I CM COPCs.~~

An analyte was retained as a Tier I CM COPC if the source zone concentration was greater than both the Tier I Source-Specific SSL and the Tier I MLSSL.

4. VZCOMML© Tier II Simulation 1 is run, using two conservative assumptions: (a) for each analyte, the maximum detected soil concentration is used to represent the soil concentration (C_t), and (b) the thickness of the source zone is assumed to be equal to the depth of the deepest available soil sample. Analytes predicted to impact groundwater at concentrations exceeding action levels within the evaluation time of 1,000 years, under the conservative conditions simulated, are retained as Tier II CM COPCs. Action levels refer to the Tier II $SSL_{T/12}$, the Tier II $MLSSL_{T1/2}$, and either the May 2016 USEPA MCL or Tapwater Standard. For an analyte to be retained as a Tier II CM COPC in VZCOMML©, the "predicted concentration in aquifer" must be greater than all 3 action levels and the analyte must have a mean travel time of less than 1,000 years.

5. Additional simulations are performed for any Tier II CM COPCs retained from Step 4. These simulations represent more realistic conditions than the maximally conservative Simulation 1. For example, an estimate of the mean analyte concentration may be used, rather than the maximum concentration; or the actual depth of the maximum concentration may be used for Layer 1, rather than the depth of the deepest sample. Analytes predicted to adversely impact groundwater under the more realistic simulations are retained as CM COCs.

6. CM COCs are evaluated further, using additional lines of inquiry. After evaluation, retained analytes are called refined COCs, or CM RCOCs.

7. Screening-level CM remedial goal options (RGOs) are calculated for each CM RCOC (generally, the CM RGO is the highest Tier II SSL concentration).

For the Tier I screening, as well as the first Tier II simulation, the thickness of Layer 1 is assumed to be the maximum depth of available data, which is typically highly conservative. This was a different depth for each subunit. If any constituents fail the initial Tier II simulation, additional simulations will be run with less conservative but more realistic parameters.

Table B-1 presents chemical and nuclear property parameters for each evaluated analyte. These parameters include organic carbon partitioning coefficient, soil-water partitioning coefficient, half-life (biological degradation for organics; radioactive decay for radiologicals), Henry's Law constant, solubility, and regulatory action level. In addition to chemical parameters, several physical parameters are also employed in CM simulations. Since the geologic environment of all evaluated subunits is similar, many physical parameters were used for all subunits. These are presented in Table B-2. In contrast to global parameters listed in Table B-2, physical parameters, which are specific to certain subunits and refined simulations are presented in Table B-3.

B-2.5. Results of the Tier I and Tier II Analyses

In this section, results of the Tier I and Tier II screening are presented for each of the four GOSB subunits. Certain constituents did not undergo SSL calculations. These constituents included compounds, which lack both MCLs and USEPA RSLs (e.g., phenanthrene), constituents that are essential nutrients (e.g. calcium), and radiological progeny of radium-226 and radium-228 (the radium MCL takes risk due to progeny into account). These analytes did not undergo CM COC evaluation, and were listed as "NA" in Tables B-4, B-6, B-8, and B-10. However, travel times and groundwater concentrations were predicted for the compounds, which lack MCLs/RSLs.

B-2.5.1. G-Area Oil Seepage Basin Interior Subunit

Although the basin no longer receives discharge from any industrial activity, rainwater continues to accumulate within the basin. Sediment in the basin is covered with approximately 20.3 cm (8 in) of leaf debris and decayed organic material. Sandy clay underlies the decayed organic material.

B-2.5.1.1 Tier I Analysis

The Tier I screening was performed with a 1.2 m (4 ft) source layer (Layer 1), corresponding to the depth of the deepest available soil sample. The water table was modeled at 5.5 m (18 ft) bgs, leading to a Layer 3 thickness of 4.3 m (14 ft). In this simulation, due to the fact the basin itself lies approximately 4.9 m (16 ft) bgs, Layer 2 did not exist. The source zone (Layer 1) extended down to Layer 3, the sandy clay loam. The Tier I analysis identified eleven constituents as CM COPCs: benzo[a]anthracene, benzo[b]fluoranthene, aldrin, dieldrin, heptachlor epoxide,

dichlorodiphenyldichloroethane (DDD), dichlorodiphenyldichloroethylene (DDE), cobalt, silver, thallium, and potassium-40 (Table B-4).

B-2.5.1.2 Tier II Analysis

The eleven constituents, which failed Tier I screening, were evaluated in a Tier II simulation. No GOSB Interior Subunit constituents were identified as Tier II CM COPCs (Table B-5).

B-2.5.2. G-Area Oil Seepage Basin Berm Subunit

The GOSB Berm Subunit is highest on the north side at approximately 0.91 m (3 ft); the southern side is approximately 0.61 m (2 ft) high. The remaining two sides are even with the surrounding grade.

B-2.5.2.1 Tier I Analysis

The Tier I screening was performed with a 2.1 m (7 ft) source layer (Layer 1), corresponding to the depth of the deepest available soil sample. The GOSB Berm Subunit rises approximately 0.9 m (3 ft) above ground surface, and the deepest soil sample was collected at 3 m (10 ft); therefore, the source layer was set at 2.1 m (7 ft). The water table was modeled at 10.4 m (34 ft) bgs, leading to a Layer 2 thickness of 4 m (13 ft) and Layer 3 thickness of 4.3 m (14 ft). The Tier I analysis identified eleven constituents as CM COPCs: benzo[a]anthracene, benzo[b]fluoranthene, dieldrin, DDD, DDE, Aroclor 1254, Aroclor 1260, arsenic, iron, lead, and potassium-40 (Table B-6).

B-2.5.2.2 Tier II Analysis

The eleven constituents, which failed Tier I screening were evaluated in a Tier II simulation. No GOSB Berm Subunit constituents were identified as Tier II CM COPCs (Table B-7).

B-2.5.3. Pipeline Subunit

The pipeline subunit includes approximately 57.9 m (190 ft) of abandoned pipeline at the northeast (inlet) of the basin and approximately 155.4 m (510 ft) of pipeline at the southeast (outlet) end of

the basin. Both inlet and outlet pipes are buried to a depth of approximately 1.8 to 2.4 m (6 to 8 ft) bgs.

B-2.5.3.1 Tier I Analysis

The Tier I screening was performed with a 3 m (10 ft) source layer (Layer 1), corresponding to the depth of the deepest available soil sample. The water table was modeled at 10.4 m (34 ft) bgs, leading to a Layer 2 thickness of 3 m (10 ft) and Layer 3 thickness of 4.3 m (14 ft). The Tier I analysis identified three constituents as CM COPCs: arsenic, iron, and potassium-40 (Table B-8).

B-2.5.3.2 Tier II Analysis

The three constituents, which failed Tier I screening were evaluated in a Tier II simulation. No Pipeline Subunit constituents were identified as Tier II CM COPCs (Table B-9).

B-2.5.4. Effluent Discharge Subunit

The Effluent Discharge Subunit lies southeast of the basin approximately 30.5 m (100 ft) from the outlet pipe. An intermittent stream conveys drainage from the surrounding topography, including basin discharge, to an unnamed tributary of Pen Branch approximately 914.4 m (3,000 ft) southeast of the basin.

B-2.5.4.1 Tier I Analysis

The Tier I screening was performed with a 3 m (10 ft) source layer (Layer 1), corresponding to the depth of the deepest available soil sample. The water table was modeled at 10.4 m (34 ft) bgs, leading to a Layer 2 thickness of 3 m (10 ft) and Layer 3 thickness of 4.3 m (14 ft). The Tier I analysis identified thirteen constituents as CM COPCs: DDE, Aroclor 1242, Aroclor 1254, Aroclor 1260, arsenic, cobalt, iron, manganese, potassium-40, radium-226, radium-228, thorium-230, and thorium-232 (Table B-10).

B-2.5.4.2 Tier II Analysis

The thirteen constituents that failed Tier I screening were evaluated in a Tier II simulation. No Effluent Discharge Subunit constituents were identified as Tier II CM COPCs (Table B-11).

B-2.6. Uncertainty Discussion

Certain assumptions are a part of VZCOMML©, including linear equilibrium, a uniformly distributed contamination in the subsurface, Darcy's Law to predict groundwater flow through the vadose zone, and instantaneous equilibrium of the system in regards to adsorption. These assumptions generally cause the model to overpredict contaminant moving through the vadose zone. However, it is important to note that small, localized but significant departures from average values as a result of heterogeneity can lead to localized underprediction of contaminant transport in some situations. Assuming a relatively large area, and long distance and time to allow mixing of groundwater before encountering potential receptors, such as at GOSB, will tend to minimize small underpredictions of contaminant transport.

In an effort to address potential uncertainties related to the VZCOMML modeling results, groundwater samples were taken upgradient, sidegradient and downgradient of the GOSB as an additional line of evidence to verify/corroborate the modeling predictions. As discussed in detail in Chapter 3, the 2016-2017 sampling campaign included groundwater sampling at eight temporary 2-inch diameter piezometers. These temporary wells were sampled and analyzed for inorganics (metals), pesticides, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semivolatile organic compound (SVOCs), and radiological indicators. The inorganic (metals) samples were also filtered to address potential turbidity issues that may be associated with the unfiltered sample results.

The maximum detected concentration of each analyte in groundwater was compared to the drinking water maximum contaminant level (MCL). In the absence of the MCL, the tapwater regional screening level (RSL) was used as a screening threshold. Table B-13 identifies cobalt and pentachlorophenol as the only constituents that exceed the screening criteria. Groundwater sampling locations and constituent exceedances are shown in Figure B-2.

Cobalt was detected in an unfiltered sample from location GOSB-60 at a concentration of 7.12 ug/L, which is higher than the tapwater RSL of 6.0 ug/L. The filtered sample had a concentration of 5.74 ug/L. It was detected in 9 of 13 samples. No other groundwater samples, either unfiltered or filtered, exceed the RSL for cobalt. There is not a MCL for cobalt.

Cobalt is a naturally occurring constituent that is common in geologic material. The maximum detected concentration in soil (and sediment) from all GOSB OU subunits, all depths, is 3.96 mg/kg (Table A.5.1). The maximum detected concentration in SRS background soils is 5.04 mg/kg (WSRC 2006). GOSB OU concentrations in soil and sediment are within (i.e., lower than) SRS background soils.

As shown on Figure 2-7 from Chapter 2 and Figure B-2, the groundwater flow direction is locally from northwest to southeast and the well location of the cobalt exceedance at GOSB-60 is upgradient from the GOSB OU.

Pentachlorophenol was detected in an unfiltered sample from location GOSB-70 at a concentration of 13.9 ug/L, which is higher than the MCL of 1 ug/L. This result is an estimated value (J-qualified), and is the only detection in groundwater. It was not detected in any other samples associated with the GOSB OU (includes all soil, sediment, surface water and groundwater data).

As shown on Figure 2-7 from Chapter 2 and Figure B-2, the groundwater flow direction is locally from northwest to southeast and the well location of the single exceedance at GOSB-70 is sidegradient to the GOSB OU.

These lines of evidence indicate that the threshold exceedances of cobalt and pentachlorophenol in groundwater are not attributable to the GOSB OU. No other constituent concentrations exceed screening thresholds. Based on this evaluation of the groundwater sampling results, it can be concluded that the GOSB OU is not a source of groundwater contamination in the area.

B-2.7. Conclusions

This contaminant migration analysis performed using VZCOMML© revealed no soil contaminants in the vadose zone with the potential to migrate to groundwater and exceed groundwater action

levels within 1,000 years. No constituents qualified as CM RCOCs for any of the four subunits (Table B-12). Since no CM RCOCs were identified for any subunit, CM RGOs calculations were not required. This analysis complements the finding of the 2016-2017 groundwater sampling campaign at GOSB OU that the GOSB OU is not a source of groundwater contamination.

B-3. REFERENCES

Rucker, Gregory G., 2011. *Soil Contaminant Migration Screen Software Calculation Check (U) for VZCOMML© v.4.0*, Q-CLC-G-00089, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

SRNS, 2012. *Environmental Compliance and Area Completion Projects Regulatory Document Handbook,* ERD-AG-003, Revision 17, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USEPA, 1996. *Soil Screening Guidance: Technical Background Document*, EPA/540/R95/128, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC

USEPA, 2000. *Soil Screening Guidance for Radionuclides*, Technical Background Document, EPA/540-R-00-006, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC

WSRC, 2006. *Background Soils Statistical Summary Report for the Savannah River Site*, ERD-EN-2005-0223, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

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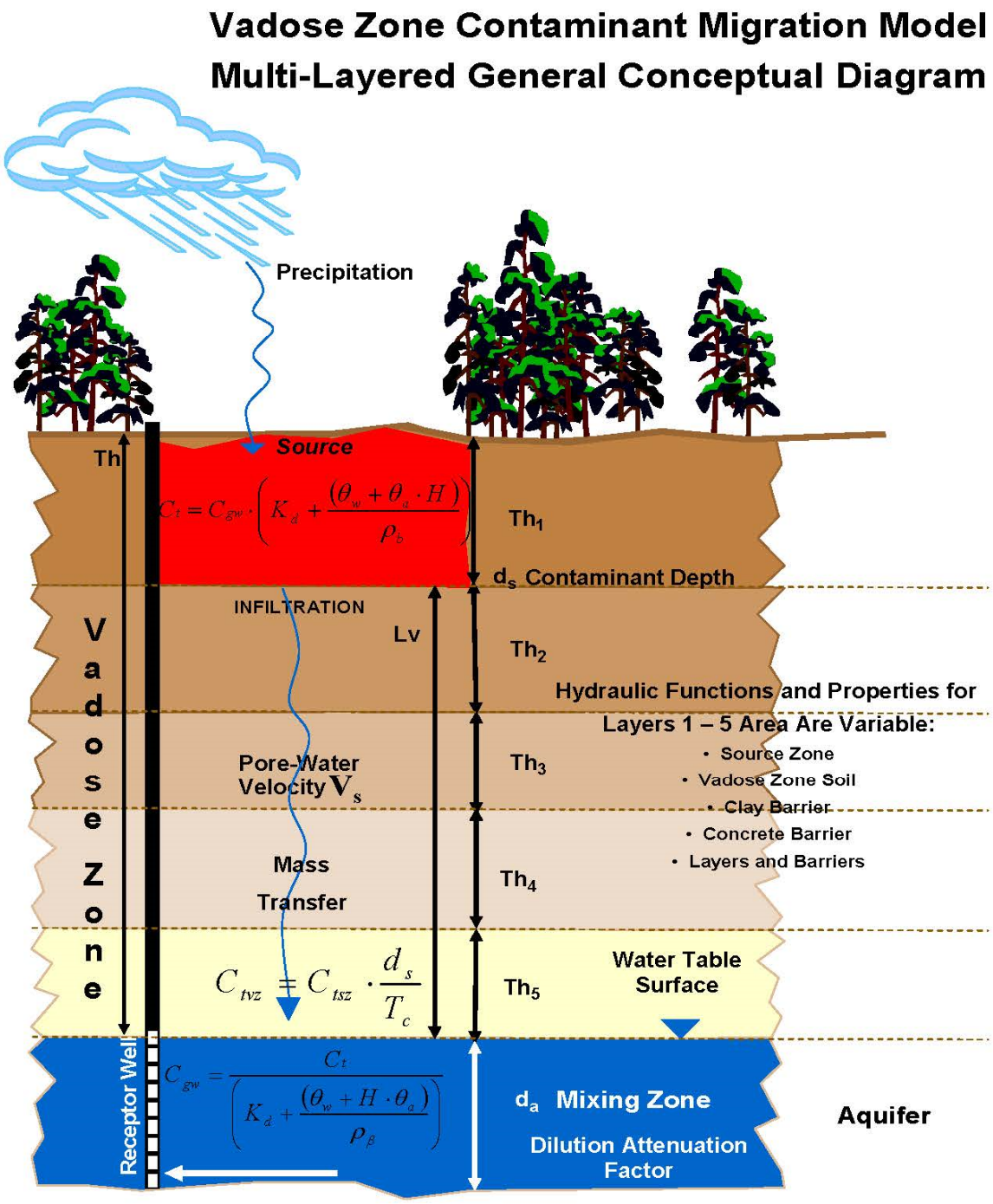

Figure B-1. VZCOMML© Contamination Migration Conceptual Diagram

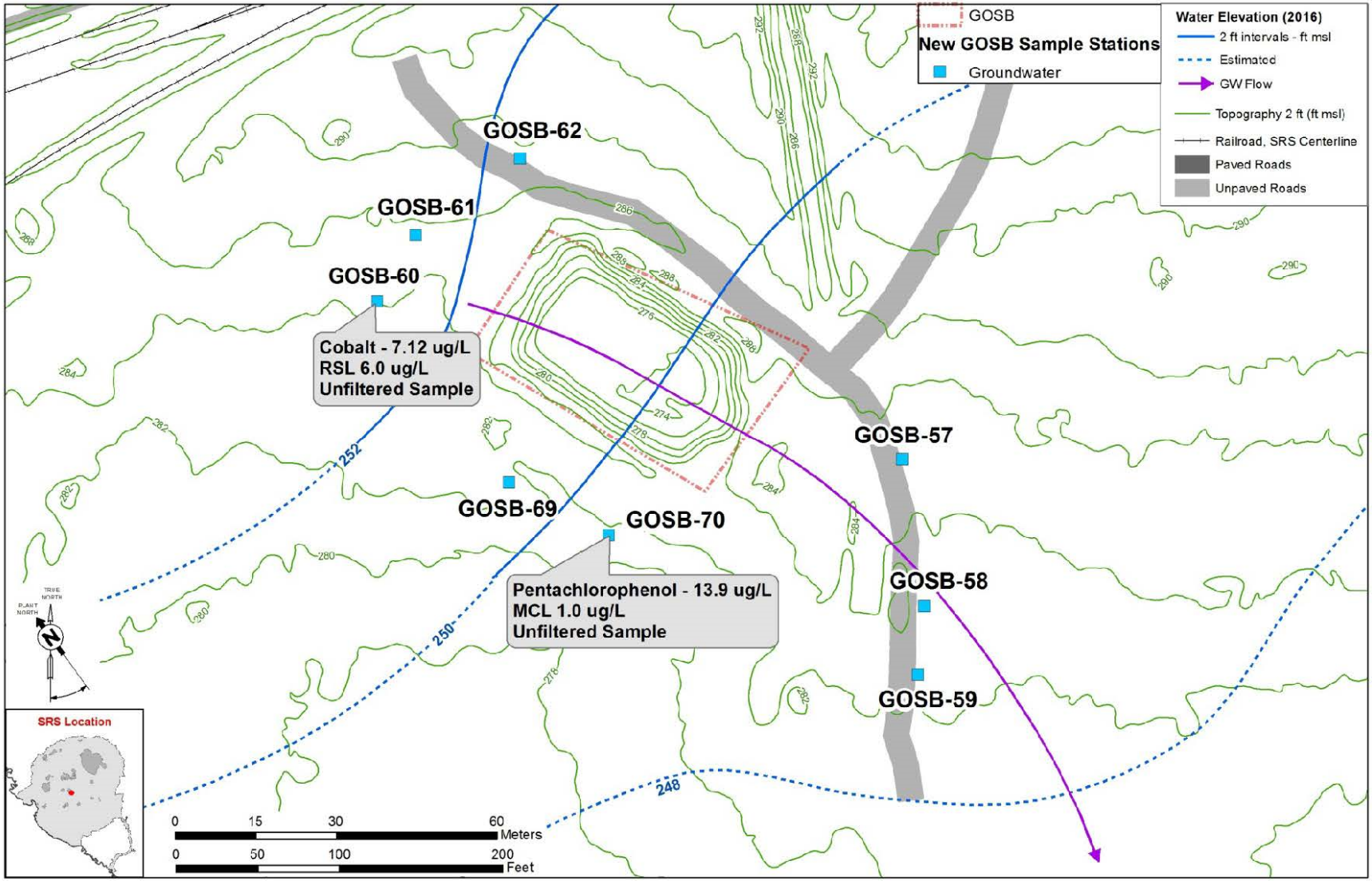

Figure B-2. GOSB Basin Interior Groundwater MCL/RSL Exceedances

Table B-1. Chemical Parameters Used for Screening

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Acetone	2.20E+00	4.40E-04	1.00E+01	1.59E-03	1.00E+06	1.40E+04
Benzene	6.17E+01	1.23E-02	1.00E+01	2.28E-01	1.75E+03	5.00E+00
Carbon disulfide	5.40E+01	1.08E-02	1.00E+01	1.24E+00	1.19E+03	8.10E+02
Chlorobenzene	2.24E+02	4.48E-02	1.00E+01	1.52E-01	4.72E+02	1.00E+02
Chloroform	5.25E+01	1.05E-02	1.00E+01	1.50E-01	7.92E+03	8.00E+01
Chloromethane (Methyl chloride)	5.50E+00	1.10E-03	1.00E+01	4.06E-01	6.50E+03	1.90E+02
Ethylbenzene	2.04E+02	4.08E-02	1.00E+01	3.23E-01	1.69E+02	7.00E+02
Isopropylbenzene (Cumene)	4.54E+02	9.08E-02	1.00E+01	4.92E+01	6.10E+01	4.50E+02
Methyl Acetate	2.20E+00	4.40E-04	1.00E+01	8.40E-04	2.50E+05	2.00E+04
Methyl ethyl ketone (2-Butanone)	4.51E+00	9.02E-04	1.00E+01	2.10E-03	2.68E+05	5.60E+03
Methylcyclohexane	6.07E+03	1.21E+00	1.00E+01	1.76E+03	1.40E+01	NA
Styrene	9.12E+02	1.82E-01	1.00E+01	1.13E-01	3.10E+02	1.00E+02
Toluene	2.34E+02	4.68E-02	1.00E+01	2.72E-01	5.26E+02	1.00E+03
1,2-Dichlorobenzene	3.79E+02	7.58E-02	1.00E+01	7.79E-02	1.56E+02	6.00E+02
1,3-Dichlorobenzene	1.70E+03	3.40E-01	1.00E+01	1.48E-01	1.33E+02	NA
1,4-Dichlorobenzene	6.16E+02	1.23E-01	1.00E+01	6.56E-02	7.38E+01	7.50E+01
2-Methylnaphthalene	7.94E+03	1.59E+00	1.00E+01	1.36E-02	2.54E+01	3.60E+01

Table B-1. Chemical Parameters Used for Screening (Continued)

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Acenaphthene	4.90E+03	9.80E-01	1.00E+01	6.36E-03	4.24E+00	5.30E+02
Anthracene	2.35E+04	4.70E+00	1.00E+01	2.67E-03	4.34E-02	1.80E+03
Benzo(a)anthracene	3.58E+05	7.16E+01	1.00E+01	1.37E-04	9.40E-03	1.20E-02
Benzo(a)pyrene	9.69E+05	1.94E+02	1.00E+01	4.63E-05	1.62E-03	2.00E-01
Benzo(b)fluoranthene	1.23E+06	2.46E+02	1.00E+01	4.55E-03	1.50E-03	3.40E-02
Benzo(g,h,i)perylene	1.60E+06	3.20E+02	1.00E+01	5.13E-06	3.00E-04	NA
Benzo(k)fluoranthene	1.23E+06	2.46E+02	1.00E+01	3.40E-05	8.00E-04	3.40E-01
Bis(2-ethylhexyl) phthalate	1.11E+05	2.22E+01	1.00E+01	4.18E-06	3.40E-01	6.00E+00
Caprolactam	5.74E+01	1.15E-02	1.00E+01	1.08E-08	7.72E+05	9.90E+03
Carbazole	3.39E+03	6.78E-01	1.00E+01	6.26E-07	1.80E+00	NA
Chrysene	3.98E+05	7.96E+01	1.00E+01	3.88E-03	1.60E-03	3.40E+00
Fluoranthene	4.90E+04	9.80E+00	1.00E+01	6.60E-04	2.06E-01	8.00E+02
Fluorene	7.71E+03	1.54E+00	1.00E+01	2.61E-03	1.98E+00	2.90E+02
Indeno(1,2,3-c,d)pyrene	3.74E+06	7.48E+02	1.00E+01	6.56E-05	2.20E-05	3.40E-02
Phenanthrene	1.40E+04	2.80E+00	1.00E+01	1.60E-03	1.29E+00	NA
Pyrene	6.80E+04	1.36E+01	1.00E+01	4.51E-04	1.35E-01	1.20E+02

Table B-1. Chemical Parameters Used for Screening (Continued)

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Aldrin	4.87E+04	9.74E+00	1.00E+01	6.97E-03	1.80E-01	9.20E-04
alpha-Benzene hexachloride	1.76E+03	3.52E-01	1.00E+01	2.38E-04	1.63E+00	NA
alpha-Chlordane	5.13E+04	1.03E+01	1.00E+01	1.99E-03	5.60E-02	NA
beta-Benzene hexachloride	2.14E+03	4.28E-01	1.00E+01	1.83E-05	2.40E-01	NA
Dieldrin	2.55E+04	5.10E+00	1.00E+01	6.19E-04	1.95E-01	1.80E-03
Endrin	1.08E+04	2.16E+00	1.08E+04	3.08E-04	2.50E-01	2.00E+00
Endrin ketone	NA	NA	NA	NA	NA	NA
Heptachlor	9.53E+03	1.91E+00	1.00E+01	6.07E+01	1.80E-01	4.00E-01
Heptachlor epoxide	8.32E+04	1.66E+01	1.00E+01	3.90E-04	2.00E-01	2.00E-01
p,p'-DDD	4.58E+04	9.16E+00	1.56E+01	1.64E-04	9.00E-02	3.20E-02
p,p'-DDE	8.64E+04	1.73E+01	1.56E+01	8.61E-04	1.20E-01	4.60E-02
p,p'-DDT	6.78E+05	1.36E+02	1.56E+01	3.32E-04	2.50E-02	2.30E-01
PCB 1242	3.09E+05	6.18E+01	3.42E+04	9.02E-03	2.40E-01	7.80E-03
PCB 1254	3.09E+05	6.18E+01	3.42E+04	8.20E-03	4.10E-02	7.80E-03
PCB 1260	3.09E+05	6.18E+01	3.42E+04	1.03E-02	1.44E-02	7.80E-03
Aluminum	NA	1.50E+03	Infinite	None	None	2.00E+04
Antimony (metallic)	NA	4.00E+03	Infinite	None	None	6.00E+00

Table B-1. Chemical Parameters Used for Screening (Continued)

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Arsenic, Inorganic	NA	3.90E+01	Infinite	None	None	1.00E+01
Barium	NA	4.10E+01	Infinite	None	None	2.00E+03
Beryllium and compounds	NA	7.90E+02	Infinite	None	None	4.00E+00
Cadmium	NA	7.50E+01	Infinite	None	None	5.00E+00
Calcium	NA	5.00E+00	Infinite	None	None	NA
Chromium, Total	NA	1.80E+06	Infinite	None	None	1.00E+02
Cobalt	NA	1.00E+01	Infinite	None	None	6.00E+00
Copper, Total	NA	2.50E+01	Infinite	None	None	1.30E+03
Cyanide (CN-)	NA	9.90E+00	Infinite	None	None	2.00E+02
Iron	NA	2.20E+02	Infinite	None	None	1.40E+04
Lead and compounds	NA	2.70E+02	Infinite	None	None	1.50E+01
Magnesium	NA	No Kd available	Infinite	None	None	NA
Manganese	NA	5.00E+01	Infinite	None	None	4.30E+02
Mercury (elemental)	NA	5.20E+01	Infinite	None	None	2.00E+00
Nickel Soluble Salts	NA	6.50E+01	Infinite	None	None	3.90E+02
Potassium	NA	5.50E+01	Infinite	None	None	NA

Table B-1. Chemical Parameters Used for Screening (Continued)

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Selenium	NA	5.50E+01	Infinite	None	None	5.00E+01
Silver	NA	9.00E+01	Infinite	None	None	9.40E+01
Sodium, total recoverable	NA	No Kd available	Infinite	None	None	NA
Thallium Soluble Salts	NA	7.10E+01	Infinite	None	None	2.00E+00
Vanadium, total recoverable	NA	1.00E+03	Infinite	None	None	8.60E+01
Zinc (metallic)	NA	6.20E+01	Infinite	None	None	6.00E+03
Actinium-228	NA	4.50E+02	7.00E-04	None	None	2.40E+01
Cesium-137	NA	5.00E+02	3.02E+01	None	None	1.20E+00
Lead-212	NA	2.70E+02	1.20E-03	None	None	1.80E+00
Potassium-40	NA	7.50E+01	1.28E+09	None	None	8.30E-01
Radium-226	NA	1.00E+02	1.60E+03	None	None	4.40E-04
Radium-228	NA	1.00E+02	5.75E+00	None	None	4.00E-02
Thorium-228	NA	1.00E+02	1.91E+00	None	None	4.10E-01
Thorium-230	NA	1.00E+02	7.70E+04	None	None	3.80E-01
Thorium-232	NA	1.00E+02	1.41E+10	None	None	3.40E-01

Table B-1. Chemical Parameters Used for Screening (Continued/End)

Analyte	K_{oc}	K_d	Half-life	H	Solubility	Standard
	(L/kg)		(yr-1)	(-)	(mg/L)	(µg/L or pCi/L)
Uranium-233/234	NA	4.50E+02	2.45E+05	None	None	4.70E-01
Uranium-235	NA	4.50E+02	7.04E+08	None	None	4.80E-01
Uranium-238	NA	4.50E+02	4.47E+09	None	None	5.30E-01

Table B-2. Physical Parameters Used for Screening

Parameter	Symbol	Value	Units	Reference
Aquifer saturated horizontal hydraulic conductivity	K_a	16,425	ft/y	WSRC, 2000c
Horizontal hydraulic gradient	i	0.006	ft/ft	Estimated from potentiometric surface
Soil classification	NA	Sandy clay loam	NA	Estimated from lithology
Total porosity	n_r	0.39	Decimal fraction	NUREG, 1999
Effective porosity	n_e	0.289	Decimal fraction	NUREG, 1999
Saturated vertical hydraulic conductivity	K_s	131	ft/y	Rucker, 2009
Exposure duration	ED	70	y	USEPA, 2000
Evaluation time	T_e	1,000	y	WSRC, 1998
Dry bulk density	ρ_b	1.7	kg/L	Rucker, 2009
Fraction organic carbon	f_{oc}	0.0002	Decimal fraction	Rucker, 2009

Table B-3. Subunit-Specific Model Parameters

Subunit	Simulation	Depth to Water (ft bgs)	Source Layer Thickness (ft)	Layer 1 Thickness (ft)	Layer 2 Thickness (ft)	Source Length (ft)	Infiltration Rate (in./y)	Aquifer Thickness (ft)	Dilution Attenuation Factor	Table(s)
GOSB Interior	Tier1*	18	4	0	14	122	10	66	14.56	4,5
GOSB Berm	Tier 1*	34	7	13	14	200	10	66	14.55	6,7
Pipeline	Tier 1*	34	10	10	14	712	12	66	10.14	8,9
Effluent Discharge	Tier 1*	34	10	10	14	172	16	66	9.82	10,11

*Also includes the Tier 2 Simulation 1, employing the same set of parameters.

Table B-4. Tier I Screening Results for the GOSB Interior Subunit

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Acetone	3.24E-02	3.54E+01	1.74E+03	
Carbon disulfide	3.34E-03	2.93E+00	1.01E+02	
Chlorobenzene	2.18E-02	3.29E-01	1.24E+01	
Chloroform	8.74E-04	2.23E-01	9.95E+00	
Ethylbenzene	5.10E-04	2.35E+00	8.71E+01	
Isopropylbenzene (Cumene)	4.00E-04	1.85E+01	5.60E+01	
Methyl ethyl ketone (2-Butanone)	3.60E-03	1.42E+01	6.97E+02	
Methylcyclohexane	4.40E-04	NA	NA	NA
Toluene	1.32E-03	3.41E+00	1.24E+02	
1,2-Dichlorobenzene	5.92E-04	2.21E+00	7.46E+01	
1,3-Dichlorobenzene	8.42E-03	NA	NA	NA
1,4-Dichlorobenzene	3.44E-02	3.28E-01	9.33E+00	
2-Methylnaphthalene	2.58E+00	9.23E-01	4.48E+00	
Anthracene	1.85E-02	1.28E+02	2.24E+02	
Benzo(a)anthracene	1.95E-01	1.25E-02	1.49E-03	Benzo(a)anthracene
Benzo(a)pyrene	1.38E-01	5.65E-01	2.49E-02	
Benzo(b)fluoranthene	2.47E-01	1.22E-01	4.23E-03	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	6.70E-02	NA	NA	NA
Caprolactam	1.42E+01	2.66E+01	1.23E+03	
Chrysene	1.67E-01	3.95E+00	4.23E-01	

Table B-4. Tier I Screening Results for the GOSB Interior Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Fluoranthene	9.93E-01	1.16E+02	9.95E+01	
Fluorene	1.59E+00	7.24E+00	3.61E+01	
Indeno(1,2,3-c,d)pyrene	6.47E-02	3.70E-01	4.23E-03	
Phenanthrene	3.91E+00	NA	NA	NA
Pyrene	6.83E-01	2.41E+01	1.49E+01	
Aldrin	1.49E-02	1.33E-04	1.14E-04	Aldrin
alpha-Chlordane	7.32E+00	NA	NA	NA
Dieldrin	5.00E-01	1.38E-04	2.24E-04	Dieldrin
Heptachlor	8.97E-03	3.05E-02	4.98E-02	
Heptachlor epoxide	9.45E-01	4.90E-02	2.49E-02	Heptachlor epoxide
p,p'-DDD	1.80E+00	4.35E-03	3.98E-03	p,p'-DDD
p,p'-DDE	4.50E+00	1.17E-02	5.72E-03	p,p'-DDE
p,p'-DDT	3.83E-02	4.55E-01	2.86E-02	
Aluminum	5.72E+03	4.37E+05	2.49E+03	
Antimony (metallic)	2.93E+00	3.49E+02	7.46E-01	
Arsenic, Inorganic	2.90E+00	5.70E+00	1.24E+00	
Barium	9.20E+01	1.20E+03	2.49E+02	
Cadmium	4.19E+00	5.47E+00	6.22E-01	
Calcium	1.57E+04	NA	NA	NA

Table B-4. Tier I Screening Results for the GOSB Interior Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Chromium, Total	5.12E+01	2.62E+06	1.24E+01	
Cobalt	2.98E+00	8.89E-01	7.46E-01	Cobalt
Copper, Total	4.81E+01	4.76E+02	1.62E+02	
Cyanide (CN-)	8.10E-01	2.93E+01	2.49E+01	
Iron	9.07E+03	4.49E+04	1.74E+03	
Lead and compounds	5.20E+01	5.90E+01	1.87E+00	
Magnesium	3.68E+02	NA	NA	NA
Manganese	5.57E+01	3.14E+02	5.35E+01	
Mercury (elemental)	5.78E-01	1.52E+00	2.49E-01	
Nickel Soluble Salts	2.49E+01	3.70E+02	4.85E+01	
Potassium	1.75E+02	NA	NA	NA
Silver	3.14E+02	1.23E+02	1.17E+01	Silver
Sodium, total recoverable	3.88E+01	NA	NA	NA
Thallium Soluble Salts	4.64E+00	2.07E+00	2.49E-01	Thallium Soluble Salts
Vanadium, total recoverable	3.80E+01	1.25E+03	1.07E+01	
Zinc (metallic)	4.60E+02	5.43E+03	7.46E+02	
Actinium-228	1.38E+00	4.67E+06	8.87E+04	
Cesium-137	4.99E-02	1.21E+01	2.06E-01	
Lead-212	1.33E+00	1.23E+05	3.88E+03	
Potassium-40	3.42E+00	9.08E-01	1.03E-01	Potassium-40

Table B-5. Tier II Simulation I Results for the GOSB Interior Subunit

Analyte	Retardation	Mean Travel Time	Predicted Concentration in Aquifer	Action Level	Failing Analytes	Tier II $SSL_{T1/2}$	Tier II $MLSSL_{T1/2}$
	(Unitless)	*(years)*	*(µg/L or pCi/L)*			*(mg/kg or pCi/g)*	
Benzo(a)anthracene	5.48E+02	2.72E+03		1.20E-02		Infinite	1.91E-01
Benzo(b)fluoranthene	1.88E+03	9.34E+03		3.40E-02		Infinite	5.41E-01
Aldrin	7.54E+01	3.75E+02		9.20E-04		Infinite	1.46E-02
Dieldrin	3.99E+01	1.99E+02	1.53E-06	1.80E-03		5.89E+02	2.86E-02
Heptachlor epoxide	1.28E+02	6.37E+02		2.00E-01		Infinite	3.18E+00
p,p'-DDD	7.09E+01	3.53E+02		3.20E-02		1.25E+05	8.92E-02
p,p'-DDE	1.33E+02	6.61E+02		4.60E-02		Infinite	1.28E-01
Cobalt	7.73E+01	3.85E+02	4.47E+00	6.00E+00		4.00E+00	
Silver	6.88E+02	3.42E+03	5.32E+01	9.40E+01		5.55E+02	
Thallium Soluble Salts	5.43E+02	2.70E+03	9.95E-01	2.00E+00		9.33E+00	
Potassium-40	5.74E+02	2.85E+03	6.94E-01	8.30E-01		4.09E+00	1.03E-01

Infinite indicates the model concentration exceeds unity: >1E+6mg/kg or >1E+12 pCi/g. Blanks indicate result is <1E-06 µg/L.

Table B-6. Tier I Screening Results for the GOSB Berm Subunit

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Acetone	7.02E-02	3.62E+01	9.95E+02	
Carbon disulfide	2.27E-03	2.83E+00	5.76E+01	
Methyl Acetate	2.04E-02	5.17E+01	1.42E+03	
Methyl ethyl ketone (2-Butanone)	2.60E-03	1.45E+01	3.98E+02	
Styrene	1.73E-03	5.30E-01	7.11E+00	
Toluene	3.90E-04	3.43E+00	7.11E+01	
Acenaphthene	1.78E-02	8.93E+00	3.77E+01	
Anthracene	2.80E-02	1.28E+02	1.28E+02	
Benzo(a)anthracene	1.01E-01	1.25E-02	8.53E-04	Benzo(a)anthracene
Benzo(a)pyrene	9.15E-02	5.65E-01	1.42E-02	
Benzo(b)fluoranthene	1.87E-01	1.22E-01	2.42E-03	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	5.79E-02	NA	NA	NA
Bis(2-ethylhexyl) phthalate	8.31E-02	1.95E+00	4.26E-01	
Caprolactam	7.57E-02	2.72E+01	7.03E+02	
Carbazole	2.64E-02	NA	NA	NA
Chrysene	1.12E-01	3.95E+00	2.42E-01	
Fluoranthene	2.45E-01	1.16E+02	5.68E+01	
Indeno(1,2,3-c,d)pyrene	5.06E-02	3.70E-01	2.42E-03	
Phenanthrene	1.32E-01	NA	NA	NA

Table B-6. Tier I Screening Results for the GOSB Berm Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Pyrene	1.79E-01	2.41E+01	8.53E+00	
alpha-Benzene hexachloride	1.12E-03	NA	NA	NA
alpha-Chlordane	2.90E-02	NA	NA	NA
beta-Benzene hexachloride	4.38E-03	NA	NA	NA
Dieldrin	1.70E-03	1.38E-04	1.28E-04	Dieldrin
Endrin	1.45E-03	6.80E-02	1.42E-01	
Endrin ketone	1.61E-03	NA	NA	NA
p,p'-DDD	5.32E-03	4.35E-03	2.27E-03	p,p'-DDD
p,p'-DDE	2.85E-02	1.17E-02	3.27E-03	p,p'-DDE
p,p'-DDT	1.94E-02	4.54E-01	1.63E-02	
PCB 1254	2.06E-02	7.04E-03	5.54E-04	PCB 1254
PCB 1260	1.36E-02	7.04E-03	5.54E-04	PCB 1260
Aluminum	1.89E+04	4.37E+05	1.42E+03	
Arsenic, Inorganic	4.81E+01	5.70E+00	7.11E-01	Arsenic, Inorganic
Barium	3.49E+01	1.20E+03	1.42E+02	
Beryllium and compounds	2.64E-01	4.60E+01	2.84E-01	
Cadmium	1.85E-01	5.47E+00	3.55E-01	
Calcium	4.82E+02	NA	NA	NA
Chromium, Total	8.67E+01	2.62E+06	7.11E+00	

Table B-6. Tier I Screening Results for the GOSB Berm Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Cobalt	8.88E-01	8.89E-01	4.26E-01	
Copper, Total	1.71E+01	4.76E+02	9.24E+01	
Cyanide (CN-)	1.67E-01	2.93E+01	1.42E+01	
Iron	8.52E+04	4.49E+04	9.95E+02	Iron
Lead and compounds	7.29E+01	5.90E+01	1.07E+00	Lead and compounds
Magnesium	3.56E+02	NA	NA	NA
Manganese	1.42E+02	3.14E+02	3.06E+01	
Mercury (elemental)	6.18E-02	1.52E+00	1.42E-01	
Nickel Soluble Salts	4.86E+00	3.70E+02	2.77E+01	
Potassium	3.80E+02	NA	NA	NA
Silver	1.74E+00	1.23E+02	6.68E+00	
Sodium, total recoverable	3.11E+02	NA	NA	NA
Thallium Soluble Salts	1.30E+00	2.07E+00	1.42E-01	
Vanadium, total recoverable	1.98E+02	1.25E+03	6.11E+00	
Zinc (metallic)	1.39E+01	5.43E+03	4.26E+02	
Actinium-228	2.11E+00	4.67E+06	5.06E+04	
Cesium-137	2.78E-01	1.21E+01	1.18E-01	
Lead-212	2.17E+00	1.23E+05	2.22E+03	
Potassium-40	4.21E+00	9.08E-01	5.90E-02	Potassium-40

Table B-7. Tier II Simulation I Results for the GOSB Berm Subunit

Analyte	Retardation	Mean Travel Time	Predicted Concentration in Aquifer	Action Level	Failing Analytes	Tier II $SSL_{T1/2}$	Tier II $MLSSL_{T1/2}$
	(Unitless)	*(years)*	*(µg/L or pCi/L)*			*(mg/kg or pCi/g)*	
Benzo(a)anthracene	5.20E+02	5.10E+03		1.20E-02		Infinite	1.09E-01
Benzo(b)fluoranthene	1.78E+03	1.75E+04		3.40E-02		Infinite	3.09E-01
Dieldrin	3.80E+01	3.72E+02		1.80E-03		Infinite	1.64E-02
p,p'-DDD	6.74E+01	6.61E+02		3.20E-02		Infinite	5.10E-02
p,p'-DDE	1.26E+02	1.24E+03		4.60E-02		Infinite	7.33E-02
PCB 1254	4.49E+02	4.40E+03	4.30E-03	7.80E-03		3.74E-02	5.55E-04
PCB 1260	4.49E+02	4.40E+03	2.84E-03	7.80E-03		3.74E-02	5.55E-04
Arsenic, Inorganic	2.84E+02	2.78E+03	1.74E+01	1.00E+01		2.77E+01	
Iron	1.60E+03	1.56E+04	5.47E+03	1.40E+04		2.18E+05	
Lead and compounds	1.96E+03	1.92E+04	3.82E+00	1.50E+01		2.86E+02	
Potassium-40	5.45E+02	5.34E+03	7.92E-01	8.30E-01		4.41E+00	5.90E-02

Infinite indicates the model concentration exceeds unity: >1E+6mg/kg or >1E+12 pCi/g. Blanks indicate result is <1E-06 µg/L.

Table B-8. Tier I Screening Results for the Pipeline Subunit

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Acetone	3.87E-02	2.55E+01	5.84E+02	
Benzene	4.78E-04	1.02E-02	2.09E-01	
Chloroform	1.09E-03	1.58E-01	3.34E+00	
Toluene	5.10E-04	2.40E+00	4.17E+01	
Bis(2-ethylhexyl) phthalate	1.14E-01	1.36E+00	2.50E-01	
alpha-Benzene hexachloride	6.46E-04	NA	NA	NA
alpha-Chlordane	2.32E-03	NA	NA	NA
p,p'-DDE	8.73E-04	8.14E-03	1.92E-03	
p,p'-DDT	3.34E-03	3.17E-01	9.60E-03	
Aluminum	1.17E+04	3.04E+05	8.35E+02	
Arsenic, Inorganic	3.98E+01	3.97E+00	4.17E-01	Arsenic, Inorganic
Barium	1.93E+01	8.35E+02	8.35E+01	
Beryllium and compounds	1.71E-01	3.20E+01	1.67E-01	
Cadmium	3.31E-01	3.81E+00	2.09E-01	
Calcium	7.33E+02	NA	NA	NA
Chromium, Total	4.14E+01	1.82E+06	4.17E+00	
Cobalt	5.28E-01	6.19E-01	2.50E-01	
Copper, Total	9.54E+00	3.32E+02	5.43E+01	
Cyanide (CN-)	1.03E-01	2.04E+01	8.35E+00	

Table B-8. Tier I Screening Results for the Pipeline Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Iron	4.23E+04	3.12E+04	5.84E+02	Iron
Lead and compounds	1.67E+01	4.11E+01	6.26E-01	
Magnesium	1.66E+02	NA	NA	NA
Manganese	3.29E+01	2.19E+02	1.79E+01	
Mercury (elemental)	5.24E-02	1.06E+00	8.35E-02	
Nickel Soluble Salts	5.48E+00	2.58E+02	1.63E+01	
Potassium	2.24E+02	NA	NA	NA
Selenium	3.10E+00	2.80E+01	2.09E+00	
Silver	1.76E+00	8.59E+01	3.92E+00	
Sodium, total recoverable	1.60E+02	NA	NA	NA
Vanadium, total recoverable	1.56E+02	8.72E+02	3.59E+00	
Zinc (metallic)	1.54E+01	3.78E+03	2.50E+02	
Actinium-228	1.94E+00	3.25E+06	2.97E+04	
Lead-212	1.85E+00	8.54E+04	1.30E+03	
Potassium-40	2.98E+00	6.32E-01	3.46E-02	Potassium-40

Table B-9. Tier II Simulation I Results for the Pipeline Subunit

Analyte	Retardation	Mean Travel Time	Predicted Concentration in Aquifer	Action Level	Failing Analytes	Tier II $SSL_{T1/2}$	Tier II $MLSSL_{T1/2}$
	(Unitless)	*(years)*	*(µg/L or pCi/L)*			*(mg/kg or pCi/g)*	
Arsenic, Inorganic	2.81E+02	2.05E+03	2.95E+01	1.00E+01		1.35E+01	
Iron	1.58E+03	1.15E+04	5.58E+03	1.40E+04		1.06E+05	
Potassium-40	5.40E+02	3.94E+03	1.15E+00	8.30E-01		2.15E+00	3.46E-02

Infinte indicates the model concentration exceeds unity: >1E+6mg/kg or >1E+12 pCi/g. Blanks indicate result is <1E-06 µg/L.

Table B-10. Tier I Screening Results for the Effluent Discharge Subunit

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Acetone	1.73E-01	2.50E+01	1.88E+03	
Chloromethane (Methyl chloride)	5.30E-04	3.69E-01	2.56E+01	
Isopropylbenzene (Cumene)	4.25E-03	9.37E+00	6.05E+01	
Methyl Acetate	5.03E-02	3.58E+01	2.69E+03	
Methyl ethyl ketone (2-Butanone)	6.13E-02	1.00E+01	7.53E+02	
Styrene	6.22E-03	3.62E-01	1.35E+01	
Benzo(a)pyrene	2.73E-02	3.81E-01	2.69E-02	
Benzo(b)fluoranthene	4.22E-02	8.22E-02	4.57E-03	
Benzo(g,h,i)perylene	1.90E-02	NA	NA	NA
Benzo(k)fluoranthene	1.92E-02	8.22E-01	4.57E-02	
Chrysene	4.15E-02	2.66E+00	4.57E-01	
Fluoranthene	6.09E-02	7.84E+01	1.08E+02	
Indeno(1,2,3-c,d)pyrene	1.75E-02	2.50E-01	4.57E-03	
Phenanthrene	3.26E-02	NA	NA	NA
Pyrene	4.27E-02	1.62E+01	1.61E+01	
alpha-Chlordane	3.86E-01	NA	NA	NA
Heptachlor epoxide	2.50E-04	3.31E-02	2.69E-02	
p,p'-DDE	1.45E-02	7.89E-03	6.19E-03	p,p'-DDE
p,p'-DDT	1.60E-02	3.07E-01	3.09E-02	

Table B-10. Tier I Screening Results for the Effluent Discharge Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
PCB 1242	3.02E-02	4.75E-03	1.05E-03	PCB 1242
PCB 1254	3.66E-02	4.75E-03	1.05E-03	PCB 1254
PCB 1260	3.57E-02	4.75E-03	1.05E-03	PCB 1260
Aluminum	1.53E+04	2.95E+05	2.69E+03	
Arsenic, Inorganic	9.84E+00	3.85E+00	1.35E+00	Arsenic, Inorganic
Barium	6.06E+01	8.09E+02	2.69E+02	
Beryllium and compounds	8.11E-01	3.11E+01	5.38E-01	
Cadmium	1.34E-01	3.69E+00	6.73E-01	
Calcium	7.80E+02	NA	NA	NA
Chromium, Total	2.13E+01	1.77E+06	1.35E+01	
Cobalt	3.96E+00	6.00E-01	8.07E-01	Cobalt
Copper, Total	2.06E+01	3.22E+02	1.75E+02	
Cyanide (CN-)	4.96E-01	1.98E+01	2.69E+01	
Iron	3.43E+04	3.03E+04	1.88E+03	Iron
Lead and compounds	1.72E+01	3.98E+01	2.02E+00	
Magnesium	2.50E+02	NA	NA	NA
Manganese	5.37E+02	2.12E+02	5.78E+01	Manganese
Mercury (elemental)	7.64E-02	1.03E+00	2.69E-01	
Nickel Soluble Salts	5.40E+00	2.50E+02	5.25E+01	

Table B-10. Tier I Screening Results for the Effluent Discharge Subunit (Continued)

Analyte	Source Zone Concentration	Tier I Source-Specific SSL	Tier I Mass Limit SSL	Failing Analytes
	(mg/kg or pCi/g)			
Potassium	2.17E+02	NA	NA	NA
Selenium	3.72E+00	2.71E+01	6.73E+00	
Silver	1.19E+01	8.33E+01	1.26E+01	
Sodium, total recoverable	5.97E+01	NA	NA	NA
Vanadium, total recoverable	7.61E+01	8.45E+02	1.16E+01	
Zinc (metallic)	3.65E+01	3.67E+03	8.07E+02	
Actinium-228	1.86E+00	3.15E+06	9.59E+04	
Cesium-137	2.84E-01	8.16E+00	2.23E-01	
Lead-212	1.88E+00	8.28E+04	4.19E+03	
Potassium-40	2.07E+00	6.13E-01	1.12E-01	Potassium-40
Radium-226	1.37E+00	4.36E-04	5.96E-05	Radium-226
Radium-228	2.47E+00	1.46E-01	2.00E-02	Radium-228
Thorium-228	2.75E+00	4.39E+00	6.00E-01	
Thorium-230	1.47E+00	3.74E-01	5.11E-02	Thorium-230
Thorium-232	2.40E+00	3.35E-01	4.57E-02	Thorium-232
Uranium-233/234	1.19E+00	2.08E+00	6.32E-02	
Uranium-235	1.69E-01	2.12E+00	6.46E-02	
Uranium-238	1.01E+00	2.34E+00	7.13E-02	

Table B-11. Tier II Simulation I Results for the Effluent Discharge Subunit

Analyte	Retardation	Mean Travel Time	Predicted Concentration in Aquifer	Action Level	Failing Analytes	Tier II $SSL_{T1/2}$	Tier II $MLSSL_{T1/2}$
	(Unitless)	*(years)*	*(µg/L or pCi/L)*			*(mg/kg or pCi/g)*	
p,p'-DDE	1.23E+02	8.58E+02		4.60E-02		Infinite	1.39E-01
PCB 1242	4.39E+02	3.05E+03	5.48E-03	7.80E-03		4.29E-02	1.05E-03
PCB 1254	4.39E+02	3.05E+03	6.65E-03	7.80E-03		4.29E-02	1.05E-03
PCB 1260	4.39E+02	3.05E+03	6.48E-03	7.80E-03		4.29E-02	1.05E-03
Arsenic, Inorganic	2.77E+02	1.93E+03	3.01E+00	1.00E+01		3.27E+01	
Cobalt	7.18E+01	5.00E+02	4.66E+00	6.00E+00		5.10E+00	
Iron	1.56E+03	1.08E+04	1.87E+03	1.40E+04		2.57E+05	
Manganese	3.55E+02	2.47E+03	1.28E+02	4.30E+02		1.80E+03	
Potassium-40	5.32E+02	3.70E+03	3.30E-01	8.30E-01		5.21E+00	1.12E-01
Radium-226	7.09E+02	4.93E+03	1.92E-02	4.40E-04		3.14E-02	6.14E-05
Radium-228	7.09E+02	4.93E+03		4.00E-02		Infinite	9.22E+01
Thorium-230	7.09E+02	4.93E+03	1.68E-01	3.80E-01		3.32E+00	5.12E-02
Thorium-232	7.09E+02	4.93E+03	2.87E-01	3.40E-01		2.84E+00	4.57E-02

Infinte indicates the model concentration exceeds unity: >1E+6mg/kg or >1E+12 pCi/g. Blanks indicate result is <1E-06 µg/L.

Table B-12. Summary Table of Tier I and Tier II Screening Results

GOSB Subunit	# of Tier I COPCs	Tier I COPCs	Tier II COPCs	CM COCs
GOSB Interior	11	Benzo(a)anthracene, Benzo(b)fluoranthene, Aldrin, Dieldrin, Heptachlor epoxide, p,p'-DDD, p,p'-DDE, Cobalt, Silver, Thallium Soluble Salts, Potassium-40	None	None
Basin Berm	11	Benzo(a)anthracene, Benzo(b)fluoranthene, Dieldrin, p,p'-DDD, p,p'-DDE, PCB 1254, PCB 1260, Aresenic (Inorganic), Iron, Lead and compounds, Potassium-40	None	None
Pipeline	3	Arsenic (Inorganic), Iron, Potassium-40	None	None
Effluent Discharge	13	p,p'-DDE, PCB 1242, PCB 1254, PCB 1260, Arsenic (Inorganic), Cobalt, Iron, Manganese, Potassium-40, Radium-226, Radium-228, Thorium-230, Thorium-232	None	None

Table B-13. Comparison of Maximum Detected Concentrations in Groundwater to MCLs

Groundwater Analyte	Units	MCL(RSL)	Maximum Detected Concentration		Maximum Result >MCL(RSL)?	
			F	U	F	U
1,4-Dichlorobenzene	µg/L	7.5E+01	NA	5.50E-01	NA	No
Acetone	µg/L	1.4E+04	NA	5.94E+00	NA	No
Aluminum	µg/L	2.0E+04	7.79E+02	1.42E+03	No	No
Barium	µg/L	2.0E+03	9.09E+01	1.11E+02	No	No
Bromodichloromethane	µg/L	8.0E+01	NA	2.39E+00	NA	No
Bromoform	µg/L	8.0E+01	NA	3.81E+00	NA	No
Calcium	µg/L	EN	1.35E+03	8.70E+02	No	No
Chlorobenzene	µg/L	1.0E+02	NA	4.20E-01	NA	No
Chloroform	µg/L	8.0E+01	NA	1.06E+01	NA	No
Chromium	µg/L	1.0E+02	3.48E+01	8.31E+01	No	No
Cobalt	µg/L	6.0E+00	5.74E+00	7.12E+00	No	Yes
Copper	µg/L	1.3E+03	ND	6.16E+00	No	No
Cyanide	µg/L	2.0E+02	5.59E+00	4.77E+01	No	No
Dibromochloromethane	µg/L	8.0E+01	NA	1.55E+00	NA	No
Gross Alpha	pCi/L	1.5E+01	NA	1.02E+01	NA	No
Iron	µg/L	1.4E+04	3.66E+03	4.90E+03	No	No
Magnesium	µg/L	EN	1.16E+03	1.13E+03	No	No
Manganese	µg/L	4.3E+02	5.29E+01	6.23E+01	No	No
Nickel	µg/L	3.9E+02	4.88E+01	7.65E+01	No	No
Nonvolatile Beta	pCi/L	5.0E+01	NA	1.18E+01	NA	No
Pentachlorophenol	µg/L	1.0E+00	NA	1.39E+01	NA	Yes
Potassium	µg/L	EN	3.63E+03	3.65E+03	No	No
Sodium	µg/L	EN	2.32E+04	2.25E+04	No	No
Vanadium	µg/L	8.6E+01	1.34E+00	3.35E+00	No	No
Zinc	µg/L	6.0E+03	3.21E+01	3.23E+01	No	No

MCL(RSL) = Maximum Contaminant Level (Regional Screening Level for tapwater). MCL concentration used as threshold level; in the absence of a MCL, the tapwater RSL is used.

F = filtered sample – inorganic analytes only (metals) U = unfiltered sample – all analytes NA = not applicable

ND = non-detect EN = essential nutrient

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APPENDIX C

HUMAN HEALTH RISK ASSESSMENT

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LIST OF ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
bgs	below ground surface
BRA	Baseline Risk Assessment
CMS	Corrective Measures Study
COC	constituent of concern
COPC	constituent of potential concern
CSM	Conceptual Site Model
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
EPC	exposure point concentration
FS	Feasibility Study
ft	feet
GOSB	G-Area Oil Seepage Basin
HCH	hexachlorocyclohexane
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IOU	Integrator Operable Unit
LTR	Lower Three Runs
m	meter
MCL	maximum contaminant level
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PRG	preliminary remediation goal
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RFI	RCRA facility investigation
RI	remedial investigation
RME	reasonable maximum exposure
RSL	regional screening level

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

SRS	Savannah River Site
SVOA	semivolatile organic analyte
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VOA	volatile organic analyte
VOC	volatile organic compound

C-1. INTRODUCTION

The human health risk assessment (HHRA) in support of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) Report with Baseline Risk Assessment (BRA) and Corrective Measures Study (CMS)/Feasibility Study (FS) for the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU) is presented in this appendix. The evaluation contained herein assesses the risks of contamination to human receptors to identify the problems warranting action from a human health standpoint to support subsequent remediation as deemed necessary.

The GOSB OU is located southeast of N Area (Central Shops) in an area currently designated for industrial use. No current or projected future development of the basin unit is planned, nor is the current land use expected to change. Nevertheless, to support the risk management decision-making, both the residential (unrestricted) and industrial land use scenarios are evaluated.

The HHRA is conducted and presented for each of four subunits for the evaluation of risk to human health receptors. Exposure is assessed by screening environmental data from the GOSB OU RI/BRA database and evaluating the potential for exposure. This approach allows for remedial decisions to be made on a smaller scale within the larger OU area. Three media types are evaluated, including sediment (associated with the GOSB Interior Subunit), soil (associated with the GOSB Berm Subunit, Pipeline Subunit, and Effluent Discharge Subunit), and surface water (associated with the GOSB Interior Subunit).

The basis for this evaluation is the preliminary conceptual site models (CSMs), which are presented in Chapter 2. The CSMs are graphical representations of the GOSB subunit sources of contamination and potential impacts to human health and the environment. The preliminary CSMs establish the focus for the risk assessment, identifying the sources of contamination, the release mechanisms into exposure media, the exposure routes associated with media, and the potential receptors evaluated in the risk assessment. As depicted in Figure 2-7 through 2-10, the CSMs include the following elements:

- Primary sources of contamination
- Primary environmental release mechanisms
- Secondary sources of contamination
- Secondary release mechanisms
- Exposure media
- Exposure routes
- Human receptors

C-1.1 Background

The GOSB OU is an earthen basin that was initially used for liquid waste disposal during Savannah River Site (SRS) plant construction in the early 1950s. It may have received unknown liquid waste from the time of plant construction until the 1960s, although no records exist of such disposals. Prior to 1983, the GOSB received effluent from a small sanitary wastewater treatment facility. Between 1983 until 1992, the GOSB received effluent from the Central Shops sanitary wastewater treatment plant via a National Pollutant Discharge Elimination System (NPDES) permitted outfall (CS-11). The designation of the basin as an oil seepage basin may be a misnomer because there is no information regarding its use for management and disposal of waste oils. The GOSB is currently inactive; however, rainwater is typically retained in the basin.

The GOSB basin is approximately 3 m (10 ft) deep around the edges of the basin, with the northern and southern sides (0.9 m [3 ft] and 0.6 m [2 ft] high, respectively, being the highest. The deepest part of the basin, near the center, is approximately 4.8 m (16 ft) below ground surface (bgs). It received wastewater input via approximately 57 m (190 ft) of buried 30-cm (12-in) vitrified clay pipe, which was previously abandoned in place. On the outlet side of the basin, approximately 153 m (510 ft) of buried 30-cm (12-in) vitrified clay pipe discharged contents southeast of the basin into an intermittent stream. Both the basin inlet and outlet pipes are buried to a depth of approximately 1.8 to 2.4 m (6 to 8 ft) bgs. Figure C-1 shows the GOSB OU and the associated subunits.

C-1.2 Data

In 2009, a sampling campaign was conducted to determine the nature and extent of any hazardous substances in the GOSB Basin and surrounding environment, and to collect sufficient data to

support the human health and ecological risk assessment, contaminant migration evaluation, and PTSM analysis. Ninety-five soil, sediment, and surface water samples from 53 locations were collected from within the basin and the surrounding area for characterization of GOSB OU. Soil, sediment and surface water samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) inorganics, and radiological indicators/gamma spectroscopy. In addition to samples collected from the GOSB Subunits, six soil samples were collected from three locations upgradient of the basin. Upgradient samples were collected from the 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) bgs intervals and analyzed for TCL VOCs, SVOCs, and pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. These upgradient samples served as local soils unimpacted by the GOSB OU.

Based on a determination that data gaps existed in the 2009 dataset, additional GOSB OU sampling took place from November 2016 through January 2017. A total of 20 soil and surface water samples were collected from 17 locations within the GOSB Basin Interior Subunit and the surrounding area for additional characterization. Soil samples were collected at the Effluent Discharge Subunit from three locations at intervals of 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) directly following the end of the pipeline subunit and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators. Surface water samples were collected at the GOSB Interior Subunit and analyzed for inorganics (metals), VOCs, SVOCs, and radiological indicators. A more thorough description of the data used in the HHRA is provided in Chapter 3. All data used in the HHRA are presented in Appendix A.

C-1.3 Receptors

The purpose of the HHRA is to evaluate the potential for adverse effects associated with exposure to constituents present in the GOSB OU. The assessment estimates the risk potential in the absence of any remedial action and provides a basis for determining whether or not remedial actions is necessary to reduce or eliminate risks to human health. A streamlined approach that considers both

standardized and site-specific receptor scenarios/exposure assumptions has been used for this evaluation.

The receptors evaluated include future resident and future industrial worker. A description of each is presented below.

The *future resident* receptor scenario evaluates long-term risks to individuals assumed to have unrestricted use of the area that consists of the GOSB subunits. This scenario considers residents (adults and children) that hypothetically live on the subunits and are exposed chronically, both indoors and outdoors, to subunit contaminants. The standard exposure assumptions are 26 years, 350 days per year, and 24 hours per day. Exposure routes associated with soil include inhalation of particulates and vapors, external exposure to radiation, dermal absorption, and incidental ingestion.

The future resident receptor scenario is also evaluated for the surface water media. This includes a comparison of constituents to surface water threshold levels based on regulatory-based limits (i.e., maximum contaminant levels) or risk-based threshold values, as appropriate.

The *future industrial worker* scenario is a standard United States Environmental Protection Agency (USEPA) exposure scenario, which addresses long-term risks to workers who are exposed to subunit contaminants within an industrial setting. The standard exposure assumptions are 25 years, 250 days per year, and 8 hours per day. This receptor is referred to as "composite worker" by USEPA and is analogous to the term "industrial worker" used herein. The future industrial worker scenario considers an adult who hypothetically works on-unit in an outdoor setting for the majority of time. Exposure routes include inhalation, external exposure to radiation, dermal absorption, and incidental ingestion to soil.

C-1.4 Sources of Risk-Based Threshold Values

The USEPA publishes regional screening levels (RSLs) for nonradiological constituents and preliminary remediation goals (PRGs) for radiological constituents that are risk-based concentrations (or activity concentrations) that can be used to evaluate potentially contaminated waste sites. Both RSLs and PRGs combine current USEPA toxicity values with standard exposure

factors that represent reasonable maximum exposure (RME) conditions to estimate contaminant concentrations in exposure media that the agency considers protective of humans over a lifetime. The concentrations are based on direct exposure pathways for which generally accepted methods, models, and assumptions have been developed for specific land use conditions.

The RSLs consists of generic exposure scenario summary tables and a calculator function to derive site-specific RSLs in which user-specific exposure parameters are exchanged for the generic scenario parameters (USEPA 2016). The generic summary table includes RSLs for the resident and industrial worker that uses all default parameters for both the residential and industrial worker scenarios (Attachment C-1).

The PRGs for a residential scenario are obtained by using the website calculator function to derive site-specific PRGs (USEPA 2017). These site-specific PRG values are calculated by eliminating the fruit and vegetable consumption pathways as standard input assumptions and using all other default parameters. The residential PRG output from the calculator is provided as Attachment C-2 to this appendix. The PRGs for an industrial worker scenario are obtained using the calculator function that assumes all default parameters. The PRG values are provided in Attachment C-3 to this appendix.

For surface water, maximum contaminant levels (MCLs) are used, where available for constituents, to screen against maximum detected concentrations and activity concentrations in water. Where MCLs are not available, the lesser of tap water RSLs or PRGs published on generic tables or ambient water quality criteria (AWQC) (SCDHEC 2014) are used. Surface water screening levels for nonradiological and radiological constituents are presented in Attachments C-4 and C-5, respectively.

C-2. HUMAN HEALTH RISK ASSESSMENT PROCESS

C-2.1 Sediment and Soil Media

As previously described, basin sediments and soils associated with the berm and the effluent discharge area are evaluated separately. The primary dataset used for the human health screening and risk/hazard calculations is the 0 to 0.3 m (0 to 1 ft) depth sample interval. Per the CSM for the Pipeline soils, a quantitative evaluation is not required since the pipeline is buried at depth. Thus, this media is addressed herein qualitatively only. Concentrations of detected constituents in the 0 to 0.3 m (0 to 1 ft) depth interval include both the maximum and the 95% upper confidence limit (UCL) on the mean concentration for screening and risk/hazard calculations, respectively.

A summary of the processes undertaken to evaluate human health associated with the various exposure media is described below.

C-2.1.1 Constituents of Potential Concern

The process used to identify constituents of potential concern (COPCs) in each subunit within the GOSB OU is described below. Maximum detected concentrations of nonradiological constituents were compared to residential soil RSLs. Maximum detected activity concentrations of radiological constituents were compared to residential soil PRGs. For naturally-occurring, non-anthropogenic constituents, maximum soil and sediment concentrations from the 0 to 0.3 m (0 to 1ft) sampling interval were also compared to two times the SRS average background concentrations (WSRC 2006). Constituents exceeding both the RSL/PRG residential screening thresholds and the SRS background values are identified as COPCs. COPCs are carried forward to the risk/hazard calculation (C.2.1.2). Appendix A presents the sediment and soil datasets for each subunit as well as those for the GOSB upgradient soil background data set. The upgradient GOSB OU soil background data (Tables A.6.1 through A.6.3) were used in the refinement of COCs for each applicable subunit.

Constituents recognized as essential human nutrients (i.e., calcium, magnesium, potassium and sodium) are not subject to further evaluation since these constituents are deemed necessary for health and consumed in normal diets.

Section C.2.4 presents the results of the sediment and soil COPC screening step.

C-2.1.2 Risk/Hazard Calculation

The next step in the HHRA is to calculate risk or hazard for the resident and industrial worker, for each GOSB OU subunit. Risk and hazard estimate calculations are based on a RME exposure point concentration (EPC), which is the lesser of the maximum detected concentration and the 95% UCL on the mean concentration. Appendix A tables indicate the EPCs for each of the COPCs.

For carcinogens, the risk estimates for constituents are calculated using the following equation:

The risk estimates by constituent grouping (i.e., inorganic, organic, and radionuclide) are then summed to provide the total risk by grouping. The total media risk is the sum of the total groupings. Constituents with an individual cancer risk greater than 1E-06 are identified as COCs and are further evaluated in the refinement of COCs step (Section C.2.4).

For noncarcinogens, hazard estimates are calculated individually for each nonradiological constituent, called hazard quotients (HQs), using the following equation:

Individual constituent HQs are summed to provide the total hazard index (HI). If the total HI is less than 1, then no COCs are identified. If the total HI is greater than 1, then the constituents are segregated based on relevant target organ or system toxicity and the grouped constituent HQs are summed. Constituents are identified as COCs if the constituent organ/system HQ is greater than 0.1 and the total organ HI is greater than 1. Constituents identified as COCs are further evaluated in the refinement of COCs step (Section C.2.4).

C-2.2 Surface Water Media

For surface water media, maximum detected surface water concentrations within the GOSB Interior Subunit are compared to threshold levels (Attachments C-4 and C-5).

C-2.2.1 Comparison of MCL/(PRG/RSL or AWQC)

Maximum detected concentrations of each constituent are conservatively compared to drinking water MCLs. In the absence of a MCL, the lowest value for the tap water RSL/PRG or promulgated AWQC (federal/state) is used as a screening threshold. Attachments C-4 and C-5 contain the surface water screening thresholds for nonradionuclides and radionuclides, respectively, used in this evaluation. Constituents that exceed the MCL/(PRG/RSL or AWQC) thresholds are further evaluated in the refinement of COCs step (Section C.2.4).

C-2.3 Refinement of Constituents of Concern/Results

To identify human health refined COCs (RCOCs) by subunit within the GOSB OU, an uncertainty analysis is performed for each individual COC. This includes an interpretive discussion of the applicable uncertainty factors (lines of evidence) and a recommendation of whether the constituent should or should not be carried forward for further remedial evaluation. The major categories of uncertainty used in this evaluation and the major emphasis include:

- Unit related uncertainty, which includes uncertainties related to the nature and extent of contamination, consistency with history of use, and presence in background
- Data quality uncertainty, which includes uncertainties related to data quality and physical characteristics
- Risk assessment uncertainty, which includes uncertainties related to toxicity data and changes in constituent concentrations due to radioactive decay

For the uncertainty evaluation, subunit concentrations are compared to SRS all-depths background concentrations (WSRC 2006) as one line of evidence to assist in the identification of RCOCs.

GOSB OU upgradient samples were collected during the sampling events to determine a site specific background value for many constituents. Table A.6.3 provides the results for the GOSB background unit (all depths). These data are used as additional weight-of evidence in the COC refinement step.

Note that for the background comparisons involving a particular decay chain, activities of the parent and its daughter products are considered. For example, the Thorium Series (thorium -232) evaluation includes not only the measured concentration of thorium-232, specifically, but also includes any analytical results from its daughter products (e.g., radium-224, actinium-228, thorium-228, lead-212, bismuth-212, thallium-208, and radium-228) since these isotopes are assumed to be in secular equilibrium. This same approach was applied for the uranium-238 decay series, including its daughter products (e.g., uranium-234, thorium-230, radium-226, lead-214, and bismuth-214). Therefore, background comparisons for the thorium-232 decay series and the uranium-238 decay series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products).

Background surface water samples were collected as part of the 2009/2010 characterization effort in support of the Lower Three Runs (LTR) Integrator Operable Unit (IOU) investigation. Four background locations were chosen to represent the various environmental conditions present in the LTR IOU and included areas identified within the SRS boundary that have not been affected by SRS processes. Background locations included the Crackerneck Wildlife Management Area located in the Savannah River floodplain upgradient of Upper Three Runs Creek , upper LTR located upgradient of PAR Pond , Meyers Branch identified as a tributary of Steel Creek , and Tinker Creek identified as a tributary of Upper Three Runs Creek . The IOU Background dataset identifies minimum, mean, and maximum concentrations (or activities) for surface water media. The IOU Background surface water dataset is published in Table A.1.10.2 of the *Remedial Investigation/Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U)* (SRNS 2017).

C-2.3.1 G-Area Oil Seepage Basin Interior Subunit

C-2.3.1.1 Sediment Media

Table C-1 presents the results of the sediment screening for GOSB ~~Berm~~ Interior Subunit. Human health COPCs for sediment include chromium, cobalt, lead, silver, thallium, benzo[a]anthracene,

benzo[a]pyrene, benzo[b]fluoranthene, alpha-chlordane, gamma-chlordane, dichlorodiphenyldichloroethylene (DDE), dieldrin, heptachlor epoxide, potassium-40, and uranium-238. These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times mean SRS background concentrations.

Table C-2 presents the total HI (8.36) and total media risk (2.79E-04) for the resident exposure scenario and associated COCs, including chromium, lead, thallium, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, alpha-chlordane, gamma-chlordane, DDE, dieldrin, heptachlor epoxide, potassium-40, and uranium-238.

Table C-3 presents the total HI (0.6) and total media risk (7.44E-05) for the industrial worker exposure scenario and the associated COCs, including chromium, gamma-chlordane, dieldrin, heptachlor epoxide, potassium-40, and uranium-238.

The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is identified as a COC for the resident (risk = 1.4E-04 and HQ = 0.18, with a total liver target organ HI = 1.37) and industrial worker (risk = 6.7E-06) scenarios. It was detected in 5/5 samples, with no results being estimated values (i.e., J-qualified). Concentrations range from 17.3 to 51.2 mg/kg with a mean concentration of 29.66 mg/kg. Sample location GOSB-49 (Figure 3-2) had the highest detected concentration. The EPC used in the risk calculations is 42.5 mg/kg.

Chromium is a naturally occurring constituent that is common in the environment. The maximum concentration in the SRS soil background dataset is 54.3 mg/kg. Soil concentrations from this subunit are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium and hexavalent chromium. Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds in the trivalent or hexavalent chromium forms are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate, which is an oxyanion of chromium

in the oxidation state of +6, was never used in coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since chromium is not considered an important source contaminant at the GOSB OU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined during the chemical analysis, only results for total chromium were provided.

The risk estimate is based on the hexavalent chromium RSL (residential RSL = 0.30 mg/kg and industrial worker RSL = 6.3 mg/kg). This overly conservative approach tends to bias the resultant risk calculations high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the GOSB OU. In addition, the RSLs for trivalent chromium are 1.2E+05 mg/kg for the residential exposure scenario and 1.8E+06 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a human health RCOC in sediment for either receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- The valence state of chromium was not determined; the analytical result was for total chromium
- Risk estimate is biased high because the most conservative RSL (hexavalent chromium) was used, but this form is not expected to be present based on unit history and environmental conditions
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard)

Lead is COC for the resident only (HQ = 0.11) based on its contribution to the central nervous system target organ HI (6.06). It was detected in 5/5 samples, with no results being estimated (i.e.,

J-qualified). Concentrations range from 14.2 to 52 mg/kg (mean = 26.74 mg/kg). Sample GOSB-50 (Figure 3-2) had the highest concentration. The EPC used in the risk calculations is 43.1 mg/kg.

Lead is a naturally occurring constituent associated with earthen materials (i.e., sediment and soil) that is common in the environment. The mean value for lead (26.74 mg/kg) is approximately equal to the maximum concentration in the SRS soil background dataset (26.6 mg/kg).

Lead is only identified as a COC due to its contribution to the target organ HI. However, this contribution is less than 2% of the target organ HI. Assuming the major contributor to the target organ HI (i.e., thallium) is naturally occurring, lead would not be considered a human health COC. Further, this evaluation is based on the 95% UCL on the mean. Using the mean concentration, lead would not meet the criteria established for determining Human health COCs using the target organ HI, as it would not have a constituent specific HQ greater than 0.1 when the target organ HI exceeds 1.

Lead is not recommended for further remedial action evaluation as a human health RCOC in sediment for either receptor scenario based on the following lines of evidence:

- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- The contribution from lead to the central nervous system target organ HI is very low (i.e., less than 2%)

Thallium is a COC for the resident only (HQ = 5.95). It was detected in 1/5 samples, which is not estimated (i.e., J-qualified). The detected concentration is 4.64 mg/kg from sample GOSB-49 (Figure 3-2). The concentration from the one detected result is used as the EPC.

Thallium is naturallyoccurring in trace amounts in the earth's crust. It was produced in the United States up until 1985, and then was obtained from imports or reserves. Thallium is used in the manufacturing of electronic devices, switches, and closures in the semiconductor industry. It also was used as a rat poison, although this use was banned in the early 1970s.

The SRS soil background maximum is 8.1 mg/kg. The result from the one sample is below the maximum SRS background.

Its presence at SRS is not likely due to any site uses or process and, therefore, may be present in trace quantities. However, at trace quantities, thallium can contribute to excessive HIs for certain receptor scenarios because the toxicity value for thallium (i.e., reference dose [RfD]) is low, resulting in low RSL values. The RfD is determined using a large uncertainty factor (i.e., 3,000) given the varied responses to doses from various animal models and information from human exposures. While alopecia is what leads to a diagnosis of thallium poisoning, effects on the nervous system as a target organ is supported only by observation rather than mode of action, which further leads to uncertainty in thallium toxicity.

Thallium is not recommended for further remedial action as a human health RCOC in sediment for either receptor scenario based on the following lines of evidence:

- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- The detected concentration is below the SRS maximum detected concentration
- Thallium is not used at SRS as a raw material in any process and historical uses as a pesticide at SRS are unknown

Polycyclic Aromatic Hydrocarbons (PAHs) benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene are COCs for the resident only (risk = 1.2E-06, 8.6E-06, and 1.5E-06, respectively). Each of the PAHs is considered ubiquitous (i.e., commonly found in soils, particularly surface soils as a result of being a component of crude oil). The combustion of oil and oil products, such as gasoline and diesel fuel, results in the emission of PAHs into the air, which eventually settle to ground surface. PAHs also are produced from the combustion of organic materials and are found in smoke from forest fires. The following three PAHs are present in SRS background soil data set with the following maximum detected concentrations in the 0 to 1ft interval: 0.050 mg/kg (benzo[a]anthracene), 0.052 mg/kg (benzo[a]pyrene), and 0.094mg/kg (benzo[b]fluoanthene).

Each of these PAHs were detected in only 1 of 5 samples, with the detected concentrations all being estimated (i.e., J-qualified). Sample GOSB-49 (Figure 3-2) had the detected concentrations of each of these PAHs. The EPCs used in the risk calculations are equal to the single detected concentration for each PAH (i.e., 0.195 mg/kg for benzo[a]anthracene, 0.138 mg/kg for benzo[a]pyrene, and 0.247 mg/kg for benzo[b]fluoranthene). The detected concentration of benzo[a]anthracene is below the maximum detected SRS background value, while the detected concentrations for benzo[a]pyrene and benzo[b]flouranthene are just slightly above the SRS background maximum for these PAHs. According to *Statistical Summary Table, Background Unit: Soil (all depths),* Table A.6.3 in Appendix A, PAHs, namely acenapthalene, anthracene, benzo[b]flouranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, and pyrene have been detected in soils upgradient of the GOSB OU. The maximum detected concentration of benzo[b]fluoranthene is 0.547 mg/kg in the upgradient dataset is greater than the basin interior maximum detected concentration. This suggests the ubiquitous nature of PAHs.

The risks calculated for benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene are based on the 2016 RSL of 0.16 mg/kg, 0.016 mg/kg, and 0.16 mg/kg, respectively from the default tables. However, use of the RSL calculator function yielded new RSLs based on updated toxicity information (2017), which resulted in generating the RSLs of 1.13, 0.115, and 1.15 for benzo[a]anthracene, benzo[a]pyrene, and benzo[b]fluoranthene, respectively. The RSL default tables were updated in June 2017. Use of the revised RSLs results in a risk of 1.2E-06 for benzo[a]pyrene and in risks less than 1E-06 for benzo[a]anthracene and benzo[b]fluoranthene.

PAHs are not recommended for further remedial evaluation as a human health RCOCs in based on the following lines of-evidence:

- They are ubiquitous PAHs with multiple man-made and natural sources
- ~~They were infrequently detected above the detection limit~~
- The evaluation used conservative RSLs, which have recently been replaced
- The risk estimate is biased high since the maximum detected concentrations was used as the EPC

- Use of the 2017 RSL results in a risk less than 1E-06 for benzo[a]anthracene and benzo[b]fluoranthene and a risk of 1.2E-06 for benzo[a]pyrene

Chlordane occurs as a mixture of pure chlordane and other related chemicals, including alpha-chlordane and gamma-chlordane. It is a COC for the resident (alpha-chlordane risk = 2.6E-06 and gamma-chlordane risk = 6.4E-06) and for the industrial worker (gamma-chlordane only; risk = 1.4E-06). Chlordane was used as a pesticide in the United States from 1948 to 1988, primarily on crops such as corn and citrus, but also on home lawns and gardens to control agricultural and vegetation pests, including termites. Chlordane is extremely persistent in the environment, so past uses and/or releases likely remain in soils for upwards of 20 years or more. Releases to the air can travel long distances and be deposited by wet or dry deposition. Movement in the environment may occur as a result of volatilization from soils and water as well as wind erosion and from suspension in water due to runoff from areas treated with chlordane. Chlordane use at SRS is not fully known, but its presence is consistent with potential for use as a pesticide at this subunit.

Both alpha-chlordane and gamma-chlordane were detected in 5/5 samples, with none being estimated (i.e., J-qualified). Maximum detected concentrations of both congeners of chlordane were from Sample GOSB-51 (Figure 3-1) that was collected on November 6, 2009. Alpha-chlordane ranges from 0.14 to 7.32 mg/kg, while gamma-chlordane ranges from 0.175-10.9 mg/kg. The EPCs used in the risk calculations for alpha-chlordane and gamma-chlordane were 4.49 mg/kg and 10.9 mg/kg, respectively.

Because the chlordane congeners contribute to a total pesticide risk of 3E-05 for the resident as well as a total target organ HI (i.e., liver) of 1.4 and to a total pesticide risk of 7E-06 for the industrial worker, both alpha-chlordane and gamma-chlordane are retained as sediment human health RCOCs in consideration for possible remedial action in the feasibility study.

DDE is both a breakdown product of dichlorodiphenyltrichloroethane (DDT), which is a pesticide once widely used to controls insects on agricultural crops and insects that carry diseases such as malaria and typhus, and a contaminant in DDT. DDT was sprayed extensively on forested areas to controls insects. Use of DDT was banned in 1973, although DDT and associated DDE may

continue to enter the environment due to its use in other parts of the world. Because it is highly persistent in the environment, trace amounts may be found everywhere. Airborne releases during use may be carried long distances in the atmosphere and deposit by wet or dry deposition. DDE use at SRS is not fully known, but its presence is consistent with potential for use as a pesticide at this subunit.

DDE was detected in 5/5 samples, with none being J-qualified (i.e., estimated). Concentrations range from 0.05-4.5 mg/kg. The maximum detected concentration of 4.5 mg/kg from sample GOSB-51 (Figure 3-2) was collected on November 6, 2009. The EPC used in the risk calculations was 4.5 mg/kg.

Because DDE (risk = 2.3E-06) contributes to a total pesticide risk of 3E-05 for the resident, it is retained as a sediment human health RCOC for consideration for possible remedial action in the feasibility study.

Dieldrin is a COC for the resident (risk = 1.0E-05 and an HQ = 0.11) and industrial worker (risk = 2.4E-06). It was detected in 3/5 samples, with these three detections being estimated (i.e., J- qualified). Concentrations range from nondetect to 0.5 mg/kg, with a mean of 0.112 mg/kg. Sample GOSB-51 (Figure 3-2) had the highest concentration. The EPC used in the risk calculations is 0.34 mg/kg.

Dieldrin is an organochlorine insecticide that was used from the 1950s to 1970 on crops such as corn and cotton. Large-scale use of dieldrin was discontinued in 1974. It tightly binds to sediment and soil particles and is extremely persistent in the environment. As a result of its widespread use and persistence, dieldrin can be found throughout the environment at very low levels. Its presence is consistent with the potential for use as a pesticide at this subunit.

While residual dieldrin may be found on the SRS due to either its use as an insecticide at SRS or as a result of its agricultural use in nearby areas off the SRS site, there is no background level to compare. Given that dieldrin contributes to a total pesticide risk of 3E-05 for the resident as well as to a total target organ HI of 1.4 (i.e., liver), and contributes to a total pesticide risk of 7E-06 for

the industrial worker, it is retained as a sediment human health RCOC for consideration for possible remedial action in the feasibility study.

Heptachlor epoxide is a COC for the resident (risk = 9.1E-06) and industrial worker (risk = 1.9E-06). It was detected in 3/5 samples, with one being estimated (i.e., J-qualified). Concentrations range from nondetect to 0.845 mg/kg. Sample GOSB-51 (Figure 3-2) had the highest concentration. The EPC used in the risk calculations is 0.65 mg/kg.

Heptachlor epoxide is a breakdown product of Heptachlor, an organochlorine insecticide. Soil microorganisms transform heptachlor to heptachlor epoxide, which is more stable in the environment than its parent and, therefore, more likely to be detected. It is both more soluble in water and more persistent in the environment than its parent heptachlor.

While the use of heptachlor at SRS is unknown, its presence is consistent with the potential for use as a pesticide at this subunit. Given the heptachlor epoxide contributes to a total pesticide risk or 3E-05 for the resident as well as to a total target organ HI of 1.4 (i.e., liver) and contributes to a total pesticide risk of 7E-06, it is retained as a sediment human health RCOC for consideration for possible remedial action in the feasibility study.

Potassium-40 is a COC for the resident (risk = 2.1E-05) and the industrial worker (risk = 1.4E-05) scenarios. It was detected in 5/5 samples, with none being estimated values (J-qualified). Concentrations range from 1.26 to 2.96 picocuries per gram (pCi/g). Sample location GOSB-52 (Figure 3-2) had the highest detected concentration. The EPC used in the risk calculations is 2.96 pCi/g.

Potassium-40 is a naturally occurring constituent that is common in the environment. The SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

Potassium-40 is a naturally occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238, and thorium-232 (and their daughter products).

Potassium-40 is not associated with any of the reactor processes at SRS. Potassium-40 is not recommended for further remedial evaluation as a human health RCOC in sediment for either of the receptor scenarios based on the following lines of evidence:

- The subunit activity is within the SRS soil background activity range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- Potassium-40 is not associated with any of the reactor processes

Uranium-238 is a COC for the resident (risk = 7.5E-05) and industrial worker (risk = 4.7E-05) scenarios. While uranium-238 was not analyzed however, its presence is based on the detection of one of its daughters, lead-214. Lead-214 was detected in 5/5 samples, with none being estimated values (J-qualified). Concentrations range from 0.636-1.01 pCi/g. Sample location GOSB-52 (Figure 3-1) had the highest detected concentration. The EPC for uranium-238 used in the risk calculations is 0.934 pCi/g based on lead-214.

Uranium is a naturally occurring constituent that is common in the environment. The maximum detected concentration of a daughter of uranium-238, thorium-230 in the SRS background dataset, is 2.78 pCi/g.

Uranium-238 is naturally occurring constituent of primordial origin with a half- life of 4.5 billion years. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238, and thorium-232 (and their daughter products).

Uranium-238 is not recommended for further remedial evaluation as a human health RCOC in sediment for either the resident or industrial worker receptor scenarios based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range
- It is a naturally occurring constituent that is common in SRS background soils

C-2.3.1.2 Basin Surface Water

Table C-4 identifies aluminum, cadmium, chromium, cobalt, iron, lead, silver, alpha-benzene hexachloride, beta-benzene hexachloride, dichlorodiphenyldichloroethane (DDD), DDE, dieldrin, and bismuth-214 as human health surface water COCs because these constituent maximum-detected concentrations and activity concentrations from Table A.1.2 in Appendix A exceeded surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Aluminum is initially identified as a surface water COC based on the maximum detected concentration 33,200 micrograms per liter (µg/L) and exceeding the tap water RSL of 20,000 µg/L. It was detected in 11/11 samples, with two being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-50 (Figure 3-3). It had a mean of 7,439 µg/L. However, using surface water sample data collected in 2016, the maximum detected concentration of aluminum in filtered and unfiltered samples are 105 µg/L and 810 µg/L, respectively, both well below the tap water RSL. The more recent 2016 data results suggest that high turbidity likely was the cause for the high maximum detected aluminum result in the full dataset.

Aluminum is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of aluminum. It was detected in the background surface water dataset for the LTR OU, with a maximum concentration of 6,060 µg/L. Both the filtered and unfiltered maximum results from the 2016 sampling event for the GOSB Interior Subunit surface water are well below the background maximum.

Aluminum is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are well below the screening level

- It is a naturally occurring constituent that is common in SRS background surface water and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Cadmium is initially identified as a surface water COC based on the maximum detected concentration of 23.1 µg/L, exceeding the MCL of 5 µg/L. It was detected in only 3/11 samples, with none being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-53 (Figure 3-3). It had a mean concentration of 4.8 µg/L. However, considering surface water sample data collected in 2016, the results for cadmium in filtered and unfiltered samples were nondetect. Therefore, results from the 2016 sample event do not exceed the screening level. The more recent data results suggest that high turbidity likely was the cause for the high maximum detected cadmium result in the dataset.

Cadmium is a naturally occurring constituent present in geologic material, including soil and sediment, and collecting a highly turbid sample can result in detections of cadmium. Cadmium was detected in the LTR OU at a maximum concentration of 4 µg/L.

Cadmium is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the ~~screening level~~MCL
- The subunit concentrations from the most recent sampling event are below the ~~screening level~~MCL
- It is a naturally occurring constituent that is common in SRS background surface water and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Chromium is initially identified as a surface water COC based on the maximum detected concentration of 147 µg/L, exceeding the MCL of 100 µg/L. It was detected in 8/11 samples, with

five being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-50 (Figure 3-3). It had a mean concentration of 29.8 µg/L. However, considering surface water sample data collected in 2016, the results for chromium in filtered and unfiltered samples were nondetect and 1.26 µg/L, respectively, both well below the MCL. The more recent data results suggest that high turbidity likely was the cause for the high maximum detected chromium result in the dataset.

Chromium is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of chromium. It was detected in the LTR OU at a maximum concentration of 2.33 µg/L. Results from the 2016 sample event are less than the maximum LTR OU background for chromium.

Chromium is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the ~~screening level~~MCL
- ~~The~~ The subunit concentrations from the most recent sampling event are well below ~~the screening level~~MCL
- It is a naturally occurring constituent that is common in SRS background surface and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Cobalt is initially identified as a surface water COC based on the maximum detected concentration of 13.6 µg/L, exceeding the tap water RSL of 6 µg/L. It was detected in only 3/11 samples, with one being estimated (i.e., J-qualified). The maximum detected concentration taken from sample location GOSB-50 (Figure 3-3). It had a mean concentration of 3.1 µg/L. However, considering surface water sample data collected in 2016, the results for cobalt in filtered and unfiltered samples were 2.79 µg/L and nondetect, respectively, both well below the RSL. The more recent data results suggest that high turbidity likely was the cause for the high maximum detected chromium result in the dataset.

Cobalt is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of cobalt. It was detected in the LTR OU at a maximum concentration of 13.1 µg/L. Results from the 2016 sample event are less than the maximum LTR OU background for cobalt.

Cobalt is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are well below the screening level
- It is a naturally occurring constituent that is common in SRS background surface water and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Iron is initially identified as a surface water COC based on the maximum detected concentration of 25,550 µg/L, exceeding the tap water RSL of 14,000 µg/L. It was detected in 11/11 samples, with none being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-53 (see Figure 3-3 in Chapter 3), was collected on November 12, 2009. It had a mean concentration of 8,299 µg/L. However, considering surface water sample data collected in 2016, the results for iron in filtered and unfiltered samples were 6,150 µg/L and 5,920 µg/L, respectively, both of which are well below the RSL. The more recent data results suggest that high turbidity likely was the cause for the high maximum detected iron result in the dataset.

Iron is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of iron. It was detected in the LTR OU at a maximum concentration of 12,400 µg/L. Results from the 2016 sample event are less than the maximum LTR OU background for iron.

Iron is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are well below the screening level
- It is a naturally occurring constituent that is common in SRS background surface water and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Lead is initially identified as a surface water COC based on the maximum detected concentration of 131 µg/L, exceeding the MCL of 15 µg/L. It was detected in 5/11 samples, with two being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-53 (Figure 3-3). However, considering surface water sample data collected in 2016, the results for lead in filtered and unfiltered samples were nondetect and 4.02 µg/L, respectively, both well below the MCL. The more recent data results suggest that high turbidity likely was the cause for the high maximum detected lead result in the dataset.

Lead is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of lead. It was detected in the LTR OU at a maximum concentration of 20 µg/L. Results from the 2016 sample event are less than the maximum LTR OU background for lead.

Lead is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~The~~ The subunit concentrations from the most recent sampling event are well below the ~~screening level~~MCL
- It is a naturally occurring constituent that is common in SRS background surface water and results from the most recent sampling event are within the background surface water concentration range
- It appears that the initial results in the dataset are associated with high turbidity in the samples

Silver is initially identified as a surface water COC based on the maximum detected concentration of 299 µg/L, exceeding the tap water RSL of 94 µg/L. It was detected in 9/11 samples, with six of these results being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-50 (Figure 3-3) and was collected on November 12, /2009. It had a mean concentration of 60.1 µg/L. However, considering surface water sample data collected in 2016, the results for silver in filtered and unfiltered samples were nondetect and 4.33 µg/L, respectively, both well the below maximum detected silver result in the full dataset.

Silver is a naturally occurring constituent present in geologic material, including soil and sediment. Collecting a highly turbid sample can result in detections of silver.

Silver is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are well below the screening level
- It appears that the initial results in the dataset are associated with high turbidity in the samples

DDD (dichlorodiphenyldichloroethane) is initially identified as a surface water COC based on the maximum detected concentration of 0.041 µg/L, exceeding the tap water RSL of 0.032 µg/L. It was detected in 3/11 samples, with two being of these results being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-51 (Figure 3-3). It had a mean concentration of 0.01 µg/L. However, considering surface water sample data collected in 2016, the results for DDD in filtered and unfiltered samples were nondetect.

DDD, an insecticide and a metabolite of DDT, is a potent insecticide used to control vectors that transmit malaria and typhus. While it shares several characteristics to that of DDT, DDD is considered to be slightly less toxic than DDT. Because it is highly persistent in the environment, trace amounts may be found everywhere. Airborne releases during use may be carried long distances in the atmosphere and deposited by wet or dry deposition. DDD use at SRS is not fully known.

DDD is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~It is infrequently detected, suggesting residual presence only~~
- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are nondetect

DDE (dichlorodiphenyldichloroethylene) is initially identified as a surface water COC based on the maximum detected concentration of 0.08 µg/L, exceeding the tap water RSL of 0.032 µg/L. It was detected in 5/11 samples, with three being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-51 (Figure 3-3). It had a mean concentration of 0.023 µg/L. However, considering surface water sample data collected in 2016, the results for DDE in filtered and unfiltered samples were nondetect.

DDE, a breakdown product of DDT in the environment, is a pesticide once widely used to controls insects on agricultural crops and insects that carry diseases such as malaria and typhus, and a contaminant in DDT. DDT was sprayed extensively on forested areas to controls insects. Use of DDT was banned in 1973, although DDT and associated DDE may continue to enter the environment due to its use in other parts of the world. DDE is formed by the loss of hydrogen chloride from DDT. Because DDE is highly persistent in the environment, trace amounts may be found everywhere. Airborne releases during use may be carried long distances in the atmosphere and deposited by wet or dry deposition. DDT use at SRS is not fully known.

DDE is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~It is infrequently detected, suggesting residual presence only~~
- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are nondetect

Dieldrin is initially identified as a surface water COC based on the maximum detected concentration of 0.0116 µg/L, exceeding the tap water RSL of 0.0018 µg/L. It was detected in 1/11

samples, with 2 being estimated (i.e., J-qualified). The maximum detected concentration is from sample location GOSB-51 (Figure 3-3). It had a mean concentration of 0.0056 µg/L. However, considering surface water sample data collected in 2016, the results for DDE in filtered and unfiltered samples were nondetect.

Dieldrin is an organochlorine insecticide used extensively from the 1950s to the 1970s in the agricultural sector, including for corn and cotton. Due to its toxicity and persistence in the environment, dieldrin is banned and no longer used. However, airborne releases can occur due to resuspension from soil and deposit by wet or dry deposition. While dieldrin use at SRS is not fully known, it is likely present due to nearby offsite uses, therefore, residual DDE may be detected.

Dieldrin is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~It is infrequently detected, suggesting residual presence only~~
- The mean concentration is below the screening level
- The subunit concentrations from the most recent sampling event are nondetect

Alpha-benzene hexachloride is initially identified as a surface water COC based on the maximum detected concentration of 0.0123 µg/L, exceeding the tap water RSL of 0.0072 µg/L. It was detected in only 1/11 samples, with this result being estimated (i.e., J-qualified). The detected concentration is from sample location GOSB-63 (Figure 3-3). It had a mean concentration for the entire dataset of 0.0038 µg/L, including nondetect values from the 2009 sampling event.

Alpha-benzene hexachloride (also called hexachlorocyclohexane [HCH]) is a component in technical grade HCH, which is used as an insecticide. Although technical grade HCH is no longer used in the U.S., alpha-benzene hexachloride, along with several other HCH isomers, have been found in soil and surface water due to their persistence in the environment. Releases to the air can travel long distances and be deposited by wet or dry deposition. Movement in the environment may occur as a result of volatilization from soils and water as well as wind erosion, and from suspension in water due to runoff from areas treated with technical grade HCH. While residual alpha-benzene hexachloride may be detected on the SRS due to either use of technical grade HCH

as an insecticide at SRS or as a result of its agricultural use in nearby areas off the SRS site, there is no background level to compare.

Alpha-benzene hexachloride is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~It is infrequently detected, suggesting residual presence only~~
- The single detection is J-qualified
- The subunit mean concentration from the most recent sampling event is below the screening level

Beta-benzene hexachloride is initially identified as a surface water COC based on the maximum detected concentration of 0.0348 µg/L, exceeding the tap water RSL of 0.025 µg/L. It was detected in only 1/11 samples, with this result not being estimated (i.e., J-qualified). The detected concentration is from sample location GOSB-68 (Figure 3-3). It had a mean concentration for the entire dataset of 0.006 µg/L.

Beta-benzene hexachloride (also called HCH) is also component in technical grade HCH (as discussed above). While residual beta-benzene hexachloride may be detected on the SRS due to either use of technical grade HCH as an insecticide at SRS or as a result of its agricultural use in nearby areas off the SRS site, there is no background level to compare to.

Beta-benzene hexachloride is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- ~~It is infrequently detected, suggesting residual presence only~~
- The single detection is J-qualified
- The subunit mean concentration from the most recent sampling event is below the screening level

Bismuth-214 is an initial COC based on an exceedance of the tap water MCL of 15 pCi/L. It was detected in 3/4 samples, with these three results all being estimated (i.e., J-qualified). The

maximum activity concentration of 23 pCi/L is from sample location GOSB-50 (Figure 3-3). It had a mean concentration of 15 µg/L.

Bismuth-214 is a naturally occurring daughter of radon and radium and was not used at SRS. Due to the high solubility and mobility of radium, and especially radon, there are many examples of elevated levels of bismuth-214 in SRS groundwater, with concentrations as high as 500 pCi/L not unknown. Bodies of surface water that are fed by groundwater, such as the small creeks, can inherit bismuth-214 concentrations. Because bismuth-214, and its parents radon and radium, were not used at SRS, and because elevated levels of bismuth-214 are well known in SRS groundwater, the detections of bismuth-214 are accepted as real and are believed to be natural.

Bismuth-214 is not recommended for further remedial evaluation as a human health RCOC in surface water based on the following lines of evidence:

- It is a daughter of naturally occurring radium
- It has a very short half-life of 19.9 minutes
- It had no historical use at SRS
- The mean activity concentration is equal to the ~~screening level~~MCL
- The detected concentrations likely are due to high sample turbidity

C-2.3.1.3 HHRA Conclusion for GOSB Interior Subunit

Sediment media:

Resident scenario: Human health RCOCs include alpha-chlordane (risk = 2.6E-06), gamma-chlordane (risk = 6.4E-06), DDE (risk = 2.3E-06); dieldrin (risk = 1.0E-05), and heptachlor epoxide (risk = 9.1E-06). Total cumulative risk associated with these RCOCs = 3.0E-05.

Industrial Worker scenario: Human health RCOCs include gamma-chlordane (risk = 1.4E-06), dieldrin (risk = 2.4E-06), and heptachlor epoxide (risk = 1.9E-06). Total cumulative risk associated with these RCOCs = 5.7E-06.

Surface water media:

No surface water RCOCs.

C-2.3.2 G-Area Oil Seepage Basin Berm Subunit

C-2.3.2.1 Soil Media

Table C-5 presents the results of soil screening for the GOSB Berm Subunit. Human health COPCs for soil include aluminum, arsenic, chromium, iron, lead, vanadium, benzo[a]pyrene, benzo[b]fluoranthene, potassium-40, and uranium-238. These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times SRS mean background concentrations.

Table C-6 presents the total HI (1.2) and total media risk (1.8E-04) for the resident exposure scenario and the associated COCs: arsenic, chromium, benzo[a]pyrene, benzo[b]fluoranthene, potassium-40, and uranium-238.

Table C-7 presents the total HI (0.13) and total media risk (6.4E-05) for the industrial worker exposure scenario and the associated COCs: arsenic, chromium, potassium-40, and uranium-238.

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident (risk = 1.1E-05) and the industrial worker (risk = 2.5E-06) scenarios. It was detected in 10/13 samples, with five results being estimated values (i.e., J-qualified). Concentrations range from nondetect to 15.8 mg/kg, with a mean concentration of 3.45 mg/kg. Sample location GOSB-39 (Figure 3-9) had the highest detected concentration. The EPC used in the risk calculations was 7.42 mg/kg.

Arsenic is a naturally occurring constituent that is common in the environment. The maximum detected concentration in the SRS Soil background dataset was 22.9 mg/kg. Both the maximum detected soil concentration and the EPC for this subunit are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust, being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure-treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and in fruit orchards. However, no significant quantities of pressure-treated wood were used in buildings within the GOSB OU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as human health RCOC in soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration ranges
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- Arsenic products where either not used or where of limited use at SRS

Chromium is identified as a COC for the resident (risk = 7.2E-05) and the industrial worker (risk = 3.4E-06) scenarios. It was detected in 13/13 samples, with no results being estimated values (i.e., J-qualified). Concentrations range from 2.73 to 32.7 mg/kg. Sample location GOSB-35 (Figure 3-9) had the highest detected concentration. The EPC used in the risk calculations was 21.4 mg/kg.

Chromium is a naturally occurring constituent that is common in the environment. The maximum concentration in the SRS Soil background dataset is 54.3 mg/kg. Soil concentrations from this subunit are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium, and hexavalent chromium. Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium. The trivalent form of chromium is considered noncancerous, whereas the hexavalent form is considered cancerous. Chromium compounds in the trivalent or hexavalent chromium forms are used for chrome plating, dyes and pigments manufacturing, and leather and wood preservation. Chromate, which is an oxyanion of

chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since chromium is not considered an important source contaminant at the GOSB OU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined during the chemical analysis, only results for total chromium were provided.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg and industrial worker RSL = 6.3 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions, it is likely the trivalent form of chromium is most prevalent at the GOSB OU. In addition, the RSLs for trivalent chromium are 1.2E+05 mg/kg for the residential exposure scenario and 1.8E+06 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a human health RCOC in soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- The valence state of chromium was not determined; the analytical result was for total chromium
- Risk estimate is biased high because the most conservative RSL (hexavalent chromium) was used; however, this form is not expected to be present based on unit history
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard)

Polycyclic Aromatic Hydrocarbons (PAHs) benzo[a]pyrene and benzo[b]fluoranthene are COCs for the resident only (risk = 5.7E-06 and 1.2E-06, respectively). Each of these PAHs are considered ubiquitous, that is commonly found in soils, particularly surface soils as a result of being a component of crude oil. Thus, combustion of oil and oil products such as gasoline and diesel fuel

results in the emission of PAHs into the air, which eventually settle to ground surface. PAHs also are produced from the combustion of organic materials and are found in smoke from forest fires. These PAHs are present in the SRS background soil data set with maximum detected concentrations of 0.052 mg/kg (benzo[a]pyrene) and 0.094 mg/kg (benzo[b]fluoanthene).

Benzo[a]pyrene was detected in only 1/13 samples, which is not estimated (i.e., J-qualified) and benzo[b]fluoranthene was detected in 2/13, with one result being estimated (i.e., J-qualified). Both of these PAHs maximum concentrations are from sample GOSB-40 (Figure 3-9). The EPCs used in the risk calculations are 0.0195 mg/kg for benzo[a]pyrene and 0.187 mg/kg for benzo[b] fluoranthene. The mean concentrations for benzo[a]pyrene and benzo[b]fluoranthene are 0.0123 mg/kg and 0.0211 mg/kg, respectively. The mean concentration for benzo[b]fluoranthene is below the maximum detected SRS background value. According to *Statistical Summary Table, Background Unit: Soil (all depths),* Table A.6.3 in Appendix A, PAHs, namely acenaphthalene, anthracene, benzo[b]fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, and pyrene have been detected in soils upgradient of the GOSB OU. The maximum detected concentration of benzo[b]fluoranthene of 0.547 mg/kg in the upgradient dataset is greater than the basin berm maximum detected concentration. This suggests the ubiquitous nature of PAHs.

The risks calculated for benzo[a]pyrene, and benzo[b]fluoranthene are based on the 2016 RSLs of 0.016 mg/kg and 0.16 mg/kg, respectively. Use of the RSL calculator function resulted in generating the new RSLs (2017 based on new toxicity information) of 0.115 and 1.15 for benzo[a]pyrene, and benzo[b]fluoranthene, respectively. Using these updated values for PAHs results in risks for each of these constituents being less than 1E-06.

PAHs are not recommended for further remedial evaluation as a human health RCOCs in based on the following lines of-evidence:

- They are ubiquitous PAHs with multiple man-made and natural sources
- ~~They were infrequently detected above the detection limit~~
- The evaluation used conservative RSLs that have recently been replaced

- The risk estimate is biased high since the maximum detected concentration was used as the EPC
- Use of the 2017 RSLs results in a risk less than 1E-06

Potassium-40 is a COC for the resident (risk = 1.5E-05) and the industrial worker (risk = 1.0E-05) scenarios. It was detected in 13/13 samples, with no results being estimated (i.e., J-qualified). Concentrations range from 1.43 pCi/g to 3.2 pCi/g. Sample location GOSB-42 (Figure 3-9) had the highest detected concentration. The EPC used in the risk calculations was 2.21 pCi/g.

Potassium-40 is a naturally occurring constituent that is common in the environment. The SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

Potassium-40 is a naturally occurring constituent of primordial origin with a half-life of 1.2 billion years. As previously discussed, primordial nuclides are those that are long lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238 and thorium-232 (and their daughter products). Potassium-40 is not associated with any of the reactor processes at SRS.

Potassium-40 is not recommended for further remedial evaluation as a human health RCOC in soil for any of the receptor scenarios based on the following lines-of-evidence:

- Unit activities are within the SRS soil background activity range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- Potassium-40 is not associated with any of the reactor processes

Uranium-238 is a COC for the resident (risk = 7.7E-05) and industrial worker (risk = 4.8E-05) scenarios. While U-238 was not analyzed however, its presence is based on the detection of one of its daughters, lead-214. Lead-214 was detected in 13/13 samples, with none being estimated values (J-qualified). Concentrations range from 0.737 to 1.02 pCi/g. Sample location GOSB-42

(Figure 3-9) had the highest detected concentration. The EPC for uranium-238 used in the risk calculations is 0.953 pCi/g, based on lead-214.

Uranium is a naturally occurring constituent that is common in the environment. The maximum detected concentration of a daughter of uranium-238 and thorium-230 in the SRS background dataset is 2.78 pCi/g.

Uranium-238 is a naturally occurring constituent of primordial origin with a half-life of 4.5 billion years. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238 and thorium-232 (and their daughter products).

Uranium-238 is not recommended for further remedial evaluation as a human health RCOC in sediment for either the resident or industrial worker receptor scenarios based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range
- It is a naturally occurring constituent that is common in SRS background soils

C-2.3.2.2 HHRA Conclusion for GOSB Berm Subunit

Soil media:

No human health RCOCs.

C-2.3.3 Pipeline Subunit

C-2.3.3.1 Soil media

According to the CSM for the Pipeline Subunit presented in Figure 2-9 , the soil media within this subunit is below ground surface and, therefore, inaccessible for human receptor contact. Because there is no potential for contact, no exposure pathways exist for either the resident or industrial worker receptors. As a result, no risk screening or subsequent risk calculations were performed for the Pipeline Subunit.

C-2.3.3.2 HHRA Conclusion for Pipeline Subunit

Soil media:

No human health RCOCs.

C-2.3.4 Effluent Discharge Subunit

C-2.3.4.1 Soil Media

Table C-8 presents the results of the soil screening for the Effluent Discharge Subunit. Human health COPCs for soil for include aluminum, arsenic, chromium, cobalt, iron, vanadium, benzo[a]pyrene, thorium-232, and uranium-238. These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times SRS mean background concentrations.

Table C-9 presents the total HI (1.05) and total media risk (4.7E-04) for the resident exposure scenario and the associated COCs arsenic, chromium, benzo[a]pyrene, Th-232, and U-238.

Table C-10 presents the total HI (0.07) and total media risk (2.6E-04) for the industrial worker exposure scenario and associated COCs arsenic, chromium, thorium-232, and uranium-238.

The refinement/uncertainty evaluation is presented below for each COC.

Arsenic is identified as a COC for the resident (risk = 9.1E-06) and industrial worker (risk = 2.1E-06) scenarios. It was detected in 6/6 samples, with three of the results being estimated values (i.e., J-qualified). Concentrations range from 2.55 to 8.55 mg/kg, with the mean concentration at 4.48 mg/kg. Sample location GOSB-30 (Figure 3-17) had the highest detected concentration. The EPC used in the risk calculations was 6.21 mg/kg.

Arsenic is a naturally occurring constituent that is common in the environment. The maximum detected concentration in the SRS Soil background dataset is 22.9 mg/kg. Soil concentrations from this subunit are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust, being present in soil and minerals. Arsenic combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and fruit orchards. However, no significant quantities of pressure treated wood were used in buildings within the GOSB OU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as human health RCOC in soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- Arsenic products were either not used or were of limited use at SRS

Chromium is identified as a COC for the resident (risk = 5.9E-05) and the industrial worker (risk = 2.8E-06) scenarios. It was detected in 6/6 samples with none being estimated (i.e., J-qualified). Concentrations range from 6.61 to 20.7 mg/kg. Sample location GOSB-30 (Figure 3-17) had the highest detected concentration. The EPC used in the risk calculations was 17.8 mg/kg.

Chromium is a naturally occurring constituent that is common in the environment. The maximum concentration in the SRS Soil background dataset is 54.3 mg/kg. Soil concentrations from this subunit are within the range of concentrations found in SRS background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium and hexavalent chromium. Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium. The trivalent chromium form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds in the trivalent or hexavalent chromium forms are used for chrome plating, dyes and pigments manufacturing, and leather and wood preservation. Chromate, which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since chromium is not considered an important source contaminant at the GOSB OU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined during the chemical analysis, only results for total chromium were provided.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg and industrial worker RSL = 6.3 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions, it is likely the trivalent form of chromium is most prevalent at the GOSB OU. In addition, the RSLs for trivalent chromium are 1.2E+05 mg/kg for the residential exposure scenario and 1.8E+06 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a human health RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range

- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background
- The valence state of chromium was not determined; analytical result was for total chromium
- Risk estimate is biased high because the most conservative RSL (hexavalent chromium) was used; however, this form is not expected to be present based on unit history and environmental conditions
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard)

Polycyclic Aromatic Hydrocarbon (PAH) benzo[a]pyrene is a COC for the resident only (risk = 1.7E-06). PAHs are considered ubiquitous (i.e., commonly found in soils, particularly surface soils as a result of being a component of crude oil). Thus, combustion of oil and oil products such as gasoline and diesel fuel results in the emission of PAHs into the air that eventually settle to ground surface. PAHs also are produced from the combustion of organic materials and are found in smoke from forest fires. Several PAHs are present in the SRS background soil data set, including benzo[a]pyrene at 0.052 mg/kg.

Benzo[a]pyrene was detected in only 1/6 samples, which is estimated (i.e., J-qualified). This PAH had a maximum concentration of 0.0273 mg/kg from location GOSB-32 (Figure 3-17). The EPC used in the risk calculations is 0.0273 mg/kg. The mean concentration for benzo[a]pyrene is 0.019 mg/kg. According to the *Statistical Summary Table, Background Unit: Soil (all depths),* Table A.6.3 in Appendix A, PAHs, namely acenaphthalene, anthracene, benzo[b]fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno[1,2,3-cd]pyrene, and pyrene have been detected in soils upgradient of the GOSB OU. This suggests the ubiquitous nature of PAHs.

The risk calculated for benzo[a]pyrene is based on the 2016 RSL of 0.016 mg/kg. However, as previously discussed, using updated toxicity information (2017) results in the RSL for benzo[a]pyrene being 0.115 mg/kg, the resultant risk for this PAH would be less than 1E-06.

The PAH, benzo[a]pyrene, is not recommended for further remedial evaluation as a human health RCOC in based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources
- ~~PAHs were infrequently detected above the detection limit~~
- The evaluation used conservative RSLs that have recently been replaced
- The risk estimate is biased high since the maximum detected concentration was used as the EPC
- Use of the 2017 RSL results in a risk less than 1E-06

Thorium-232 is a COC for the resident (risk = 2.8E-04) and the industrial worker (risk = 1.8E-04), scenarios. The Thorium Series (thorium-232) evaluation includes not only the measured activity concentration of thorium-232 specifically, but also considers any analytical results from its daughter products (e.g., actinium-228, thorium-228, lead-212, and thallium-208) since these isotopes are assumed to be present in secular equilibrium. Data screening performed using the highest detected activity concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, thorium-228 had the maximum activity concentration (2.75 pCi/g, which is also the EPC). Sample location GOSB-56 had the highest detected concentration (Figure 3-17). The daughter products are not evaluated separately since they are considered in the thorium-232 secular equilibrium PRG.

Background comparisons for the thorium-232 series includes consideration of the range of activity concentrations for the entire decay chain (i.e., includes daughter products). The SRS Soil background maximum detected activity concentration is 6.75 pCi/g (based on the radium-228 result). Soil activity concentrations from this subunit are within the range of activity concentrations found in background soil.

Thorium-232 is a naturally occurring constituent of primordial origin with a half-life of 14 billion years. As previously discussed, primordial nuclides are those that are long lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238, and thorium-232 (and their daughter products). Thorium series concentrations are typical of natural thorium.

Thorium-232 is not recommended for further remedial evaluation as a human health RCOC in soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activity concentrations are within the SRS soil background activity concentration range
- It is a naturally occurring constituent that is common in SRS background soils
- It does not appear to be unit related since it is indistinguishable from background

Uranium-238 is a COC for the resident (risk = 1.2E-04) and the industrial worker (risk = 7.4E-05) scenarios. These risks are based on the activity concentration of the daughter thorium-230. Thorium-230 was detected in 2/2 samples, with no result being an estimated value (i.e., J-qualified). Sample location GOSB-56 (Figure 3-17) had the highest detected activity concentration (i.e., 1.47 pCi/g). The EPC used in the risk calculations was 1.47 pCi/g.

Uranium is a naturally occurring constituent that is common in the environment. The maximum detected activity concentration for uranium-238 in the SRS Soil background data set is 2.78 pCi/g. The maximum detected activity concentration for any daughter in the uranium decay series collected in the Effluent Discharge Subunit is less than background.

Uranium-238 is a naturally occurring constituent of primordial origin with a half-life of 4.5 billion years. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238, and thorium-232 (and their daughter products).

Uranium-238 is not recommended for further remedial evaluation as a human health RCOC in soil for any receptor scenario based on the following lines of evidence:

- Unit activity concentrations are consistent with the SRS soil background activity concentration range
- It is a naturally occurring constituent that is common in SRS background soils

C-2.3.4.2 HHRA Conclusion for Effluent Discharge Subunit

Soil media:

No human health RCOCs.

C-3. SUMMARY/CONCLUSION OF THE HUMAN HEALTH RISK ASSESSMENT

The table presented below shows the overall summary of the HHRA by subunit. The revised CSM is presented in Chapter 3.

Summary of the GOSB OU Human Health Risk Assessment

Subunit	Human Health Residential RCOCs	Human Health Industrial Worker RCOCs
GOSB Interior	Sediment (0-1 ft) Alpha-chlordane (risk = 2.6E-06) Gamma-chlordane (risk = 6.4E-06) DDE (risk = 2.3E-06) Dieldrin (risk = 1.0E-05) Heptachlor epoxide (risk = 9.1E-06) TCR = 3.0E-05 Surface Water None	Sediment (0-1 ft) Gamma-chlordane (risk = 1.4E-06) Dieldrin (risk = 2.4E-06) Heptachlor epoxide (risk = 1.9E-06) TCR = 5.7E-06
GOSB Berm	Soil (0-1 ft) None	Soil (0-1 ft) None
Pipeline	NA: no exposure[1]	NA: no exposure[1]
Effluent Discharge	Soil (0-1 ft) None	Soil (0-1 ft) None

NA = not applicable
TCR = total cumulative risk
[1] Pipeline subunit does not offer a complete exposure pathway for human receptors (potential contamination at depth, 8-10 ft bgs)

C-4. REFERENCES

SCDHEC, 2014. *Water Classification & Standards,* R.61-68, South Carolina Department of Health and Environmental Control, Bureau of Water, Columbia, SC

SRNS, 2017, *Remedial Investigation/Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U),* SRNS-RP-2017-00139, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USEPA, 2016. USEPA Regional Screening Levels, U.S. Environmental Protection Agency, National Center for Environmental Assessment, Arlington, VA, accessed May 2017, https://www.epa.gov/risk/regional-screening-levels-rsls

USEPA, 2017. *Preliminary Remediation Goals for Radionuclides,* U.S. Environmental Protection Agency, Office of Land and Emergency Management, Washington, DC, accessed May 2017, https://epa-prgs.ornl.gov/radionuclides

WSRC, 1991. *RCRA Facility Investigation/Remedial Investigation Plan for the G-Area Oil Seepage Basin (U), WRSC-RP-91-200, Revision 0*, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Background Soils Statistical Summary Report for the Savannah River Site*, ERD-EN-2005-0223 Rev. 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

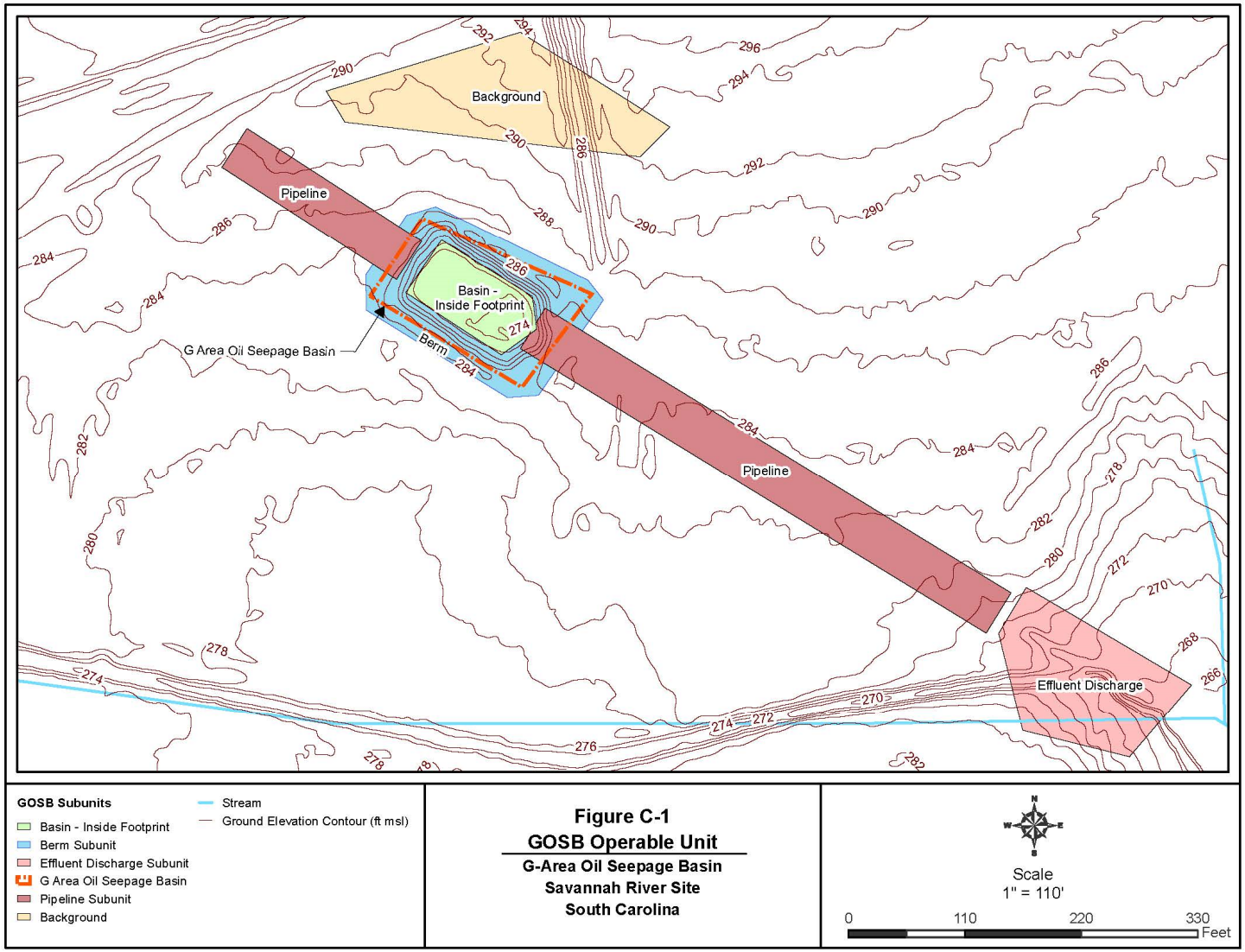

Figure C-1. GOSB Operable Unit

Table C-1.Human Health COPC Screening for GOSB Interior Subunit Sediment Media (0-1 ft)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	5.72E+03	7.7E+03	0.1xRSL	no	1.05E+04	no	no
Antimony	2.93E+00	3.1E+00	0.1xRSL	no	2.69E+00	YES	no
Arsenic	2.90E+00	6.8E-01	RSL	YES	4.28E+00	no	no
Barium	9.20E+01	1.5E+03	0.1xRSL	no	3.91E+01	YES	no
Cadmium	4.19E+00	7.1E+00	0.1xRSL	no	4.83E-01	YES	no
Calcium	1.57E+04	EN[6]	Nutrient	no	4.76E+02	YES	no
Chromium[7]	5.12E+01	3.0E-01	RSL	YES	1.54E+01	YES	YES
Cobalt	2.98E+00	2.3E+00	0.1xRSL	YES	1.55E+00	YES	YES
Copper	4.81E+01	3.1E+02	0.1xRSL	no	4.34E+00	YES	no
Cyanide	8.10E-01	2.3E+00	0.1xRSL	no	NA[8]	---	no
Iron	9.07E+03	5.5E+03	0.1xRSL	YES	1.27E+04	no	no
Lead	5.20E+01	4.0E+01	0.1xRSL	YES	1.03E+01	YES	YES
Magnesium	3.68E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	2.77E+01	1.8E+02	0.1xRSL	no	1.53E+02	no	no
Mercury[9]	5.78E-01	7.8E-01	0.1xRSL	no	7.10E-02	YES	no
Nickel	2.49E+01	1.5E+02	0.1xRSL	no	3.48E+00	YES	no
Potassium	1.40E+02	EN[6]	Nutrient	no	2.16E+02	no	no
Silver	3.14E+02	3.9E+01	0.1xRSL	YES	7.28E-01	YES	YES
Sodium	3.88E+01	EN[6]	Nutrient	no	4.02E+01	no	no
Thallium	4.64E+00	7.8E-02	0.1xRSL	YES	3.12E+00	YES	YES
Vanadium	3.80E+01	3.9E+01	0.1xRSL	no	3.91E+01	no	no
Zinc	4.49E+02	2.3E+03	0.1xRSL	no	9.47E+00	YES	no
Organics *(mg/kg)*							
1,3-Dichlorobenzene	8.24E-03	NA[10]	---	---	NA[8]	---	no
1,4-Dichlorobenzene	3.44E-02	2.6E+00	RSL	no	NA[8]	---	no
2-Methylnaphthalene	2.58E+00	2.4E+01	0.1xRSL	no	NA[8]	---	no
Acetone	2.84E-02	6.1E+03	0.1xRSL	no	NA[8]	---	no
Anthracene	1.85E-02	1.8E+03	0.1xRSL	no	NA[8]	---	no
Benzo(g,h,i)perylene	6.70E-02	NA[10]	---	---	NA[8]	---	no
Benzo[a]anthracene	1.95E-01	1.6E-01	RSL	YES	2.45E-02	YES	YES
Benzo[a]pyrene	1.38E-01	1.6E-02	RSL	YES	2.53E-02	YES	YES
Benzo[b]fluoranthene	2.47E-01	1.6E-01	RSL	YES	4.10E-02	YES	YES
Caprolactam	1.42E+01	3.1E+03	0.1xRSL	no	NA[8]	---	no
Carbon disulfide	1.62E-03	7.7E+01	0.1xRSL	no	NA[8]	---	no
Chlorobenzene	2.18E-02	2.8E+01	0.1xRSL	no	NA[8]	---	no
Chrysene	1.67E-01	1.6E+01	RSL	no	NA[8]	---	no
Cumene	4.00E-04	1.9E+02	0.1xRSL	no	NA[8]	---	no
Ethylbenzene	5.10E-04	5.8E+00	RSL	no	NA[8]	---	no
Fluoranthene	9.93E-01	2.4E+02	0.1xRSL	no	NA[8]	---	no
Fluorene	1.59E+00	2.4E+02	0.1xRSL	no	NA[8]	---	no
Indeno[1,2,3-cd]pyrene	6.47E-02	1.6E-01	RSL	no	NA[8]	---	no

Table C-1. Human Health COPC Screening for GOSB Interior Subunit Sediment Media (0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Methyl ethyl ketone	1.61E-03	2.7E+03	0.1xRSL	no	NA[8]	---	no
Methylcyclohexane	4.40E-04	NA[10]	---	no	NA[8]	---	no
m,p-Xylene	6.40E-04	5.8E+01	0.1xRSL	no	NA[8]	---	no
Phenanthrene	3.91E+00	NA[10]	---	---	NA[8]	---	no
Pyrene	6.83E-01	1.8E+02	0.1xRSL	no	NA[8]	---	no
Toluene	1.00E-03	4.9E+02	0.1xRSL	no	NA[8]	---	no
Pesticides/PCBs *(mg/kg)*							
DDD	1.80E+00	2.3E+00	RSL	no	NA[8]	---	no
DDE	4.50E+00	2.0E+00	RSL	YES	NA[8]	---	YES
Alpha-Chlordane	7.32E+00	1.7E+00	RSL	YES	NA[8]	---	YES
Dieldrin	5.00E-01	3.4E-02	RSL	YES	NA[8]	---	YES
Gamma-Chlordane	1.09E+01	1.7E+00	RSL	YES	NA[8]	---	YES
Heptachlor	8.97E-03	1.3E-01	RSL	no	NA[8]	---	no
Heptachlor Epoxide	9.45E-01	7.0E-02	RSL	YES	NA[8]	---	YES
Radionuclides *pCi/g)*							
Cesium-137	4.99E-02	4.6E-02	PRG	YES	2.84E-01	no	no
Potassium-40	2.96E+00	1.4E-01	PRG	YES	2.33E+00	YES	YES
Thorium-232[11]	1.38E+00	9.9E-03	PRG	YES	1.80E+00	no	no
Actinium-228	1.38E+00	na[13]	---	---	---	---	---
Lead-212	1.33E+00	na[13]	---	---	---	---	---
Thallium-208	4.31E-01	na[13]	---	---	---	---	---
Uranium-238[12]	1.01E+00	1.2E-02	PRG	YES	1.01E+00	YES	YES
Lead-214	1.01E+00	na[13]	---	---	---	---	---
Bismuth-214	8.82E-01	na[13]	---	---	---	---	---

1 - Maximum detected concentration from surface soil interval (0-1 ft.) from Table A.1.1 in Appendix A.
2 - Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed May 2017.
3 - Background screening values obtained from Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN2005-0223, Rev 1, October 2006 Appendix B-1 (0-1 ft interval).
4 - For screening purposes, maximum concentration of the naturally occurring (nonanthropogenic) constituents are compared to 2X average background concentration.
5 - Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6 - EN = essential nutrient. RSL not available
7 - RSL for hexavalent chromium (most conservative) used.
8 - NA - not available- a background value is not available for this constituent
9 - RSL for methyl mercury (most conservative) used.
10 - NA – not available - RSL or PRG not available for this constituent.
11 - Actinium-228, lead-212, and thallium-208 are daughter products of thorium-232 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used in this assessment. The daughter products are not screened separately since they are considered in the thorium-232 secular equilibrium PRG.
12 - Lead-214 and bismuth-214 are daughter products of uranium-238 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used in this assessment. The daughter products are not screened separately since they are considered in the uranium-238 secular equilibrium PRG.
13 - na = not applicable per footnotes 11 and 12 above.

Table C-2. Human Health Risk/Hazard Calculation for GOSB Interior Subunit Sediment Media (0-1 ft) Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Chromium	4.25E+01	2.3E+02	0.18	---	Yes
Cobalt	2.98E+00	2.3E+01	0.13	---	No
Lead	4.31E+01	4.0E+02	0.11	---	Yes
Silver	3.14E+02	3.9E+02	0.81	---	No
Thallium	4.64E+00	7.8E-01	5.95	---	Yes
Pesticides/PCBs mg/kg					
Alpha-chlordane	4.49E+00	3.5E+01	0.13	---	Yes
Dieldrin	3.40E-01	3.2E+00	0.11	---	Yes
Gamma-chlordane	1.09E+01	3.5E+01	0.31	---	Yes
Heptachlor epoxide	6.35E-01	1.0E+00	0.63	---	Yes
		Total Hazard Index (HI) =	**8.36**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Chromium	4.25E+01	3.0E-01	---	1.42E-04	Yes
Cobalt	2.98E+00	4.2E+02	---	7.10E-09	No
			Total Inorganic Risk =	**1.42E-04**	
Organics (mg/kg)					
Benzo[a]anthracene	1.95E-01	1.6E-01	---	1.22E-06	Yes
Benzo[a]pyrene	1.38E-01	1.6E-02	---	8.63E-06	Yes
Benzo[b]fluoranthene	2.47E-01	1.6E-01	---	1.54E-06	Yes
			Total Organic Risk =	**1.14E-05**	
Pesticides/PCBs (mg/kg)					
DDE	4.50E+00	2.0E+00	---	2.25E-06	Yes
Alpha-Chlordane	4.49E+00	1.7E+00	---	2.64E-06	Yes
Dieldrin	3.40E-01	3.4E-02	---	9.99E-06	Yes
Gamma-Chlordane	1.09E+01	1.7E+00	---	6.41E-06	Yes
Heptachlor Epoxide	6.35E-01	7.0E-02	---	9.07E-06	Yes
			Total Pesticide/PCB Risk =	**3.04E-05**	
Radionuclides (pCi/g)					
Potassium-40	2.96E+00	1.44E-01	---	2.06E-05	Yes
Uranium-238	9.34E-01	1.24E-02	---	7.53E-05	Yes
Lead-214	9.34E-01	---	---	---	---
Bismuth-214	8.09E-01	---	---	---	---
			Total Radionuclide Risk =	**9.59E-05**	
			Total Media Risk =	**2.79E-04**	

Table C-2. Human Health Risk/Hazard Calculation for GOSB Interior Subunit Sediment Media (0-1 ft) Residential Scenario (cont.)

1 - Analytes from Table C-1 that were identified as COPCs.
2 - EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1).
3 - Nonradiological RSLs are residential soil site-specific values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment C-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters; website accessed May 2017 (see Attachment C-2).
4 - Residential Hazard Estimate = EPC / RSL.
5 - Residential Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. If the total media HI≥1, then the constituents are segregated based on relevant target organs. Hazard quotients (HQs) are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI>1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Constituent	Target Organ	Residential HQ	
Chromium	Liver	0.18	Liver target organ HQ
Alpha-chlordane		0.13	Liver target organ HQ
Dieldrin		0.11	Liver target organ HQ
Gamma-chlordane		0.31	Liver target organ HQ
Heptachlor epoxide		0.63	Liver target organ HQ
		1.37	Total liver target organ HI
Silver	Skin	0.81	Total skin target organ HI
Cobalt	Thyroid	0.13	Total thyroid target organ HI
Lead	Central nervous system	0.11	Central nervous system target organ HQ
Thallium	Central nervous system	5.95	Central nervous system target organ HQ
		6.06	Total central nervous system target organ HI

Table C-3. Human Health Risk/Hazard Calculation for GOSB Interior Subunit Sediment Media (0-1 ft) Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Chromium	4.25E+01	3.5E+03	0.01	---	No
Cobalt	2.98E+00	3.5E+02	0.01	---	No
Lead	4.31E+01	8.0E+02	0.05	---	No
Silver	3.14E+02	5.8E+03	0.05	---	No
Thallium	4.64E+00	1.2E+01	0.39	---	No
Pesticides/PCBs (mg/kg)					
Alpha-chlordane	4.49E+00	4.5E+02	0.01	---	No
Dieldrin	3.40E-01	4.1E+01	0.01	---	No
Gamma-chlordane	1.09E+01	4.5E+02	0.02	---	No
Heptachlor epoxide	6.35E-01	1.5E+01	0.04	---	No
		Total Hazard Index (HI) =	**0.6**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Chromium	4.25E+01	6.3E+00	---	6.74E-06	Yes
Cobalt	2.98E+00	1.9E+03	---	1.57E-09	No
			Total Inorganic Risk =	**6.74E-06**	
Organics (mg/kg)					
Benzo[a]anthracene	1.95E-01	2.9E+00	---	6.72E-08	No
Benzo[a]pyrene	1.38E-01	2.9E-01	---	4.76E-07	No
Benzo[b]fluoranthene	2.47E-01	2.9E+00	---	8.52E-08	No
			Total Organic Risk =	**6.28E-07**	
Pesticides/PCBs (mg/kg)					
DDE	4.50E+00	9.3E+00	---	4.84E-07	No
Alpha-Chlordane	4.49E+00	7.7E+00	---	5.84E-07	No
Dieldrin	3.40E-01	1.4E-01	---	2.43E-06	Yes
Gamma-Chlordane	1.09E+01	7.7E+00	---	1.42E-06	Yes
Heptachlor Epoxide	6.35E-01	3.3E-01	---	1.92E-06	Yes
			Total Pesticides/PCB Risk =	**6.83E-06**	
Radionuclides (pCi/g)					
Potassium-40	2.96E+00	2.2E-01	---	1.35E-05	Yes
Uranium-238	9.34E-01	2.0E-02	---	4.67E-05	Yes
Lead-214	9.34E-01	---	---	---	---
Bismuth-214	8.09E-01	---	---	---	---
			Total Radionuclide Risk =	**6.02E-05**	
			Total Media Risk =	**7.44E-05**	

Table C-3. Human Health Risk/Hazard Calculation for GOSB Interior Subunit Sediment Media (0-1 ft) Industrial Worker Scenario (cont.)

1 - Analytes from Table C-1 that were identified as COPCs.
2 - EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1).
3 - Nonradiological RSLs are default industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment C-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* calculator; website accessed May 2017 (see Attachment C-3).
4 - Industrial Worker Hazard Estimate = EPC / RSL.
5 - Industrial Worker Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. If the total media HI≥1, then the constituents are segregated based on relevant target organs. Hazard quotients are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI>1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Table C-4. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for GOSB Interior Subunit

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	3.32E+04	µg/L	NA	---	2.0E+04	NA	YES
Antimony	3.62E+00	µg/L	6.0E+00	no			
Barium	3.05E+02	µg/L	2.0E+03	no			
Beryllium	1.40E+00	µg/L	4.0E+00	no			
Cadmium	2.31E+01	µg/L	5.0E+00	YES			
Calcium	1.35E+04	µg/L	NA	---	NA	NA	---
Chromium	1.47E+02	µg/L	1.0E+02	YES			
Cobalt	1.36E+01	µg/L	NA	---	6.0E+00	1.3E+03	YES
Copper	8.05E+02	µg/L	1.3E+03	no			
Cyanide	5.27E+00	µg/L	2.0E+02	no			
Iron	2.55E+04	µg/L	NA	---	1.4E+04	NA	YES
Lead	1.31E+02	µg/L	1.5E+01	YES			
Magnesium	2.08E+03	µg/L	NA	---	NA	NA	---
Manganese	3.40E+02	µg/L	NA	---	4.3E+02	NA	no
Mercury	2.37E-01	µg/L	2.0E+00	no			
Nickel	1.28E+02	µg/L	NA	---	3.9E+02	6.1E+02	no
Potassium	5.53E+03	µg/L	NA	---	NA	NA	---
Silver	2.99E+02	µg/L	NA	---	9.4E+01	NA	YES
Sodium	8.70E+03	µg/L	NA	---	NA	NA	---
Vanadium	6.88E+01	µg/L	NA	---	8.6E+01	NA	no
Zinc	3.80E+03	µg/L	NA	---	6.0E+03	7.4E+04	no
Organics							
Acetone	4.02E+00	µg/L	NA	---	1.4E+04	NA	no
Caprolactam	3.64E+01	µg/L	NA	---	9.9E+03	NA	no
Toluene	5.06E+00	µg/L	1.0E+03	no			
Pesticides/PCBs							
Alpha-Chlordane	2.22E-01	µg/L	2.0E+00	no			
Alpha-Benzene Hexachloride	1.23E-02	µg/L	NA	---	7.2E-03	NA	YES
Beta-Benzene Hexachloride	3.48E-02	µg/L	NA	---	2.5E-02	NA	YES
DDD	4.08E-02	µg/L	NA	---	3.2E-02	3.1E-04	YES
DDE	8.04E-02	µg/L	NA	---	4.6E-02	2.2E-04	YES
DDT	2.28E-02	µg/L	NA	---	2.3E-01	2.2E-04	no
Dieldrin	1.16E-02	µg/L	NA	---	1.8E-03	5.2E-05	YES
Gamma-Chlordane	2.34E-01	µg/L	2.0E+00	no			
Radionuclides							
Bismuth-214	2.30E+01	pCi/L	1.5E+01	YES			
Lead-214	1.61E+01	pCi/L	NA	---	1.3E+02	NA	no
Tritium	1.37E+03	pCi/L	2.0E+04	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1 - Maximum detected concentrations from surface water samples (see Table A.1.2).
2 - Nonradiological constituent values from Attachment C-4; radiological constituent values from C-5.
3 - Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC

Table C-5. Human Health COPC Screening for GOSB Berm Subunit Soil Media (0-1 ft)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	1.15E+04	7.7E+03	0.1xRSL	YES	1.05E+04	YES	YES
Arsenic	1.58E+01	6.8E-01	RSL	YES	4.28E+00	YES	YES
Barium	2.23E+01	1.5E+03	0.1xRSL	no	3.91E+01	no	no
Beryllium	1.94E-01	1.6E+01	0.1xRSL	no	2.89E-01	no	no
Cadmium	1.68E-01	7.1E+00	0.1xRSL	no	4.83E-01	no	no
Calcium	4.82E+02	EN[6]	Nutrient	no	4.76E+02	YES	no
Chromium[7]	3.27E+01	3.0E-01	RSL	YES	1.54E+01	YES	YES
Cobalt	7.30E-01	2.3E+00	0.1xRSL	no	1.55E+00	no	no
Copper	1.71E+01	3.1E+02	0.1xRSL	no	4.34E+00	YES	no
Cyanide	1.67E-01	2.3E+00	0.1xRSL	no	NA[8]	---	no
Iron	2.71E+04	5.5E+03	0.1xRSL	YES	1.27E+04	YES	YES
Lead	7.29E+01	4.0E+01	0.1xRSL	YES	1.03E+01	YES	YES
Magnesium	3.56E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	8.55E+01	1.8E+02	0.1xRSL	no	1.53E+02	no	no
Mercury[9]	4.70E-02	7.8E-01	0.1xRSL	no	7.10E-02	no	no
Nickel	2.55E+00	1.5E+02	0.1xRSL	no	3.48E+00	no	no
Potassium	3.80E+02	EN[6]	Nutrient	no	2.16E+02	YES	no
Silver	4.96E-01	3.9E+01	0.1xRSL	no	7.28E-01	no	no
Sodium	6.19E+01	EN[6]	Nutrient	no	4.02E+01	YES	no
Thallium	1.30E+00	7.8E-02	0.1xRSL	YES	3.12E+00	no	no
Vanadium	6.69E+01	3.9E+01	0.1xRSL	YES	3.91E+01	YES	YES
Zinc	1.39E+01	2.3E+03	0.1xRSL	no	9.47E+00	YES	no
Organics *(mg/kg)*							
Acenaphthene	1.78E-02	3.6E+02	0.1xRSL	no	NA[8]	---	no
Acetone	7.02E-02	6.1E+03	0.1xRSL	no	NA[8]	---	no
Anthracene	2.80E-02	1.8E+03	0.1xRSL	no	NA[8]	---	no
Benzo(g,h,i)perylene	5.79E-02	NA[10]	---	---	NA[8]	---	no
Benzo[a]anthracene	1.01E-01	1.6E-01	RSL	no	2.45E-02	YES	no
Benzo[a]pyrene	9.15E-02	1.6E-02	RSL	YES	2.53E-02	YES	YES
Benzo[b]fluoranthene	1.87E-01	1.6E-01	RSL	YES	4.10E-02	YES	YES
Bis(2-ethylhexyl)phthalate	7.68E-02	3.9E+01	RSL	no	NA[8]	---	no
Carbazole	2.64E-02	NA[10]	---	---	NA[8]	---	no
Chrysene	1.12E-01	1.6E+01	RSL	no	NA[8]	---	no
Fluoranthene	2.45E-01	2.4E+02	0.1xRSL	no	NA[8]	---	no
Indeno[1,2,3-cd]pyrene	5.06E-02	1.6E-01	RSL	no	NA[8]	---	no
Methyl Acetate	1.30E-02	7.8E+03	0.1xRSL	no	NA[8]	---	no
Methyl Ethyl Ketone	2.60E-03	2.7E+03	0.1xRSL	no	NA[8]	---	no
Phenanthrene	1.32E-01	NA[10]	---	---	NA[8]	---	no
Pyrene	1.79E-01	1.8E+02	0.1xRSL	no	NA[8]	---	no
Styrene	1.73E-03	6.0E+02	0.1xRSL	no	NA[8]	---	no
Toluene	3.90E-04	4.9E+02	0.1xRSL	no	NA[8]	---	no

Table C-5. Human Health COPC Screening for GOSB Berm Subunit Soil Media (0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Aroclor 1260	1.36E-02	2.4E-01	RSL	no	NA[8]	---	no
DDD	5.32E-03	2.3E+00	RSL	no	NA[8]	---	no
DDE	2.85E-02	2.0E+00	RSL	no	NA[8]	---	no
DDT	1.94E-02	1.9E+00	RSL	no	NA[8]	---	no
Alpha-Chlordane	1.23E-02	1.7E+00	RSL	no	NA[8]	---	no
Dieldrin	1.70E-03	3.4E-02	RSL	no	NA[8]	---	no
Endosulfan Sulfate	7.13E-04	NA[10]	---	---	NA[8]	---	no
Endrin	1.45E-03	1.9E+00	0.1xRSL	no	NA[8]	---	no
Endrin Ketone	1.61E-03	NA[10]	---	---	NA[8]	---	no
Gamma-Chlordane	4.80E-03	1.7E+00	RSL	no	NA[8]	---	no
Radionuclides *(pCi/g)*							
Cesium-137	2.78E-01	4.6E-02	PRG	YES	2.84E-01	no	no
Potassium-40	3.25E+00	1.4E-01	PRG	YES	2.33E+00	YES	YES
Thorium-232[11]	1.68E+00	9.9E-03	PRG	YES	1.80E+00	no	no
Actinium-228	1.62E+00	na[13]	---	---	---	---	---
Lead-212	1.68E+00	na[13]	---	---	---	---	---
Thallium-208	5.42E-01	na[13]	---	---	---	---	---
Uranium-238[12]	1.02E+00	1.2E-02	PRG	YES	1.01E+00	YES	YES
Bismuth-214	9.92E-01	na[13]	---	---	---	---	---
Lead-214	1.02E+00	na[13]	---	---	---	---	---

1 - Maximum detected concentration from surface soil interval (0-1 ft.) from Table A.2.1.1.
2 - Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed May 2017.
3 - Background screening values obtained from *Background Soils Statistical Summary Report for the Savannah River Site,* Table B-1, ERD-EN2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).
4 - For screening purposes, maximum concentration of the naturally occurring (nonanthropogenic) constituents are compared to 2X average background concentration.
5 - Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6 - EN = essential nutrient. RSL not available
7 - RSL for hexavalent chromium (most conservative) used.
8 - NA - not available- a background value is not available for this constituent
9 - RSL for methyl mercury (most conservative) used.
10 - NA - not available - RSL or PRG not available for this constituent.
11 - Actinium-228, lead (Pb)-212, and thallium-208 are daughter products of thorium-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of thorium-232. The daughter products are not screened separately since they are considered in the thorium-232 secular equilibrium PRG.
12 - Bismuth-214 and lead-214 are daughter products of uranium-238 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used in this assessment. The daughter products are not screened separately since they are considered in the uranium-238 secular equilibrium PRG.
13 - na = not applicable per footnotes 11 and 12 above.

Table C-6. Human Health Risk/Hazard Calculation for GOSB Berm Subunit Soil Media (0-1 ft) Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	8.70E+03	7.7E+04	0.11	---	No
Arsenic	7.42E+00	3.5E+01	0.21	---	No
Chromium	2.14E+01	2.3E+02	0.09	---	No
Iron	2.71E+04	5.5E+04	0.49	---	No
Lead	4.53E+01	4.0E+02	0.11	---	No
Vanadium	5.38E+01	3.9E+02	0.14	---	No
		Total Hazard Index (HI) =	**1.2**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	7.42E+00	6.8E-01	---	1.09E-05	Yes
Chromium	2.14E+01	3.0E-01	---	7.15E-05	Yes
			Total Inorganic Risk =	**8.24E-05**	
Organics (mg/kg)					
Benzo[a]pyrene	9.15E-02	1.6E-02	---	5.72E-06	Yes
Benzo[b]fluoranthene	1.87E-01	1.6E-01	---	1.17E-06	Yes
			Total Organic Risk =	**6.89E-06**	
Radionuclides (pCi/g)					
Potassium-40	2.21E+00	1.44E-01	---	1.54E-05	Yes
Uranium-238	9.53E-01	1.24E-02	---	7.69E-05	Yes
Bismuth-214	8.93E-01	---	---	---	---
Lead-214	9.53E-01	---	---	---	---
			Total Radionuclide Risk =	**9.22E-05**	
			Total Media Risk =	**1.81E-04**	

1 - Analytes from Table C-5that were identified as COPCs.
2 - EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1).
3 - Nonradiological RSLs are residential soil site-specific values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment C-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters; website accessed May 017 (see Attachment C-2).
4 - Residential Hazard Estimate = EPC / RSL.
5 - Residential Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. If the total media HI≥1, then the constituents are segregated based on relevant target organs. Hazard quotients (HQs) are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI>1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Table C-6. Human Health Risk/Hazard Calculation for GOSB Berm Subunit Soil Media (0-1 ft) Residential Scenario (cont.)

Constituent	Target Organ	Residential (HQ)	
Aluminum	Hematologic system	0.11	Total hematologic system HI
Chromium	Liver	0.09	Total liver target organ HI
Iron	Skin	0.49	
Arsenic	Skin	0.21	
Vanadium	Skin	0.14	
		0.84	Total skin target organ HI
Lead	Central nervous system	0.11	Central nervous system target organ HQ
		0.11	Total central nervous system target organ HI

Table C-7. Human Health Risk/Hazard Calculation for GOSB Berm Subunit Soil Media (0-1 ft) Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	8.70E+03	1.10E+06	0.008	---	No
Arsenic	7.42E+00	4.80E+02	0.015	---	No
Chromium	2.14E+01	3.50E+03	0.006	---	No
Iron	2.71E+04	8.20E+05	0.033	---	No
Lead	4.53E+01	8.0E+02	0.057	---	No
Vanadium	5.38E+01	5.80E+03	0.009	---	No
		Total Hazard Index (HI) =	**0.13**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	7.42E+00	3.00E+00	---	2.47E-06	Yes
Chromium	2.14E+01	6.30E+00	---	3.40E-06	Yes
			Total Inorganic Risk =	**5.88E-06**	
Organics (mg/kg)					
Benzo[a]pyrene	9.15E-02	2.90E-01	---	3.16E-07	No
Benzo[b]fluoranthene	1.87E-01	2.90E+00	---	6.45E-08	No
			Total Organic Risk =	**3.80E-07**	
Radionuclides (pCi/g)					
Potassium-40	2.21E+00	2.19E-01	---	1.01E-05	Yes
Uranium-238	9.53E-01	2.00E-02	---	4.77E-05	Yes
Bismuth-214	8.93E-01	---	---	---	---
Lead-214	9.53E-01	---	---	---	---
			Total Radionuclide Risk =	**5.78E-05**	
			Total Media Risk =	**6.40E-05**	

1 - Analytes from Table C-5 that were identified as COPCs.

2- EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration.

3 - Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment C-1). Radiological PRGs are industrial worker soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* calculator; website accessed May 2017 (see Attachment C-3).

4 - Industrial Worker Hazard Estimate = EPC / RSL.

5 - Industrial Worker Risk Estimate - (EPC / RSL or PRG) x 1E-06.

6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. If the total media HI≥1, then the constituents are segregated based on relevant target organs. Hazard quotients are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI>1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Table C-8. Human Health COPC Screening for Effluent Discharge Subunit Soil Media (0-1 ft)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	1.53E+04	7.7E+03	0.1xRSL	YES	1.05E+04	YES	YES
Arsenic	8.55E+00	6.8E-01	RSL	YES	4.28E+00	YES	YES
Barium	4.20E+01	1.5E+03	0.1xRSL	no	3.91E+01	YES	no
Beryllium	2.95E-01	1.6E+01	0.1xRSL	no	2.89E-01	YES	no
Cadmium	1.34E-01	7.1E+00	0.1xRSL	no	4.83E-01	no	no
Calcium	6.84E+02	EN[6]	Nutrient	no	4.76E+02	YES	no
Chromium[7]	2.07E+01	3.0E-01	RSL	YES	1.54E+01	YES	YES
Cobalt	2.48E+00	2.3E+00	0.1xRSL	YES	1.55E+00	YES	YES
Copper	2.06E+01	3.1E+02	0.1xRSL	no	4.34E+00	YES	no
Cyanide	4.96E-01	2.3E+00	0.1xRSL	no	NA[8]	---	no
Iron	3.05E+04	5.5E+03	0.1xRSL	YES	1.27E+04	YES	YES
Lead	1.72E+01	4.0E+01	0.1xRSL	no	1.03E+01	YES	no
Magnesium	2.47E+02	EN[6]	Nutrient	no	2.75E+02	no	no
Manganese	1.15E+02	1.8E+02	0.1xRSL	no	1.53E+02	no	no
Mercury[9]	7.64E-02	7.8E-01	0.1xRSL	no	7.10E-02	YES	no
Nickel	4.84E+00	1.5E+02	0.1xRSL	no	3.48E+00	YES	no
Potassium	1.78E+02	EN[6]	Nutrient	no	2.16E+02	no	no
Selenium	3.27E+00	3.9E+01	0.1xRSL	no	2.99E+00	YES	no
Silver	1.19E+01	3.9E+01	0.1xRSL	no	7.28E-01	YES	no
Sodium	5.97E+01	EN[6]	Nutrient	no	4.02E+01	YES	no
Vanadium	7.61E+01	3.9E+01	0.1xRSL	YES	3.91E+01	YES	YES
Zinc	3.65E+01	2.3E+03	0.1xRSL	no	9.47E+00	YES	no
Organics *(mg/kg)*							
Acetone	1.73E-01	6.1E+03	0.1xRSL	no	NA[8]	---	no
Benzo(g,h,i)perylene	1.90E-02	NA[10]	---	---	NA[8]	---	no
Benzo[a]pyrene	2.73E-02	1.6E-02	RSL	YES	2.53E-02	YES	YES
Benzo[b]fluoranthene	4.22E-02	1.6E-01	RSL	no	4.10E-02	YES	no
Benzo[k]fluoranthene	1.92E-02	1.6E+00	RSL	no	NA[8]	---	no
Chrysene	4.15E-02	1.6E+01	RSL	no	NA[8]	---	no
Cumene	4.25E-03	1.9E+02	0.1xRSL	no	NA[8]	---	no
Fluoranthene	6.09E-02	2.4E+02	0.1xRSL	no	NA[8]	---	no
Indeno[1,2,3-cd]pyrene	1.75E-02	1.6E-01	RSL	no	NA[8]	---	no
Methyl Acetate	5.03E-02	7.8E+03	0.1xRSL	no	NA[8]	---	no
Methyl Ethyl Ketone	6.13E-02	2.7E+03	0.1xRSL	no	NA[8]	---	no
Phenanthrene	3.26E-02	NA[10]	---	---	NA[8]	---	no
Pyrene	4.27E-02	1.8E+02	0.1xRSL	no	NA[8]	---	no
Styrene	6.22E-03	6.0E+02	0.1xRSL	no	NA[8]	---	no
Pesticides/PCBs *(mg/kg)*							
Alpha-Chlordane	3.86E-01	1.7E+00	RSL	no	NA[8]	---	no
Aroclor 1254	3.66E-02	2.4E-01	RSL	no	NA[8]	---	no
Aroclor 1260	3.57E-02	2.4E-01	RSL	no	NA[8]	---	no
DDE	1.45E-02	2.0E+00	RSL	no	NA[8]	---	no

Table C-8. Human Health COPC Screening for Effluent Discharge Subunit Soil Media (0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
DDT	1.60E-02	1.9E+00	RSL	no	NA[8]	---	no
Gamma-Chlordane	2.77E-01	1.7E+00	RSL	no	NA[8]	---	no
Heptachlor Epoxide	2.50E-04	7.0E-02	RSL	no	NA[8]	---	no
Radionuclides *(pCi/g)*							
Cesium-137	2.84E-01	4.6E-02	PRG	YES	2.84E-01	no	no
Potassium-40	1.95E+00	1.4E-01	PRG	YES	2.33E+00	no	no
Thorium-232[11]	2.75E+00	9.9E-03	PRG	YES	1.80E+00	YES	YES
Radium-228	2.47E+00	na[13]	---	---	---	---	---
Actinium-228	1.86E+00	na[13]	---	---	---	---	---
Thorium-228	2.75E+00	na[13]	---	---	---	---	---
Lead-212	1.88E+00	na[13]	---	---	---	---	---
Thallium-208	5.90E-01	na[13]	---	---	---	---	---
Uranium-238[12]	1.47E+00	1.2E-02	PRG	YES	1.01E+00	YES	YES
Uranium-233/-234[14]	1.19E+00	na[13]	---	---	---	---	---
Thorium-230	1.47E+00	na[13]	---	---	---	---	---
Radium-226	1.37E+00	na[13]	---	---	---	---	---
Lead-214	1.22E+00	na[13]	---	---	---	---	---
Bismuth-214	1.10E+00	na[13]	---	---	---	---	---

1 - Maximum detected concentration from surface soil/sediment interval (0-1 ft.) from Table A.4.1.
2 - Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed May 2017.
3 - Background screening values obtained from *Background Soils Statistical Summary Report for the Savannah River Site,* Table B-1, ERD-EN2005-0223, Rev 1, October 2006 Appendix B-1 (0-1 ft interval).
4 - For screening purposes, maximum concentration of the naturally occurring (nonanthropogenic) constituents are compared to 2X average background concentration.
5 - Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6 -EN = essential nutrient. RSL not available
7 - RSL for hexavalent chromium (most conservative) used.
8 - NA - not available- a background value is not available for this constituent
9 - RSL for methyl mercury (most conservative) used.
10 - NA - not available - RSL or PRG not available for this constituent.
11 – Radium-228, actinium-228, thorium -228, Lead-212, and thallium-208, are daughter products of thorium-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of thorium-232. The daughter products are not screened separately since they are considered in the thorium-232 secular equilibrium PRG.
12 – Uranium-234, thorium-230, radium-226, lead-214, and bismuth-214 are daughter products of uranium-238 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of uranium-238. The daughter products are not screened separately since they are considered in the uranium-238 secular equilibrium PRG.
13 - na = not applicable per footnotes 11 and 12 above.
14 - Uranium-233/-234 assumed to be uranium-234 for evaluation purposes.

Table C-9. Human Health Risk/Hazard Calculation for Effluent Discharge Soil Media (0-1 ft) Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	1.22E+04	7.7E+04	0.158	---	No
Arsenic	6.21E+00	3.5E+01	0.177	---	No
Chromium	1.78E+01	2.3E+02	0.077	---	No
Cobalt	2.27E+00	2.3E+01	0.099	---	No
Iron	2.23E+04	5.5E+04	0.405	---	No
Vanadium	5.38E+01	3.9E+02	0.138	---	No
		Total Hazard Index (HI) =	**1.05**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	6.21E+00	6.8E-01	---	9.13E-06	Yes
Chromium	1.78E+01	3.0E-01	---	5.94E-05	Yes
Cobalt	2.27E+00	4.2E+02	---	5.40E-09	No
			Total Inorganic Risk =	**6.85E-05**	
Organics (mg/kg)					
Benzo[a]pyrene	2.73E-02	1.6E-02	---	1.71E-06	Yes
			Total Organic Risk =	**1.71E-06**	
Radionuclides (pCi/g)					
Thorium-232	2.75E+00	9.85E-03	---	2.79E-04	Yes
Radium-228	2.47E+00	---	---	---	---
Actinium-228	1.86E+00	---	---	---	---
Thorium-228	2.75E+00	---	---	---	---
Lead-212	1.88E+00	---	---	---	---
Thallium-208	5.90E-01	---	---	---	---
Uranium-238	1.47E+00	1.24E-02	---	1.19E-04	Yes
Uranium-233/234	1.19E+00	---	---	---	---
Thorium-230	1.47E+00	---	---	---	---
Radium-226	1.37E+00	---	---	---	---
Lead-214	1.22E+00	---	---	---	---
Bismuth-214	1.10E+00	---	---	---	---
			Total Radionuclide Risk =	**3.98E-04**	
			Total Media Risk =	**4.68E-04**	

1 - Analytes from Table C-8 that were identified as COPCs.
2 - EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration.
3 - Nonradiological RSLs are residential soil site-specific values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment C-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters; website accessed May 2017 (see Attachment C-2).

Table C-9. Human Health Risk/Hazard Calculation for Effluent Discharge Soil Media (0-1 ft) Residential Scenario (cont.)

4 - Residential Hazard Estimate = EPC / RSL.
5 - Residential Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. If the total media HI≥1, then the constituents are segregated based on relevant target organs. Hazard quotients (HQs) are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI>1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Constituent	Target Organ	Residential HQ	
Aluminum	Hematologic system	0.158	Total hematologic organ HI
Chromium	Liver	0.077	Total liver target organ HI
Cobalt	Thyroid	0.099	Total thyroid target organ HI
Arsenic	Skin	0.177	
Iron	Skin	0.405	
Vanadium	Skin	0.138	
		0.720	Total skin target organ HI

Table C-10. Human Health Risk/Hazard Calculation for Effluent Discharge Soil Media (0-1 ft) Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	1.22E+04	1.1E+06	0.011	---	No
Arsenic	6.21E+00	4.8E+02	0.013	---	No
Chromium	1.78E+01	3.5E+03	0.005	---	No
Cobalt	2.27E+00	3.5E+02	0.006	---	No
Iron	2.23E+04	8.2E+05	0.027	---	No
Vanadium	5.38E+01	5.8E+03	0.009	---	No
Total Hazard Index (HI) =			**0.07**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	6.21E+00	3.0E+00	---	2.07E-06	Yes
Chromium	1.78E+01	6.3E+00	---	2.83E-06	Yes
Cobalt	2.27E+00	1.9E+03	---	1.19E-09	No
Total Inorganic Risk =				**4.90E-06**	
Organics (mg/kg)					
Benzo[a]pyrene	2.73E-02	2.9E-01	---	9.41E-08	No
Total Organic Risk =				**9.41E-08**	
Radionuclides (pCi/g)					
Thorium-232	2.75E+00	1.53E-02	---	1.80E-04	Yes
Radium-228	2.47E+00	---	---	---	---
Actinium-228	1.86E+00	---	---	---	---
Thorium-228	2.75E+00	---	---	---	---
Lead-212	1.88E+00	---	---	---	---
Thallium-208	5.90E-01	---	---	---	---
Uranium-238	1.47E+00	2.00E-02	---	7.35E-05	Yes
Uranium-233/234	1.19E+00	---	---	---	---
Thorium-230	1.47E+00	---	---	---	---
Radium-226	1.37E+00	---	---	---	---
Lead-214	1.22E+00	---	---	---	---
Bismuth-214	1.10E+00	---	---	---	---
Total Radionuclide Risk =				**2.53E-04**	
Total Media Risk =				**2.58E-04**	

1 - Analytes from Table C-8 that were identified as COPCs.
2 - EPC = reasonable maximum exposure (RME) exposure pointe concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration.
3 - Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Appendix C-1). Radiological PRGs are industrial worker soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* calculator; website accessed May 2017 (see Attachment C-3).
4 - Industrial Work Hazard Estimate = EPC / RSL.
5 - Industrial Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI<1. For carcinogens, constituents are identified as COCs if the individual cancer risk ≥1E-06.

Attachment C-1

USEPA Regional Screening Levels Table
RSLs for Default Resident and Default Industrial Worker Scenarios
(website accessed May 7, 2017)

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USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed May 7, 2017)

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tap Water *(µg/L)*	key	MCL *(µg/L)*
				6.0E-02	I			V	Acenaphthene	83-32-9	3.6E+03	n	4.5E+04	n	5.3E+02	n	
									Acenaphthalene								
				9.0E-01	I	3.1E+01	A	V	Acetone	67-64-1	6.1E+04	n	6.7E+05	nms	1.4E+04	n	
1.70E+01		4.90E-03		3.00E-05					Aldrin	309-00-02	3.9E-02	ca*	1.8E-01	ca*	9.2E-04	ca*	
6.3E+00	I	1.8E-03	I	8.0E-03	A				Alpha-Benzene Hexachloride	319-84-6	8.6E-02	c	3.6E-01	c	7.2E-03	c	
3.5E-01	I	1.0E-01	I	5.0E-04	I	7.0E-04	I	V	Alpha Chlordane[1]	12789-03-6	1.7E+00 3.5E+01	c* n	7.7E+00 4.5E+02	c* n	2.0E-02	c*	2.0E+00
				1.0E+00	P	5.0E-03	P		Aluminum	7429-90-5	7.7E+04	n	1.1E+06	nm	2.0E+04	n	
				3.0E-01	I			V	Anthracene	120-12-7	1.8E+04	n	2.3E+05	nm	1.8E+03	n	
				4.0E-04	I				Antimony	7440-36-0	3.1E+01	n	4.7E+02	n	7.8E+00	n	6.0E+00
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C		Arsenic	7440-38-2	6.8E-01 3.5E+01	c*R n	3.0E+00 4.8E+02	cR n	5.2E-02	c	1.0E+01
2.0E+00	S	5.7E-04	S					V	Aroclor 1242	53469-21-9	2.3E-01	c	9.5E-01	c	7.8E-03	c	
2.0E+00	S	5.7E-04	S	2.0E-05	I			V	Aroclor 1254	11097-69-1	2.4E-01	c**	9.7E-01	c*	7.8E-03	c*	
2.0E+00	S	5.7E-04	S					V	Aroclor 1260	11096-82-5	2.4E-01	c	9.9E-01	c	7.8E-03	c	
				2.0E-01	I	5.0E-04	H		Barium	7440-39-3	1.5E+04	n	2.2E+05	nm	3.8E+03	n	2.0E+03
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V	Benzene	71-43-2	1.2E+00	c*	5.1E+00	c*	4.6E-01	c*	5.0E+00
7.3E-01	E	1.1E-04	C					V	Benz[a]anthracene	56-55-3	1.6E-01	c	2.9E+00	c	1.2E-02	c	
7.3E+00	I	1.1E-03	C						Benzo[a]pyrene	50-32-8	1.6E-02	c	2.9E-01	c	3.4E-03	c	2.0E-01
									Benzo(g,h,i)perylene								
7.3E-01	E	1.1E-04	C						Benzo[b]fluoranthene	205-99-2	1.6E-01	c	2.9E+00	c	3.4E-02	c	
7.3E-02	E	1.1E-04	C						Benzo[k]fluoranthene	207-08-9	1.6E+00	c	2.9E+01	c	3.4E-01	c	
		2.4E-03	I	2.0E-03	I	2.0E-05	I		Beryllium	7440-41-7	1.6E+02	n	2.3E+03	n	2.5E+01	n	4.0E+00
1.8E+00	I	5.3E-04							Beta-Benzene Hexachloride	319-85-7	3.0E-01	c	1.3E+00	c	2.5E-02	c	
1.4E-02	I	2.4E-06	C	2.0E-02	I				Bis(2-ethylhexyl)phthalate	117-81-7	3.9E+01	c*	1.6E+02	c	5.6E+00	c*	6.0E+00
		1.8E-03	I	1.0E-03	I	1.0E-05	A		Cadmium (Diet)	7440-43-9	7.1E+01	n	9.8E+02	n			
		1.8E-03	I	5.0E-04	I	1.0E-05	A		Cadmium (Water)	7440-43-9					9.2E+00	n	5.0E+00
				5.0E-01	I	2.2E-03	C		Caprolactam	105-60-2	3.1E+04	n	4.0E+05	nm	9.9E+03	n	
									Carbazole								
				1.0E-01	I	7.0E-01	I	V	Carbon Disulfide	75-15-0	7.7E+02	ns	3.5E+03	ns	8.1E+02	n	
				2.0E-02	I	5.0E-02	P	V	Chlorobenzene	108-90-7	2.8E+02	n	1.3E+03	ns	7.8E+01	n	1.0E+02
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V	Chloroform	67-66-3	3.2E-01	c	1.4E+00	c	2.2E-01	c	8.0E+01(F)
						9.0E-02	I	V	Chloromethane	74-87-3	1.1E+02	n	4.6E+02	n	1.9E+02	n	
				1.5E+00	I				Chromium(III)	16065-83-1	1.2E+05	nm	1.8E+06	nm	2.2E+04	n	
5.0E-01	J	8.4E-02	S	3.0E-03	I	1.0E-04	I		Chromium(VI)	18540-29-9	3.0E-01 2.3E+02	c n	6.3E+00 3.5E+03	c n	3.5E-02	c	

USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed May 7, 2017) (cont.)

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tap Water *(µg/L)*	key	MCL *(µg/L)*
									Chromium, Total	7440-47-3							1.0E+02
7.3E-03	E	1.1E-05	C						Chrysene	218-01-9	1.6E+01	c	2.9E+02	c	3.4E+00	c	
		9.0E-03	P	3.0E-04	P	6.0E-06	P		Cobalt	7440-48-4	2.3E+01 4.2E+02	n c	3.5E+02 1.9E+03	n c	6.0E+00	n	
				4.0E-02	H				Copper	7440-50-8	3.1E+03	n	4.7E+04	n	8.0E+02	n	1.3E+03
				1.0E-01	I	4.0E-01	I	V	Cumene (isopropylbenzene)	98-82-8	1.9E+03	ns	9.9E+03	ns	4.5E+02	n	
				6.0E-04	I	8.0E-04	S	V	Cyanide (CN-)	57-12-5	2.3E+01	n	1.5E+02	n	1.5E+00	n	2.0E+02
2.4E-01	I	6.9E-05	C						DDD	72-54-8	2.3E+00	c	9.6E+00	c	3.2E-02	c	
3.4E-01	I	9.7E-05	C					V	DDE	72-55-9	2.0E+00	c	9.3E+00	c	4.6E-02	c	
3.4E-01	I	9.7E-05	I	5.0E-04	I				DDT	50-29-3	1.9E+00	c*	8.5E+00	c*	2.3E-01	c*	
				9.0E-02	I	2.0E-01	H	V	1,2-Dichlorobenzene	95-50-1	1.8E+03	ns	9.3E+03	ns	3.0E+02	n	6.0E+02
									Dichclorobenzene, 1,3-								
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V	Dichlorobenzene, 1,4-	106-46-7	2.6E+00	c	1.1E+01	c	4.8E-01	c	7.5E+01
1.6E+01	I	4.6E-03	I	5.0E-05	I				Dieldrin	60-57-1	3.4E-02 3.2E+00	c* n	1.4E-01 4.1E+01	c n	1.8E-03	c	
									Endosulfan Sulfate	1031-07-8							
				3.0E-04	I				Endrin	72-20-8	1.9E+01	n	2.5E+02	n	2.3E+00	n	2.0E+00
									Endrin Ketone								
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V	Ethylbenzene	100-41-4	5.8E+00	c	2.5E+01	c	1.5E+00	c	7.0E+02
				4.0E-02	I				Fluoranthene	206-44-0	2.4E+03	n	3.0E+04	n	8.0E+02	n	
				4.0E-02	I			V	Fluorene	86-73-7	2.4E+03	n	3.0E+04	n	2.9E+02	n	
3.5E-01	I	1.0E-04	I	5.0E-04	I	7.0E-04	I	V	Gamma Chlordane[1]	5566-34-7	1.7E+00 3.5E+01	c* n	7.7E+00 4.5E+02	c* n	2.0E-02	c*	2.0E+00
4.5E+00	I	1.3E-03	I	5.0E-04	I			V	Heptachlor	76-44-8	1.3E-01	c	6.3E-01	c	1.4E-03	c	4.0E-01
9.1E+00	I	2.6E-03	I	1.3E-05	I			V	Heptachlor Epoxide	1024-57-3	7.0E-02 1.0E+00	c* n	3.3E-01 1.5E+01	c* n	1.4E-03	c*	2.0E-01
7.3E-01	E	1.1E-04	C						Indeno[1,2,3-cd]pyrene	193-39-5	1.6E-01	c	2.9E+00	c	3.4E-02	c	
				7.0E-01	P				Iron	7439-89-6	5.5E+04	n	8.2E+05	nm	1.4E+04	n	
									Lead and Compounds	7439-92-1	4.0E+02	L	8.0E+02	L	1.5E+01	L	1.5E+01
				2.4E-02	S	5.0E-05	I		Manganese	7439-96-5	1.8E+03	n	2.6E+04	n	4.3E+02	n	
				3.0E-04	I	3.0E-04	S		Mercuric Chloride	7487-94-7	2.3E+01	n	3.5E+02	n	5.7E+00	n	2.0E+00
						3.0E-04	I	V	Mercury (elemental)	7439-97-6	1.1E+01	ns	4.6E+01	ns	6.3E-01	n	2.0E+00
				1.0E-04	I				Methyl Mercury	22967-92-6	7.8E+00	n	1.2E+02	n	2.0E+00	n	
				1.0E+00	X			V	Methyl Acetate	79-20-9	7.8E+04	ns	1.2E+06	nms	2.0E+04	n	
				4.0E-03	I			V	2-Methylnaphthalene	91-57-6	2.4E+02	n	3.0E+03	n	3.6E+01	n	
				6.0E-01	I	5.0E+00	I	V	Methyl Ethyl Ketone	78-93-3	2.7E+04	n	1.9E+05	nms	5.6E+03	n	

USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed May 7, 2017) (cont.)

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tap Water *(µg/L)*	key	MCL *(µg/L)*
									Methylcyclohexane	108-87-2							
		2.6E-04	C	2.0E-02	I	9.0E-05	A		Nickel	7440-02-0	1.5E+03	n	2.2E+04	n	3.9E+02	n	
									Phenanthrene	85-01-8							
				3.0E-02	I			V	Pyrene	129-00-0	1.8E+03	n	2.3E+04	n	1.2E+02	n	
				5.0E-03	I	2.0E-02	C		Selenium	7782-49-2	3.9E+02	n	5.8E+03	n	1.0E+02	n	5.0E+01
				5.0E-03	I				Silver	7440-22-4	3.9E+02	n	5.8E+03	n	9.4E+01	n	
				2.0E-01	I	1.0E+00	I	V	Styrene	100-42-5	6.0E+03	ns	3.5E+04	ns	1.2E+03	n	1.0E+02
				1.0E-05	X				Thallium	7440-28-0	7.8E-01	n	1.2E+01	n	2.0E-01	n	2.0E+00
				8.0E-02	I	5.0E+00	I	V	Toluene	108-88-3	4.9E+03	ns	4.7E+04	ns	1.1E+03	n	1.0E+03
				5.0E-03	S	1.0E-04	A		Vanadium	7440-62-2	3.9E+02	n	5.8E+03	n	8.6E+01	n	
				2.0E-01	S	1.0E-01	S	V	Xylene, P-	106-42-3	5.6E+02	ns	2.4E+03	ns	1.9E+02	n	
				2.0E-01	S	1.0E-01	S	V	Xylene, m-	108-38-3	5.5E+02	ns	2.4E+03	ns	1.9E+02	n	
				2.0E-01	I	1.0E-01	I	V	Xylenes	1330-20-7	5.8E+02	ns	2.5E+03	ns	1.9E+02	n	1.0E+04
				3.0E-01	I				Zinc	7440-66-6	2.3E+04	n	3.5E+05	nm	6.0E+03	n	

I = Integrated Risk Information System
V = volatile
n = noncancer
nms = noncancer, concentration may exceed ceiling limit, concentration may exceed Csat
P = Provisional Peer-Reviewed Toxicity Values
nm = noncancer, concentration may exceed ceiling limit
C = California Environmental Protection Agency
c*R = cancer, where: n SL < 100X SL, Relative Bioavailability Applied (RBA)
cR = cancer, RBA
c* = cancer – where SL < 100X c SL
c = cancer
H = Health Effects Assessment Summary Table
J = New Jersey
A = Agency for Toxic Substances and Disease Registry
ns = noncancer, concentration may exceed Csat
S = see user guide Section 5
X = Appendix PPRTV Screen
c** = cancer – where SL < 10X c SL
[1]Screening levels based on Chlordane which is composed of a mixture including alpha and gamma chlordane

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Attachment C-2

USEPA Radionuclide Preliminary Remediation Goals Website
Site-Specific PRGs for Resident Scenario
(website accessed May 8, 2017)

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Site-Specific Resident Equation Inputs for Sediment/Soil

Variable	Value	Variable	Value	Variable	Value
TR (target cancer risk) unitless	0.000001	IRA_{res-c} (inhalation rate - resident child) m^3/day	10	ED_{res-a} (exposure duration - resident adult) yr	0
t_{res} (time - resident) yr	26	$IFS_{res-adj}$ (age-adjusted soil ingestion factor - resident) mg	1120000	EF_{res-c} (exposure frequency - resident child) day/yr	0
ED_{res} (exposure duration - resident) yr	26	$IFA_{res-adj}$ (age-adjusted soil inhalation factor - resident) m^3	161000	EF_{res-a} (exposure frequency - resident adult) day/yr	0
ET_{res} (exposure time - resident) hr/day	24	GSF_i (gamma shielding factor - indoor) unitless	0.4	City (Climate Zone)	0
ET_{res-c} (exposure time - resident child) hr/day	24	$MLF_{produce}$ (produce plant mass loading factor) unitless	0.26	A_s (acres)	0.5
ET_{res-a} (exposure time - resident adult) hr/day	24	Slab size for ACF (area correction factor) m^2	1000000	Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
ET_{res-i} (exposure time - indoor resident) hr/day	16.416	Cover thickness for GSF (gamma shielding factor) cm	0	PEF (particulate emission factor) m^3/kg	1.36E+09
ET_{res-o} (exposure time - outdoor resident) hr/day	1.752	IRV_{res-a} (vegetable consumption rate - resident adult) g/day	0	A (PEF Dispersion Constant)	16.2302
ED_{res-c} (exposure duration - resident child) yr	6	IRV_{res-c} (vegetable consumption rate - resident child) g/day	0	B (PEF Dispersion Constant)	18.7762
ED_{res-a} (exposure duration - resident adult) yr	20	$IFV_{res-adj}$ (age-adjusted vegetable ingestion factor - resident) g	0	C (PEF Dispersion Constant)	216.108
EF_{res} (exposure frequency - resident) day/yr	350	$IFF_{res-adj}$ (age-adjusted fruit ingestion factor - resident) g	0	V (fraction of vegetative cover) unitless	0.5
EF_{res-c} (exposure frequency - resident child) day/yr	350	IRF_{res-a} (fruit consumption rate - resident adult) g/day	0	U_m (mean annual wind speed) m/s	4.69
EF_{res-a} (exposure frequency - resident adult) day/yr	350	IRF_{res-c} (fruit consumption rate - resident child) g/day	0	U_t (equivalent threshold value)	11.32
IRS_{res-a} (soil intake rate - resident adult) mg/day	100	$CF_{res-produce}$ (contaminated plant fraction) unitless	0	F(x) (function dependent on U_m/U_t) unitless	0.194
IRS_{res-c} (soil intake rate - resident child) mg/day	200	TR (target cancer risk) unitless	0		
IRA_{res-a} (inhalation rate - resident adult) m^3/day	20	ED_{res-c} (exposure duration - resident child) yr	0		

Output generated 08May2017

Site-Specific Resident PRGs for Soil

Isotope	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Produce Consumption PRG *(pCi/g)*	Total PRG *(pCi/g)*
Secular Equilibrium PRG for Barium-133	6.82E+01	2.57E+05	8.06E-02	-	8.05E-02
Secular Equilibrium PRG for Cesium-137	2.10E+01	7.51E+04	4.56E-02	-	4.55E-02
Secular Equilibrium PRG for Potassium-40	1.53E+01	3.80E+04	1.45E-01	-	1.44E-01
Secular Equilibrium PRG for Thorium-232	3.08E-01	3.65E+01	1.02E-02	-	9.85E-03
Secular Equilibrium PRG for Tritium	-	1.25E-01	-	-	1.25E-01
Secular Equilibrium PRG for Uranium-235	6.08E-01	2.68E+01	4.96E-02	-	4.58E-02
Secular Equilibrium PRG for Uranium-238	1.44E-01	5.83E+01	1.36E-02	-	1.24E-02

PRG = preliminary remediation goal

Attachment C-3

USEPA Radionuclide Preliminary Remediation Goals for Superfund Table:
Default PRGs for Industrial Worker Scenario
(website accessed May 8, 2017)

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Default Industrial Worker Equation Inputs for Soil

Variable	Value
Cover layer thickness for GSF (gamma shielding factor) cm	Default
TR (target cancer risk) unitless	0.000001
t_w (time - composite worker) yr	25
EF_w (exposure frequency - composite worker) day/yr	250
ED_w (exposure duration - composite worker) yr	25
ET_w (exposure time - composite worker) hr/day	8
IRA_w (inhalation rate - composite worker) m^3/day	60
IRS_w (soil intake rate - composite worker) mg/day	100
Site area for ACF (area correction factor) m^2	Default
City (Climate Zone)	Default
A_s (acres)	0.5
Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
PEF (particulate emission factor) m^3/kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U_m (mean annual wind speed) m/s	4.69
U_t (equivalent threshold value)	11.32
F(x) (function dependent on U_m/U_t) unitless	0.194

Default Industrial Worker PRGs for Soil

Isotope	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)
Secular Equilibrium PRG for Barium-133	3.63E+02	3.31E+05	1.22E-01	1.22E-01
Secular Equilibrium PRG for Cesium-137	5.03E+01	9.67E+04	6.91E-02	6.90E-02
Secular Equilibrium PRG for Potassium-40	1.06E+02	4.90E+04	2.19E-01	2.19E-01
Secular Equilibrium PRG for Thorium-232	1.74E+00	4.70E+01	1.54E-02	1.53E-02
Secular Equilibrium PRG for Tritium	-	1.61E-01	-	1.61E-01
Secular Equilibrium PRG for Uranium-235	2.91E+00	3.46E+01	7.51E-02	7.31E-02
Secular Equilibrium PRG for Uranium-238	6.35E-01	7.51E+01	2.06E-02	2.00E-02

PRG = preliminary remediation goal

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Attachment C-4

MCLs/RSLs/AWQC for Surface Water Data Screening of Nonradiological Constituents (website accessed May 8, 2017)

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MCLs/RSLs/AWQC for Surface Water Data Screening of Nonradiological Constituents

Analyte	CAS No.	MCL[1] *(µg/L)*	Tap Water SL[2] *(µg/L)*	SCDHEC AWQC[3] *(µg/L)*
Acetone	67-64-1		14000	
Alpha-Benzene Hexachloride	319-84-6		0.0072	
Alpha-Chlordane[4]	5103-71-9	2		
Aluminum	7429-90-5		20000	
Antimony (metallic)	7440-36-0	6		
Barium	7440-39-3	2000		
Beryllium	7440-41-7	4		
Beta-Benzene Hexachloride	319-85-7		0.025	
Bis[2-ethylhexyl]phthalate	117-81-7	6		
Cadmium (Water)	7440-43-9	5		
Caprolactam	105-60-2		9900	
Chromium(III), Insoluble Salts	16065-83-1		22000	
Chromium(VI)	18540-29-9		0.035	
Chromium	7440-47-3	100		
Cobalt	7440-48-4		6	1300
Copper	7440-50-8	1300		
Cyanide	57-12-5	200		
DDD			0.032	0.00031
DDE, p,p'-	72-55-9		0.046	0.00022
DDT	50-29-3		0.23	0.00022
Dieldrin	60-57-1		0.0018	0.000052
Gamma-Chlordane[4]	5566-34-7	2		
Iron	7439-89-6		14000	
Lead	7439-92-1	15		
Manganese	7439-96-5		430	
Mercury	7439-97-6	2		
Methyl Mercury	22967-92-6		2	
Nickel Soluble Salts	7440-02-0		390	610
Silver	7440-22-4		94	
Toluene	108-88-3	1000		
Vanadium	7440-62-2		86	
Zinc	7440-66-6		6000	74000

MCL = maximum contaminant level
SL = screening level
SCDHEC = South Carolina Department of Health and Environmental Control
AWQC = ambient water quality criteria
[1]Values from *USEPA, EPA-816-F-09-004,* May 2009.
[2]Values from *USEPA Regional Screening Levels (RSLS) – Generic Tables, Summary Table* (May 2016).
[3]Values from *R.61-68, Water Classification& Standards, South Carolina Department of Health and Environmental Control, Bureau of Water*
[4]Value for chlordane which is composed of a mixture including gamma chlordane

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Attachment C-5

MCLs/PRGs for Surface Water Data Screening of Radiological Constituents (website accessed May 8, 2017)

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MCLs/PRGs for Surface Water Data Screening of Radiological Constituents

Isotope	MCL *(pCi/L)*	Tap Water PRG *(pCi/L)*
Bismuth-214	1.50E+01	
Tritium	2.0E+04	
Gross Alpha	1.5E+01	
Nonvolatile Beta	a	
Lead-214		1.30E+02

MCL = maximum contaminant level
PRG = preliminary remediation goal
a - MCL = activity concentration for beta emitters equivalent to an annual dose of 4 mrem/yr

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APPENDIX D

ECOLOGICAL RISK ASSESSMENT

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LIST OF ABBREVIATIONS AND ACRONYMS

AWQC	ambient water quality criteria
bgs	below ground surface
BRA	Baseline Risk Assessment
CMS	Corrective Measures Study
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSM	Conceptual Site Model
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
ESV	ecological screening value
FS	Feasibility Study
ft	feet
GOSB	G-Area Oil Seepage Basin (761-13G)
HQ	hazard quotient
IOU	Integrator Operable Unit
LANL	Los Alamos National Laboratory
LOAEL	Low Observed Adverse Effect Level
LTR	Lower Three Runs
m	meter
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RI	remedial investigation
RME	reasonable maximum exposure
RSV	refinement screening values

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

SRS	Savannah River Site
SVOA	semivolatile organic analyte
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VOA	volatile organic analyte
VOC	volatile organic compound

D-1. INTRODUCTION

The ecological risk assessment (ERA) in support of the G-Area Oil Seepage Basin (761-13G) (GOSB) Operable Unit (OU) is presented in this appendix. From this point forward, the investigation area will be referred to as the GOSB OU. The GOSB OU is defined as the water and sediment of the seepage basin and the soil in the adjacent berm, pipeline, and discharge area.

The ERA process is in accordance with the conceptual site model (CSM) presented in Section 2.3. The CSM is a graphical depiction of the known and suspected sources of contamination within the GOSB OU, the types of contaminants and potentially affected media, the known and potential routes of migrations, and the potential ecological receptors, including terrestrial and aquatic/semi-aquatic receptors. Concentrations of constituents present in sediment, soil, and surface water are screened in a multi-step process to screening values to determine the potential for impact to either of these receptor groups.

The GOSB OU is comprised of four subunits; the ERA is conducted and presented for three of these subunits. Subunits represent geographically distinct locations within the GOSB OU, each of which contain environmental media to which a receptor may be exposed, that allow for the summary of data and evaluation of potential exposure. This approach allows for remedial decisions to be made on a smaller scale within the larger OU area. The subunits include the following:

- GOSB Interior Subunit
- GOSB Berm Subunit
- Pipeline Subunit (no ERA conducted, no potential for exposure)
- Effluent Discharge Subunit

Figure D-1 presents the GOSB OU and the associated four subunits.

D-1.1 Background

The GOSB OU is an earthen basin that was initially used for liquid waste disposal during Savannah River Site (SRS) plant construction in the early 1950s. It may have received unknown

liquid waste from the time of plant construction until the 1960s, although no records exist of such disposals. Until 1983, the GOSB received effluent from a small sanitary wastewater treatment facility; between 1983 and 1992 the GOSB received effluent from the Central Shops sanitary wastewater treatment plant via a National Pollutant Discharge Elimination System (NPDES) permitted outfall (CS-11). The designation of the basin as an oil seepage basin may be a misnomer because there is no information regarding its use for management and disposal of waste oils. The GOSB is currently inactive; however, rainwater is typically retained in the basin.

The GOSB basin is approximately 3 m (10 ft) deep around the edges of the basin with the northern and southern sides (0.9 m [3 ft] and 0.6 m [2 ft] high), respectively, being the highest. The deepest part of the basin, near the center, is approximately 4.8 m (16 ft) below ground surface (bgs). It receives wastewater input via approximately 57 m (190 ft) of buried 30 cm (12 in) vitrified clay pipe that was previously abandoned in place. On the outlet side of the basin, approximately 153 m (510 ft) of buried 30 cm (12 in) vitrified clay pipe discharged contents southeast of the basin into an intermittent stream. Both the basin inlet and outlet pipes are buried to a depth of approximately 1.8 to 2.4 m (6 to 8 ft) bgs. Figure D-1 shows the GOSB OU and the associated subunits.

The risk assessment considers environmental media within the basin itself, including sediment and surface water and surface and subsurface soil in the adjacent berm and downstream discharge area.

D-1.2 Data

In 2009, a sampling campaign was conducted to determine the nature and extent of any hazardous substances in the GOSB Basin and surrounding environment, and to collect sufficient data to support the human health and ecological risk assessment, contaminant migration evaluation, and PTSM analysis. Ninety-five soil, sediment, and surface water samples from 53 locations were collected from within the basin and the surrounding area for characterization of GOSB OU. Soil, sediment and surface water samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs), Target Analyte List (TAL) inorganics, and

radiological indicators/gamma spectroscopy. In addition to samples collected from the GOSB Subunits, six soil samples were collected from three locations upgradient of the basin. Upgradient samples were collected from the 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) bgs intervals and analyzed for TCL VOCs, SVOCs, and pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy. These upgradient samples served as local soils unimpacted by the GOSB OU.

Based on a determination that data gaps existed in the 2009 dataset, additional GOSB OU sampling took place from November 2016 through January 2017. A total of 20 soil and surface water samples were collected from 17 locations within the GOSB Basin Interior Subunit and the surrounding area for additional characterization. Soil samples were collected at the Effluent Discharge Subunit from three locations at intervals of 0 to 0.3 m (0 to 1 ft) and 0.3 to 1.2 m (1 to 4 ft) directly following the end of the pipeline subunit and analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL inorganics, and radiological indicators/gamma spectroscopy inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators. Surface water samples were collected at the GOSB Interior Subunit and analyzed for inorganics (metals), VOCs, SVOCs, and radiological indicators. A more thorough description of the data used in the ERA is provided in Chapter 3. All data used in the ERA are presented in Appendix A.

D-1.3 Habitats/Receptors/Preliminary Assessment and Measurement Endpoints

The GOSB OU includes the water and sediment in the drainage basin, the soil in the berm surrounding the basin, the soil surrounding the abandoned drainage pipeline, and the soil in the effluent discharge downstream of the drainage basin. The ecological setting species, including habitats, wildlife, and Threatened and Endangered Species (TES), are discussed in Section 2.1.

The habitats within the GOSB OU support both terrestrial and aquatic/semi-aquatic receptors. The media of concern is primarily sediment (pond sediment), soil (basin berm and pipe discharge area), and surface water.

Assessment endpoints are tailored to groups of organisms with similar feeding strategies and/or exposure scenarios appropriate for the GOSB OU. Based on these considerations, the following

assessment and measurement endpoints and their representative receptors were selected as discussed below:

- Protection of terrestrial autotrophs (plants) to maintain habitat structure and functional base for terrestrial animals. Plants are a food source for many animals and have direct exposure to contaminated soil. The use of a "generic" plant as receptor is indicative of the broad concern for plants in general and the role they play in the ecosystem rather than any particular species. The measurement endpoint is a comparison of the measured constituent concentration in soil to generic plant toxicity benchmarks. This preliminary comparison is expressed as a hazard quotient (HQ) calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of soil-dwelling invertebrate communities to maintain species diversity and nutrient cycling. Soil-dwelling invertebrate communities are selected because the soil invertebrate community is ecologically important, is susceptible to constituents in soil, and may be exposed at the GOSB OU. The soil-dwelling invertebrate community is essential for decomposition of detritus, for energy and nutrient cycling, and is an important component of the diet of insectivorous mammals and birds. Earthworms are chosen as the representative species of soil-dwelling invertebrates because they are important in promoting soil fertility, are highly exposed to soil constituents, and toxicity information is available. The measurement endpoint is a comparison of the measured constituent concentration in soil-to-earthworm toxicity benchmarks. This preliminary comparison is expressed as a HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of herbivorous mammal communities to ensure that exposure of contaminants in forage and soils does not have a negative impact on growth, survival, and reproduction. Herbivorous mammals are ecologically important because they provide a food base for higher trophic level receptors and are susceptible to soil constituents within the GOSB OU. Rabbits are chosen as the representative species of herbivorous mammals because they are exposed to soil constituents by their consumption of plant material and they ingest soil during

feeding. This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of insectivorous mammal communities to ensure that exposure of contaminants in prey, forage, and soils does not have a negative impact on growth or survival. Insectivorous mammals are ecologically important because they help to control the size of the terrestrial invertebrate population that might otherwise damage populations of plant primary producers. They also are susceptible to soil constituents within the GOSB OU. Shrews are chosen as the representative species of the insectivorous mammals because they are highly exposed to constituents by their consumption of large quantities of terrestrial invertebrates. They also ingest soil during feeding, including soil within the bodies of earthworms and other prey. This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of omnivorous mammal communities to ensure that exposure of contaminants in prey, forage, and abiotic media does not have a negative impact on growth, survival, and reproduction. Mammalian omnivores are ecologically important because they consume a variety of small mammals and plants, helping balance the populations of terrestrial invertebrates, rodents, and other small mammals as well as disperse seeds for plant reproduction. They also are susceptible to soil constituents at the waste unit. The mouse was chosen as the representative receptor because of its omnivorous food habits and largely to represent the importance of rodents as a food source for higher consumers (carnivores and omnivores), making it important in the functional food web. They are ubiquitous, abundant, and ingest soil during feeding, including soil within the bodies of earthworms and other prey. This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of insectivorous, herbivorous, and omnivorous bird communities to ensure that exposure of contaminants in prey, forage, surface water, and soils does not have a negative impact on growth, survival, and reproduction. Insectivorous birds are ecologically important because they help to control the size of the terrestrial invertebrate population that might

otherwise damage populations of plant primary producers. American robins are chosen as the representative terrestrial species because they are representative of birds that forage for ground-dwelling invertebrates and fruits, with a relatively high potential exposure to contaminants from its diet. The American robin is considered in several functional roles for avian receptors: an insectivore, herbivore, and omnivore. They also ingest soil during feeding, including soil within the bodies of earthworms and other prey. The violet-green swallow is selected as the representative avian aerial insectivore because 100 percent of its diet can be assumed to come from emergent aquatic insects, which allows for the consideration of bioaccumulation from aquatic sources to a high-level avian receptor. This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of aerial insectivorous mammal communities to ensure that exposure of contaminants in prey, forage, and surface water does not have a negative impact on growth, survival, and reproduction. Aerial insectivorous mammals are ecologically important because they help to control the size of the invertebrate population that might otherwise damage populations of plant primary producers. They also are susceptible to soil or water constituents within the GOSB OU. Bats are chosen as the representative species of the aerial insectivorous mammal niche because they are exposed to constituents by their consumption of flying invertebrates and they utilize aquatic habitats as a source of water. Bats provide a beneficial service by foraging on flying insects, many of which are pests. They also eat large numbers of moths and beetles that cause agricultural damage. Bats will opportunistically roost and forage in various habitats. This comparison is expressed as an HQ calculation based on the screening of the GOSB OU data summarized in Appendix A

- Protection of carnivorous bird communities to ensure that exposure of contaminants in prey does not have a negative impact on growth, survival, and reproduction. American kestrels are selected as the representative species because abundant information has been gathered concerning the kestrel's biology and it represents an organism with high susceptibility to contaminant biomagnification from soil via terrestrial pathways. The American kestrel is considered in two functional roles for avian receptors, intermediate carnivore and top

carnivore. This comparison is expressed as an HQ calculation based on the screening of the GOSB OU data summarized in Appendix A

- Protection of top carnivorous mammal communities to ensure that exposure of contaminants in prey does not have a negative impact on growth, survival, and reproduction. Carnivorous mammals are ecologically important because they maintain ecosystem structure and function by feeding on primary consumers (herbivores), reducing the impacts of herbivory. The red foxes are selected as the representative top carnivore because they represent a mammal with a relatively high contaminant biomagnification potential due to their largely carnivorous feeding habits. This comparison is expressed as an HQ calculation based on the screening of the GOSB OU data summarized in Appendix A

- Protection of benthic invertebrate (sediment dwelling organism) communities from toxic effects of contaminants to maintain species diversity, biomass, and nutrient cycling (trophic structure). Identification of a specific receptor for this endpoint is not necessary. The benthic invertebrate community is ecologically important, serving as prey items for many other species as well as maintaining nutrient cycling in an aquatic system. Benthic organisms also are susceptible to constituents in sediment and are potentially exposed within the GOSB OU. The measurement endpoint is the measured concentration in sediment media compared to sediment toxicity threshold values. This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

- Protection of aquatic organism communities from the toxic effects of contaminants in abiotic media and food to maintain species diversity and ensure that ingestion of contaminants in fish and aquatic invertebrates do not have a negative impact on growth, survival, and reproduction. The aquatic community is ecologically important, serving as prey items for many species. Aquatic organisms are susceptible to constituents in surface water and are potentially exposed to contamination within the GOSB OU. The measurement endpoint is the measured concentration in surface water media compared to ambient water quality criteria (AWQC). This preliminary comparison is expressed as an HQ calculation based on the screening of GOSB OU data summarized in Appendix A

The preliminary CSM for the GOSB OU is provided in Section 2.3. Data used in this evaluation are provided in Appendix A of this document.

D-1.4 Sources of Literature-Based Thresholds

Ecological threshold levels are media- and receptor-specific values that can be used to evaluate (i.e., screen) sediment, soil, and surface water data from potentially contaminated sites. The thresholds are derived from several sources and are used to evaluate No Observed Adverse Effect Level (NOAEL) and Low Observed Adverse Effect Level (LOAEL). The GOSB ecological screening values (ESVs) are used in the initial screening-level effects evaluation and are based on NOAEL thresholds. For constituents that exceed ESVs and background screening, refinement screening values (RSVs) are used for the refinement-level risk calculation. The RSVs are based on LOAEL thresholds appropriate for refinement of sediment, soil, and surface water media constituents.

The threshold values used for the ESV and RSV assessments were derived from three sources: 1) the U.S. Environmental Protection Agency (USEPA) Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft (USEPA 2015); 2) the Los Alamos National Laboratory (LANL) ECORISK Database Tool (LANL, Ecorisk Database 2015); and 3) the South Carolina Department of Health and Environmental Control (SCDHEC), R.61-68, Water Classifications and Standards (SCDHEC 2014). A brief discussion of the hierarchy of values and generic methodology used to derive values in these sources follows:

- The USEPA Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft (USEPA 2015) provides threshold values for hazardous waste sites for surface water (Table 1a), sediment (Tables 2a,. b,. and c), and soil (Table 3) for non-radiological constituents and is provided in Attachment D-2
  - The sediment screening values in Table 2 are derived from the statistical interpretation of effects databases obtained from the literature. These benchmarks are generally based on observations of direct toxicity to benthic organisms. Table 2 provides both ESVs (for the screening level assessment) and RSVs (for the refinement level assessment)

  - The soil screening values in Table 3 typically address toxicity through direct exposure (i.e., toxicity to soil invertebrates such as earthworms, plants and wildlife). The hierarchy for soil benchmarks is as follows: EPA Ecological Screening levels, U.S. Department of Energy laboratories (i.e., Los Alamos National Laboratory [LANL] and Oak Ridge National Laboratory), and equilibrium partitioning-modeled values for organic chemicals. Table 3 provides only a screening level threshold
  - The hierarchy of surface water values compiled in Table 1 is as follows: National Recommended Surface Water Criteria (NWQC), Tier 2 values or equivalent from the Great Lakes Initiative, state surface water standards, Suter and Tsao 1996 values, Canadian water quality values, the minimum value from either the Target Lipid Model or Ecological Structure Activity Relationship model, and the Office of Pesticide Programs Aquatic Life Benchmarks. In general, the most conservative was selected as the ESV. For the NWQC, the chronic AWQC value for the protection of aquatic life was used as the screening value. Table 1 chronic values are used for both the screening and refinement level assessments

- LANL developed the ECORISK Database Tool (LANL 2015) to document and archive ecological screening levels. The LANL database tool includes thresholds for surface water and sediment/soil. LANL develops literature-based toxicity reference values (TRVs) for various chemical exposure pathways, and using the derived TRVs as well as dose rates (for radionuclides) and other benchmarks, LANL calculated No Effect and Low Effect ecological screening levels (ESLs) for various media and receptors. Details of this process are described in Toxicity Reference Value Development Methods for the Los Alamos National Laboratory, Revision 1 (LANL 2014). The ECORISK Database Tool compiles the resulting No Effect and Low Effect ESLs by media (surface water, sediment, soil) and receptor. The minimum ESL available from all receptors for a given media and constituent was used as the threshold level as follows: the minimum No Effect ESL was used as the threshold for the screening level assessment, and the minimum Low Effect ESL was used as the threshold for the refinement level assessment. Copies of the screening value tables used in this evaluation are provided in Attachment D-3 to this appendix

- An additional source of threshold values used only for the assessment of surface water is the South Carolina Department of Health and Environmental Control, R.61-68, Water Classifications and Standards (freshwater aquatic life chronic values) regulation (SCDHEC 2014). These thresholds were used for both the screening level and refinement level assessments. A copy of this regulation is provided in Attachment D-4

The screening values derived from these sources are compared in six tables that are presented in Attachment D-1. All ESVs available for a given constituent are identified by source, with the most conservative (i.e., lowest selected screening value) highlighted in yellow. The six tables are as follows:

- Table I.A. SEDIMENT MEDIA Screening Level (No Effect Screening Level)
  - The source of the "EPA R4 Sediment" column is the Freshwater Sediment Screening Value ESV column from USEPA Table 2 for sediment
  - The source of the "EPA R4 Soil" column is the Screening Level column from USEPA Table 3 for soils
  - The source of the "LANL Sediment" column is the No Effect ESL for sediment from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level
  - The source of the "LANL Soil" column is the No Effect ESL for soil from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level

- Table I.B.SEDIMENT MEDIA Refinement Level (Low Effect Screening Level)
  - The source of the "EPA R4 Sediment" column is the Freshwater Sediment Screening Value RSV column from EPA Table 2 for sediment
  - There are no EPA Region 4 RSV values for soil, so "NA" is listed under "EPA R4 Soil"

  - The source of the "LANL Sediment" column is the Low Effect ESL for sediment from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level
  - The source of the "LANL Soil" column is the Low Effect ESL for soil from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level

- Table II.A. SOIL MEDIA Screening Level (No Effect Screening Level)
  - The source of the "EPA R4 Soil" column is the Screening Level column from EPA Table 3 for soils
  - The source of the "LANL Soil" column is the No Effect ESL for soil from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level

- Table II.B.SOIL MEDIA Refinement Level (Low Effect Screening Level)
  - There are no EPA Region 4 RSV values for soil, so "NA" is listed under "EPA R4 Soil"
  - The source of the "LANL Soil" column is the Low Effect ESL for soil from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level

- Table III.A.SURFACE WATER MEDIA Screening Level (Chronic/No Effect Screening Level)
  - The source of the "SCDHEC WQS" column is the Freshwater Aquatic Life Criterion Continuous Concentration (CCC) column from the SCDHEC regulation
  - The source of the "EPA R4 Surface Water" column is the Freshwater Screening Values Chronic column from EPA Table 1 for surface water
  - The source of the "LANL Surface Water" column is the No Effect ESL for surface water from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level

- Table III.B.SURFACE WATER MEDIA Refinement Level (Chronic/Low Effect Screening Level)
  - The source of the "SCDHEC WQS" column is the Freshwater Aquatic Life CCC column from the SCDHEC regulation
  - The source of the "EPA R4 Surface Water" column is the Freshwater Screening Values Chronic column from EPA Table 1
  - The source of the "LANL Surface Water" column is determined as follows: If the lowest of the LANL values from Attachment D-3 LANL ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level is for protection of aquatic communities, the No Effect ESL is used; if the lowest of the LANL values is for wildlife receptors, the Low Effect ESL is used

D-2. ECOLOGICAL RISK ASSESSMENT PROCESS

This GOSB OU ERA consists of steps designed to provide a scientifically based and defensible assessment of exposure and hazard assessment for ecological receptors that will support a risk management decision regarding site remediation. The ERA for the GOSB OU includes a screening-level ecological effects evaluation (Section D.2.1) in which constituent concentrations in sediment, soil, or surface water media are compared to relevant ecological screening levels; constituents that exceed ESVs or that have no ESV are considered contaminants of potential ecological concern (COPECs). COPECs that result from the screening-level evaluation are carried forward to a refinement-level risk (hazard) calculation (Section D.2.2) in which refinement level HQs are calculated for each COPEC. The refinement level screening is based on LOAEL or chronic level thresholds and the 95% upper confidence level (UCL) on the mean. Constituents that fail the refinement level screening are considered constituents of potential concern (COPCs). Uncertainties associated with the screening thresholds, background concentrations, nature and extent of contamination, ~~frequency of detection,~~ age of data, or contaminants that result from the screening and refinement processes are discussed in an uncertainty evaluation presented in Section D.2.3. The uncertainty discussion concludes with a

determination of whether the constituent should or should not be considered a refined constituent of concern (RCOC). If RCOCs are identified, final action consideration is warranted.

D-2.1 Screening-Level Effects Evaluation

The purpose of the ecological screening-level effects evaluation for the GOSB OU is to conduct a conservative screen to identify constituents that may pose unacceptable risk to ecological receptors. The screening level evaluation is the initial step in determining constituents that require further evaluation. Screening is conducted by comparing the maximum concentration to the ESVs found in Attachment D-1 Tables I.A, II.A and III.A and to two times the average SRS background level (for sediment and soil media only). The maximum values of each constituent with detected values for each subunit are presented in Appendix A. Table A.1.1 provides summary statistics for the sediment medium, Table A.1.2 provides summary statistics for the surface water medium, Tables A.2.1.1 and A.4.1 provide summary statistics for the soil medium 0 to 1 ft interval, and Tables A.2.1.2 and A.4.2 provide summary statistics for the soil medium 1 to 4 ft interval. The background data used in the screening level effects evaluation for both sediment and soil are taken from *Background Soils Statistical Summary Report for the Savannah River Site* (WSRC 2006). The report provides statistical summaries for many naturally-occurring constituents at SRS. No background screen is performed for the surface water media.

Since maximum media concentrations are used in this step of the process, the assumption is made that ecological receptors are exposed to the highest (i.e., worst) concentration of a given constituent present at the unit. The combination of maximum media concentrations and conservative threshold values provide confidence that the COPCs resulting from the screenings are indeed protective.

Constituents that are recognized as essential nutrients (calcium, magnesium, potassium, and sodium) are identified as such and are not subject to further evaluation. These constituents are deemed necessary for life processes, therefore, consumption from natural sources is deemed to not be detrimental.

The ecological effects evaluation identifies the potential for adverse ecological effects based on conservative assumptions. The most conservative value (i.e., lowest concentration) between the EPA Region 4 and the NOAEL-based LANL values are used to conduct the screening level assessment. For the evaluation of surface water media, the April 2008 SCDHEC water quality standards (chronic values) also are considered.

D-2.1.1 ESV Screening - Soil Media

The screening level evaluation process is outlined below:

- Compare the unit maximum detected concentration to the GOSB ESV concentration (No Effect Screening Level) for the surface interval (0 to 1 ft) and subsurface interval (1 to 4 ft) and calculate a screening level HQ for each interval. HQ = Maximum Detected Concentration/ESV

- Compare the unit maximum concentration of the naturally-occurring (non-anthropogenic) constituents for each interval to two times the average SRS background concentration (Appendix B-1)

- Constituents exceeding the ESV (HQ > 1) or with no ESV and exceeding background screen are identified as COPECs and are carried forward to step D.2.2. Constituents that are not identified as COPECs are dropped from further evaluation

D-2.1.2 ESV Screening - Sediment Media

The screening-level evaluation process is outlined below:

- Compare the unit maximum detected concentration to the GOSB ESV concentration (No Effect Screening Level) for the surface interval (0 to 1 ft) and calculate a screening level HQ = Maximum Detected Concentration/ESV

- Compare the unit maximum concentration of the naturally-occurring (non-anthropogenic) constituents to two times the average SRS background concentration (Appendix B-1)

- Constituents exceeding the ESV (HQ > 1) or with no ESV and exceeding background screen are identified as COPECs and are carried forward to step D.2.2. Constituents that are not identified as COPECs are dropped from further evaluation

D-2.1.3 ESV Screening - Surface Water Media

The screening-level evaluation process is outlined below:

- Compare the unit maximum concentration to the GOSB ESV concentration (AWQC chronic values or No Effect ESL) and calculate a screening level. HQ = Maximum Detected Concentration/ESV
- Constituents exceeding the ESV (HQ > 1) or with no ESV are identified as COPECs and are carried forward to step D.2.2. Constituents that are not identified as COPECs are dropped from further evaluation

Tables summarizing the ecological screening-level effects evaluation for the GOSB subunits are as follows:

- Table D-1 (for sediment in the GOSB Interior Subunit)
- Table D-3 (for surface water in the GOSB Interior Subunit)
- Table D-5 (for soil 0 to 1 ft interval in the GOSB Berm Subunit)
- Table D-7 (for soil 1 to 4 ft interval in the GOSB Berm Subunit)
- Table D-9 (for soil 0 to 1 ft interval in the Effluent Discharge Subunit)
- Table D-11 (for soil 1 to 4 ft interval in the Effluent Discharge Subunit)

The refinement tables are discussed below in Section D.2.2.

D-2.2 Refinement-Level Risk (Hazard) Calculation

The refinement evaluation uses the RSVs found in Attachment D-1 Tables I.B, II.B, and III.B. Because of the conservative approach of the initial screening level evaluation (i.e., ESV screening), some of the constituents identified for further evaluation may or may not pose a

possible unacceptable risk to ecological receptors. The refined screening process applies a more realistic and holistic approach to screening to further refine the list to those constituents that require further discussion and scrutiny. The method used to further refine ecological COPCs is based on the calculation of a refinement-level HQ by comparing the Exposure Point Concentration (EPC) to a LOAEL RSV. LOAEL-based RSVs are derived from Low Effect ESLs. The EPC is represented by the lower of the 95% UCL on the mean and maximum detected concentrations. Calculation of the HQ is illustrated in the equation below:

$$HQ = EPC/(LOAEL - based\ RSV)$$

Constituents with an HQ >1 are further discussed in Section D.2.3.

D-2.2.1 RSV Screening - Soil Media

For the COPECs identified in Section D.2.1.1, the refinement level process is outlined below:

- Calculate a refinement level HQ using the EPC and GOSB RSV (LOAEL-based ESL)
- Constituents with refinement levels HQ > 1 or with no RSV are identified as COPCs and are carried forward to Section D.2.3. Constituents that are not identified as COPCs are dropped from further evaluation

D-2.2.2 RSV Screening - Sediment Media

For COPECs identified from Step D.2.1.2, the refinement level process is outlined below:

- Calculate a refinement level HQ using the EPC and GOSB RSV (LOAEL-based ESL)
- Constituents with refinement levels HQ > 1 or with no RSV are identified as COPCs and are carried forward to Section D.2.3. Constituents that are not identified as COPCs are dropped from further evaluation

D-2.2.3 RSV Screening - Surface Water Media

For the COPECs identified from Section D.2.1.3, the refinement level process is outlined below:

- Calculate a refinement level HQ using the EPC and GOSB RSV (chronic value for AWQC, LOAEL ESL for wildlife receptors)
- Constituents with refinement levels HQ > 1 or with no RSV are identified as COPCs and are carried forward to Section D.2.3. Constituents that are not identified as COPCs are dropped from further evaluation

D-2.3 Results/Refinement of Constituents of Concern

The refinement level risk calculation is based, in general, on LOAEL or chronic level thresholds. Constituents that fail the refinement level screening are considered COPCs. Tables summarizing the ecological refinement level effects evaluation for the GOSB subunits are as follows:

- Table D-2 (for sediment in the GOSB Interior Subunit)
- Table D-4 (for surface water in the GOSB Interior Subunit)
- Table D-6 (for soil 0 to 1 ft interval in the GOSB Berm Subunit)
- Table D-8 (for soil 1 to 4 ft interval in the GOSB Berm Subunit)
- Table D-10 (for soil 0 to 1 ft interval in the Effluent Discharge Subunit)
- Table D-12 (for soil 1 to 4 ft interval in the Effluent Discharge Subunit)

Uncertainties associated with the screening thresholds, background concentrations, ~~frequency of detection~~nature and extent of contamination, age of data, or contaminants that result from the screening and refinement processes are discussed in an uncertainty evaluation presented below. The uncertainty discussion concludes with a determination of whether the constituent is considered a RCOC. The major categories of uncertainty used in this evaluation and the major emphasis include the following:

- Unit related uncertainty, which includes uncertainties related to the nature and extent of contamination, consistency with history of use, and presence in background
- Data quality uncertainty and risk assessment uncertainties which includes uncertainties related to data quality and physical characteristics

- Risk assessment uncertainty which includes uncertainties related to toxicity data and changes in constituent activity concentrations due to radioactive decay

Using the three step process described above, results of the ecological risk assessment are presented below by subunit.

In the uncertainty evaluation, exposure area concentrations are compared to background concentrations as one line of evidence to assist in the identification of RCOCs. A brief description of the primary sources of background information is provided below:

- The GOSB background dataset provided in Appendix A (Table A.6.3 for all depths) identifies minimum, mean, and maximum concentrations (or activities) for soil media. A more thorough description of the OU background dataset is provided in Section 3.2
- *Background Soils Statistical Summary Report for the Savannah River Site* (WSRC 2006) provides statistical summaries for many naturally-occurring constituents at SRS. Appendix B-2 (all-depth intervals) is the primary source of information used in this evaluation
- The Integrator Operable Unit (IOU) background dataset identifies minimum, mean, and maximum concentrations (or activities) for surface water media. IOU background data were collected as part of the 2009/2010 characterization effort. The IOU background surface water dataset is published in Table A.1.10.2 of *Remedial Investigation/Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U)* (SRNS 2017).

As an additional line of evidence, toxicity uncertainty is addressed for radionuclides with no available ESLs by comparing unit activity concentrations to Tier 3 Biota Concentration Guides (BCGs) found in the RESidual RADioactivity (RESRAD) BIOTA database (Argonne National Laboratory [ANL] 2006), which is provided in Attachment D-6. The RESRAD Tier 3 values were generated by Savannah River National Laboratory based on the most conservative activity for each nuclide available for terrestrial animals and terrestrial plants for terrestrial systems, and aquatic animals and riparian animals for aquatic systems.

In this ecological risk assessment, average unit concentrations are given more significance than maximum concentrations since the wildlife receptors under consideration are not sedentary and

their exposure is over a larger area than that encountered at a single sampling location. The exception to the assumption of non-sedentary behavior are soil invertebrates (i.e., earthworm), benthic organisms (for sediment media), and aquatic organisms (surface water). However, this is offset by the fact that the soil invertebrate, benthic organism, and aquatic organism endpoints are established at the community-level, and effects caused by a maximum concentration at a single location would not cause community-level impacts.

As a protective assumption appropriate for ecological risk screening, the area use factor (AUF) is set to 1 when calculating the HQ, making the conservative assumption that the animal receives all of its exposure from the contaminated site. This approach may overestimate risks to receptors whose home ranges are larger than the area of contamination being evaluated. To account for this overestimation of risk, the HQ can be modified by applying a population area use factor (PAUF), which uses the estimated area occupied by the population of a receptor species to assess the likelihood of any individual within the assessment population encountering the contaminated area. The PAUF is calculated based on the ratio of the subunit area to the known home range of the receptor (Mirenda 2012) to reflect the fact that receptors utilize an area beyond just the contaminated site. AUF-adjusted HQs based on mean concentrations are discussed in the uncertainty section and can be found in Attachment D-9. Calculated PAUFs based on GOSB subunit areas can be found in Attachment D-8.

D-2.3.1 GOSB Interior Subunit

Results of the ESV screening (Step D.2.1), refinement-level risk calculations (Step D.2.2), and a discussion of associated uncertainties for each constituent of potential concern for the GOSB Interior Subunit are provided below.

D-2.3.1.1 D.2.3.1.1 Screening Results for GOSB Interior Subunit for Sediment Media

Using maximum detected values, Table D-1 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment interval evaluated for terrestrial and aquatic receptors: 1,4-dichlorobenzene, 2-methylnaphthalene, alpha-chlordane, antimony, barium, benzo[a]anthracene, benzo[b]fluoranthene, cadmium, caprolactam, chromium, chrysene, copper,

cyanide, DDD, DDE, dieldrin, fluoranthene, fluorene, gamma-chlordane, heptachlor, heptachlor epoxide, lead, lead-214, mercury, methylcyclohexane, nickel, phenanthrene, potassium-40, pyrene, silver, thallium, thallium-208, and zinc. Sampling locations described for the GOSB Interior Subunit are shown in Figure 3-1.

The radionuclide constituents are identified as COPECs since there are no published ESVs available for these constituents. There also is no screening value for caprolactam or methylcyclohexane. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

D-2.3.1.2 Refinement Results for GOSB Interior Subunit for Sediment Media

Using EPC values (i.e., 95% UCL on the mean), Table D-2 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft sediment interval: 2-methylnaphthalene, alpha-chlordane, barium, cadmium, caprolactam, copper, DDD, DDE, dieldrin, fluoranthene, fluorene, gamma-chlordane, heptachlor epoxide, lead, lead-214, mercury, methylcyclohexane, phenanthrene, potassium-40, silver, thallium, and thallium-208.

The radionuclide constituents are identified as COPCs since there are no published RSVs available for these constituents. There also are no screening values for caprolactam or methylcyclohexane. The COPCs are discussed further below.

D-2.3.1.3 Uncertainty Discussion for GOSB Interior Subunit for Sediment Media

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors, resulting in a recommendation whether the constituent should be considered an RCOC. HQ calculations for receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5, Table 1.A, for the sediment medium.

2-Methylnaphthalene was detected in four of five samples. One of the four samples was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 2.58 mg/kg at the GOSB-51 location. The mean detected concentration was 0.55 mg/kg and the EPC was also

2.58 mg/kg. The EPC (2.58 mg/kg) and mean (0.55 mg/kg) exceed the RSV of 0.447 mg/kg (HQ with mean = 1.23). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 5.77). There is no background available for comparison, but 2-methylnaphthalene is ubiquitous in the environment and there are polycyclic aromatic hydrocarbons (PAHs) present in upgradient samples. 2-methylnaphthalene is a naphthalene-related compound associated with moth balls, dyes, resins, and vitamin K. Naphthalene binds weakly to soils and sediments and microorganisms will break it down in 1-3 months (Agency for Toxic Substances and Disease Registry [ATSDR] 2005).

2-methylnaphthalene is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- The HQ calculated with the mean is close to one
- There is no background available for comparison
- It binds weakly in sediment and is broken down quickly
- It is ubiquitous in the environment

Alpha-chlordane was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 7.32 mg/kg at the GOSB-51 location (see Figure 3-7). The mean detected concentration was 1.69 mg/kg and the EPC was 4.49 mg/kg. The EPC (4.49 mg/kg) and mean (1.69 mg/kg) exceed the RSV of 0.018 mg/kg (HQ calculated with mean = 99.4). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for aquatic community organisms (HQ = 264.35), montane shrew (mammalian insectivore) (HQ = 1.66), occult little brown myotis bat (mammalian aerial insectivore) (HQ = 1.36), American robin (avian omnivore) (HQ = 1.66), American robin (avian insectivore) (HQ = 3.21), and violet-green swallow (Avian aerial insectivore) (HQ = 2.5). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: montane shrew (mammalian insectivore) (HQ = 0.0041), occult little brown myotis bat (mammalian aerial insectivore)

(HQ = 0.000013), American robin (avian omnivore) (HQ = 0.0038), American robin (avian insectivore) (HQ = 0.0073), and violet-green swallow (Avian aerial insectivore) (HQ = 0.0035).

There is no background available for comparison. Chlordane was used primarily as a pesticide for termite control and persists in the environment for years. Its use was banned by the EPA in 1988 *(*Breast Cancer and Environmental Risk Factors [BCERF] 1998). Its presence is consistent with potential for previous use as a pesticide at this subunit.

Alpha-chlordane is recommended for further remedial evaluation as an ecological RCOC for benthic organisms in sediment based on the following lines of evidence:

- AUF-adjusted HQs are less than 1 for wildlife receptors, but the HQ for aquatic community organisms is still > 1
- There is no background available for comparison
- The mean exceeds the RSV (HQ = 100)
- Pesticides were likely used within the basin

Barium was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 92 mg/kg at the GOSB-49 location. The mean detected concentration was 32.07 mg/kg and the EPC was 92 mg/kg. The EPC exceeds the RSV of 60 mg/kg, but the mean concentration does not exceed the RSV (HQ calculated with mean = 0.53). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 1.53). However, barium is naturally-occurring, and the maximum detected concentration is well within background levels, the GOSB background maximum is 38.6 mg/kg and SRS background maximum is 252 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Barium is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring
- The mean detected concentration does not exceed the RSV

- It is within GOSB and SRS background levels
- Screening level is likely overprotective

Cadmium was detected in five of five samples. Two of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 4.19 mg/kg at the GOSB-50 location. The mean detected concentration was 1.82 mg/kg and the EPC was 3.26 mg/kg. The EPC (3.26 mg/kg) exceeds the RSV of 2.7 mg/kg, but the mean (1.82 mg/kg) does not exceed the RSV (HQ calculated with mean = 0.67). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for the montane shrew (mammalian insectivore) (HQ = 1.21) and American robin (avian insectivore) (HQ = 1.12). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted, resulting in HQs as follows: montane shrew (mammalian insectivore) (HQ = 0.0044) and American robin (avian insectivore) (HQ = 0.0038). Additionally, cadmium is naturally-occurring and the mean detected concentration is within background levels, the GOSB background maximum is 0.16 mg/kg and the SRS background maximum is 2.01 mg/kg.

Cadmium is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring
- The mean detected concentration does not exceed the RSV
- AUF-adjusted HQs are < 1
- It is within SRS background levels
- Screening level is likely overprotective

Caprolactam was detected in one of five samples. The one sample was not J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 14.2 mg/kg at the GOSB-51 location. The mean detected concentration was 2.88 mg/kg and the EPC was 14.2 mg/kg.

Caprolactam came through screening because there is no published ecological screening threshold level and there is also no background available to compare.

Caprolactam is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- ~~It has a low frequency of detection (1/5)~~
- There is no history of use, not unit-related
- There is no screening threshold

Copper was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 48.1 mg/kg at the GOSB-49 location. The mean detected concentration was 31.99 mg/kg and the EPC was also 48.1 mg/kg. The EPC (48.1 mg/kg) exceeds the RSV of 46 mg/kg, but the mean (31.99 mg/kg) does not exceed the R SV (HQ calculated with mean = 0.70). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for American robin (avian insectivore) (HQ = 1.05). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific HQ for American robin changes from 1.05 to 0.0042. Additionally, copper is naturally-occurring and the maximum detected concentration is within background, the GOSB background maximum is 5.31 mg/kg and the SRS background maximum is 74.2 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Copper is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring
- The mean detected concentration does not exceed the RSV (HQ = 0.7)
- AUF-adjusted HQs are < 1
- It is within SRS background levels

- Screening level is likely overprotective

DDD was detected in four of five samples. Two of the four samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.8 mg/kg at the GOSB-51 location (see Figure 3-7). The mean detected concentration was 0.39 mg/kg and the EPC was 1.8 mg/kg, which both exceed the RSV of 0.00781 mg/kg (HQ calculated with mean = 49.94). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 230.47). There is no background available to compare. Its presence is consistent with potential for previous use as a pesticide at this subunit.

DDD is recommended for further remedial evaluation as an ecological RCOC for benthic organisms in sediment based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 50)
- There is no background available to compare
- Pesticides were likely used within the basin

DDE was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 4.5 mg/kg at the GOSB-51 location (see Figure 3-7). The mean detected concentration was 1.04 mg/kg and the EPC was also 4.5 mg/kg, which both exceed the RSV of 0.00374 mg/kg (HQ = 278.07). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 1,203.21). The maximum detected concentration exceeds background, the GOSB background maximum is 0.00082 mg/kg. Its presence is consistent with the potential for previous use as a pesticide at this subunit.

DDE is recommended for further remedial evaluation as an ecological RCOC for benthic organisms in sediment based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 278)
- ~~It has a high frequency of detection (5/5)~~
- Pesticides were likely used within the basin

Dieldrin was detected in three of five samples. All three of the samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.5 mg/kg at the GOSB-51 location (see Figure 3-7). The mean detected concentration was 0.11 mg/kg and the EPC was 0.34 mg/kg, which both exceed the RSV of 0.009 mg/kg (HQ = 12.22). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for aquatic community organisms (HQ = 17.88), deer mouse (mammalian omnivore) (HQ = 19.99), montane shrew (mammalian insectivore) (HQ = 37.76), and occult little brown myotis bat (mammalian aerial insectivore) (HQ = 30.89). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted, resulting in HQs as follows: deer mouse (mammalian omnivore) (HQ = 0.22), montane shrew (mammalian insectivore) (HQ = 0.081), and occult little brown myotis bat (mammalian aerial insectivore) (HQ = 0.00026).

There is no background available to compare dieldrin against. Dieldrin is an insecticide that was used from the 1950s through the 1970s on corn and cotton, through 1987 it was used to kill termites, and it degrades slowly in the environment (ATSDR 2002). Its presence is consistent with the potential for use as a pesticide at this subunit.

Dieldrin is recommended for further remedial evaluation as an ecological RCOC for benthic organisms in sediment based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 12)
- AUF-adjusted HQs are less than 1 for wildlife receptors, but the HQ for aquatic community organisms is still >1
- Pesticides were likely used within the basin

Fluoranthene was detected in five of five samples. Two of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.99 mg/kg at the GOSB-51 location. The mean detected concentration was 0.3 mg/kg and the EPC was 0.99 mg/kg. The EPC exceeds the RSV of 0.707 mg/kg, but the mean does not exceed the RSV (HQ calculated

with mean = 0.42). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 1.4). The maximum detected concentration exceeds background, but the mean concentration is similar to background, the GOSB background maximum is 0.27 mg/kg. Fluoranthene is a ubiquitous combustion byproduct that is common in the environment.

Fluoranthene is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- The mean detected concentration does not exceed the RSV
- It is ubiquitous in the environment
- The mean detected concentration is similar to the GOSB background level

Fluorene was detected in two of five samples. None of the samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.59 mg/kg at the GOSB-51 location. The mean detected concentration was 0.33 mg/kg and the EPC was 1.59 mg/kg. The EPC exceeds the RSV of 0.53 mg/kg, but the mean concentration does not exceed the RSV (HQ calculated with mean = 0.62). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for aquatic community organisms (HQ = 3). There is no background available with to compare against.

Fluorene is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- The mean detected concentration does not exceed the RSV (HQ = 0.6)
- ~~It has a low frequency of detection (2/5)~~
- It is ubiquitous in the environment

Gamma-chlordane was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 10.9 mg/kg at the GOSB-51 location (see Figure 3-7). The mean detected concentration was 2.51 mg/kg and the EPC was 10.9 mg/kg, which both exceed the RSV of 0.017 mg/kg (HQ calculated with mean =

147.65). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for aquatic community organisms (HQ = 641.18), but wildlife HQs are all less than 1. There is no background available for comparison. Chlordane was used primarily as a pesticide for termite control and persists in the environment for years. Its use was banned by EPA in 1988 (BCERF 1998). Its presence is consistent with the potential for previous use as a pesticide at this subunit.

Gamma-chlordane is recommended for further remedial evaluation as an ecological RCOC in sediment for benthic organisms based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 148)
- ~~It was detected in all samples (5/5)~~
- Pesticides were likely used within the basin

Heptachlor epoxide was detected in three of five samples. One of the samples was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.945 mg/kg at the GOSB-51 location. The mean detected concentration was 0.198 mg/kg and the EPC was 0.635 mg/kg, which both exceed the RSV of 0.016 mg/kg (HQ calculated with mean = 12.38). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for aquatic community organisms (HQ = 39.7). There is no background available for comparison. Heptachlor epoxide is a breakdown product of heptachlor, an organochlorine insecticide. Soil microorganisms transform heptachlor to heptachlor epoxide, which is more stable in the environment than its parent and, therefore, more likely to be detected. It is both more soluble in water and more persistent in the environment than its parent heptachlor. While the use of heptachlor at SRS is unknown, its presence is consistent with the potential for use as a pesticide at this subunit.

Heptachlor epoxide is recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 12)
- Pesticides were likely used within the basin

Lead was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 52 mg/kg at the GOSB-50 location. The mean detected concentration was 26.74 mg/kg and the EPC was 43.07 mg/kg. The EPC exceeds the RSV of 28 mg/kg, but the mean concentration does not exceed the RSV (HQ = 0.955). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for the American robin (avian herbivore) (HQ = 1.03), American robin (avian omnivore) (HQ = 1.31), and American robin (avian insectivore) (HQ = 1.54). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: American robin (avian herbivore) (HQ = 0.0038), American robin (avian omnivore) (HQ =0.0049), and American robin (avian insectivore) (HQ = 0.0058). Additionally, lead is naturally-occurring. The maximum detected concentration exceeds background, but the mean concentration is similar to background levels, the GOSB background maximum is 13.5 mg/kg and the SRS background maximum is 26.6 mg/kg.

Lead is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring
- The mean detected concentration does not exceed the RSV (HQ = 0.955)
- AUF-adjusted HQs are < 1
- It is similar to SRS background levels

Lead-214 was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected activity was 1.01 pCi/g at the GOSB-52 location. The mean detected activity was 0.81 pCi/g and the EPC was 0.93 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. However, lead-214 is a naturally-occurring radionuclide with a short half-life of 26.81 minutes.

Further, the maximum for the uranium-238 decay is within background; the SRS background maximum for the uranium-238 decay series is 2.78 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- It is within background

Mercury was detected in five of five samples. One of the five samples was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.58 mg/kg at the GOSB-49 location. The mean detected concentration was 0.26 mg/kg and the EPC was 0.58 mg/kg, which both exceed the RSV of 0.0035 mg/kg. The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for deer mouse (mammalian omnivore) (HQ = 18.65), montane shrew (mammalian insectivore) (HQ = 38.53), occult little brown myotis bat (mammalian aerial insectivore) (HQ = 30.42), American robin (avian omnivore) (HQ = 81.41), American robin (avian insectivore) (HQ = 165.14), violet-green swallow (avian aerial insectivore) (HQ = 125.65), American kestrel (avian intermediate carnivore) (HQ = 34), American kestrel (avian top carnivore) (HQ = 7.41), and red fox (mammalian top carnivore) (HQ = 1.03). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: deer mouse (mammalian omnivore) (HQ = 0.28), montane shrew (mammalian insectivore) (HQ = 0.11), occult little brown myotis bat (mammalian aerial insectivore) (HQ = 0.00035), American robin (avian omnivore) (HQ = 0.22), American robin (avian insectivore) (HQ = 0.45), violet-green swallow (avian aerial insectivore) (HQ = 0.21), American kestrel (avian intermediate carnivore) (HQ = 0.00036), American kestrel (avian top carnivore) (HQ = 0.000079), and red fox (mammalian top carnivore) (HQ = 0.0000011).

Additionally, mercury is naturally-occurring and the mean detected concentration is within background levels, the GOSB background maximum is 0.067 mg/kg and the SRS background maximum is 0.3 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective. The RSV used for screening is for methylmercury (rather than total mercury), which may be overly conservative. Also, mercury is ubiquitous in the environment due to atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring and ubiquitous in the environment
- AUF-adjusted HQs are < 1
- Screening threshold may be overprotective
- The mean is within SRS background levels

Methylcyclohexane was detected in one of five samples. The one sample was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.00044 mg/kg at the GOSB-51 location. The mean detected concentration was 0.00026 mg/kg and the EPC was 0.00044 mg/kg. Methylcyclohexane came through screening because there is no published ecological screening threshold level. There also is no background available for comparison.

Methylcyclohexane is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- ~~It has a low frequency of detection (1/5)~~
- The only detection is an estimated result (J-qualified)
- There is no screening threshold

Phenanthrene was detected in five of five samples. Two of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 3.91 mg/kg at the GOSB-51 location. The mean detected concentration was 0.87 mg/kg and the EPC was 3.91 mg/kg, which both exceed the RSV of 0.596 mg/kg (HQ calculated with the mean = 1.46). The uncertainty

evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 6.56). There is no background available for comparison, but phenanthrene is ubiquitous in the environment and there are PAHs present in upgradient samples.

Phenanthrene is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- The mean HQ is close to one
- It is ubiquitous in the environment

Potassium-40 was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 2.96 pCi/g at the GOSB-52 location. The mean detected concentration was 2.53 pCi/g and the EPC was 2.96 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. However, potassium-40 is a naturally-occurring radionuclide and the maximum detected concentration is within background activity levels; the SRS background maximum is 8.53 pCi/g. Additionally, the maximum detected concentration (2.96 pCi/g) is less than the RESRAD biota level of 119 pCi/g.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It is within SRS background activity levels
- It is well below the RESRAD Biota level

Silver was detected in five of five samples. One of the five samples was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 314 mg/kg at the GOSB-49 location (see Figure 3-7). The mean detected concentration was 87.15 mg/kg and the EPC was 314 mg/kg, which both exceed the RSV of 2.2 mg/kg (HQ = 39.61). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows one HQ exceedance for benthic organisms (HQ = 142.73). While silver is naturally-occurring, the mean and maximum detected

concentrations exceed background, the GOSB background maximum is 0.24 mg/kg and the SRS background maximum is 1.96 mg/kg. Silver is an active ingredient in some pesticide/fungicide formulations.

Silver is recommended for further remedial evaluation as an ecological RCOC in sediment for benthic organisms based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 40)
- The mean exceeds GOSB and SRS background
- It is an active ingredient in some pesticide/fungicide formulations, and pesticides were likely used in the basin

Thallium was detected in one of five samples. No samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 4.64 mg/kg at the GOSB-49 location. The mean detected concentration was 1.18 mg/kg and the EPC was 4.64 mg/kg, which both exceed the RSV of 0.5 mg/kg (HQ calculated with the mean = 2.36). The uncertainty evaluation presented in Attachment D-5, Table 1.A, shows HQ exceedances for generic plant (terrestrial autotroph-producer) (HQ = 9.28) and montane shrew (mammalian insectivore) (HQ = 2.11). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific HQ for the montane shrew changes from 2.11 to 0.0035. Additionally, thallium is naturally-occurring and the maximum detected concentration is within background; the SRS background maximum is 8.13 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Thallium is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is naturally-occurring
- It is within SRS background levels
- AUF-adjusted HQ is <1

- Screening level is likely overprotective

Thallium-208 was detected in five of five samples. None of the five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.43 pCi/g at the GOSB-50 location. The mean detected concentration was 0.37 pCi/g and the EPC was 0.43 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is a naturally-occurring radionuclide with a very short half-life at 3.05 minutes. Further, the maximum concentration is within background; the SRS background maximum for the thorium-232 decay series is 6.75 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOC in sediment based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- It is within background

Summary: The following constituents are identified as RCOCs for the GOSB Interior Subunit for sediment: alpha-chlordane, DDD, DDE, dieldrin, gamma-chlordane, heptachlor epoxide, and silver. The RCOCs all exceeded RSVs and background levels. Metals, other than silver, were screened out as they are naturally-occurring, fall within background levels, and may have overprotective screening thresholds. All detected radionuclides came through screening because there are no screening thresholds available, but they are all naturally-occurring and fall within background activity levels. Additionally, lead-214 and thallium-208 have very short half-lives and the potassium-40 activity level is well below the RESRAD biota level. There also was no screening value for caprolactam or methylcyclohexane~~, both having a very low detection frequency~~.

D-2.3.1.4 Screening Results for GOSB Interior Subunit for Surface Water Media

Using maximum detected values, Table D-3 identifies the following constituents as COPECs based on ESV screening in the surface water media evaluated for terrestrial and aquatic

receptors: alpha-benzene hexachloride (BHC), alpha-chlordane, aluminum, barium, beryllium, bismuth-214, cadmium, caprolactam, chromium, cobalt, copper, cyanide, DDD, DDT, gamma-chlordane, iron, lead, lead-214, manganese, mercury, nickel, silver, vanadium, and zinc. Sampling locations described for the GOSB Interior Subunit are shown in Figure 3-1.

The radionuclide constituents were identified as COPECs since there were no published ESVs available for these constituents. There also was no screening value for caprolactam or alpha-BHC. The COPECs are carried forward and processed further in the refinement-level evaluation section discussed below.

D-2.3.1.5 Refinement Results for GOSB Interior Subunit for Surface Water Media

Using EPC values (i.e., 95% UCL on the mean), Table D-4 identifies the following constituents as COPCs based on RSV screening in the surface water medium: alpha-BHC, alpha-chlordane, aluminum, barium, beryllium, bismuth-214, cadmium, caprolactam, chromium, cobalt, copper, DDD, DDT, gamma-chlordane, iron, lead, lead-214, manganese, mercury, nickel, silver, vanadium, and zinc.

The radionuclide constituents were identified as COPCs since there were no published RSVs available for these constituents. There also were no screening values for caprolactam or alpha-BHC. The COPCs are discussed further below.

D-2.3.1.6 Uncertainty Discussion for GOSB Interior Subunit for Surface Water Media

An uncertainty analysis was performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation whether the constituent should be considered an RCOC. HQ calculations for receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5, Table 1.B, for the surface water medium.

Alpha-BHC was detected in 1 of 11 samples. The one sample was J-qualified (i.e., estimated). The maximum detected concentration was 0.012 µg/L at the GOSB-63 location in 2016. The mean detected concentration was 0.0038 µg/L and the EPC was 0.012 µg/L. Alpha-BHC came

through screening because there is no published ecological screening threshold level, but the maximum concentration (0.012 µg/L) is below the RSV for beta-BHC (0.046 µg/L). Using the RSV for beta-BHC as a surrogate, the HQ calculated with the maximum detected concentration is 0.26 and the HQ calculated with the mean is 0.08. There also is no background available for comparison.

Alpha-BHC is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- ~~It has a low frequency of detection (1/11)~~
- The one detection is an estimated result (J-qualified)
- There is no screening threshold, but the maximum is below the surrogate threshold (HQ < 1)

Alpha-chlordane was detected in 6 of 11 samples. One of the six samples was J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 0.22 µg/L at the GOSB-64 location (see Figure 3-8). The mean detected concentration was 0.07 µg/L and the EPC was 0.12 µg/L, which both exceed the RSV of 0.0043 µg/L (HQ calculated with mean = 16.28). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 26.74). There is no background available for comparison. Chlordane was used primarily as a pesticide for termite control and persists in the environment for years. Its use was banned by EPA in 1988 (BCERF 1998). The HQ calculated with the 2016 mean is 9.25.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration was from the 2016 (less turbid) data set.

Alpha-chlordane is recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 16)
- The 2016 mean HQ = 9

- There is no background available for comparison

- Chlordane was identified in sediment media as a RCOC

Aluminum was detected in 11 of 11 samples. Two of the 11 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 33,200 µg/L at the GOSB-50 location. The mean detected concentration was 7,439.18 µg/L and the EPC was 24,064 µg/L, which both exceed the RSV of 87 µg/L (HQ calculated with the mean = 85.5). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for aquatic life (EPA) (HQ = 276.6). The maximum detected concentration exceeds the IOU background maximum of 6,060 µg/L. However, aluminum is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 810 µg/L, with a mean of 394.17 µg/L at the GOSB-64 location (detected in six of six samples, with two J-qualified). The maximum detected concentration for 2016 filtered samples was 105 µg/L, with a mean of 63.98 µg/L (detected in three of six samples, with all three J-qualified). While the 2016 values still exceed the RSV (87 µg/L), there is a lower rate of detection and a higher rate of estimated concentrations. Ultimately these concentrations are even further below the IOU background maximum concentration (6,060 µg/L). The HQ calculated with the 2016 mean is 4.53 compared to 276.6.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring

- Screening level is likely overprotective

- Recent samples (2016) had lower turbidity and have far lower concentrations than the 2009 samples

- All detected samples in 2016 are estimated results (J-qualified)

Barium was detected in 11 of 11 samples. None of the 11 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 305 µg/L at the GOSB-53 location. The mean detected concentration was 80.97 µg/L and the EPC was 203.9 µg/L, which both exceed the RSV of 3.9 µg/L (HQ calculated with the mean = 20.76). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 52.28). The maximum detected concentration exceeds the IOU maximum background concentration of 72.4 µg/L. However, barium is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 50.7 µg/L, with a mean of 18.58 µg/L at the GOSB-63 location (detected in six of six samples with none J-qualified). The maximum detected concentration for 2016 filtered samples was 13.6 µg/L, with a mean of 8.69 µg/L (detected in six of six samples with none J-qualified). While the 2016 values still exceed the RSV (3.9 µg/L), these concentrations are significantly below the IOU background maximum concentration (72.4 µg/L). The HQ calculated with the 2016 mean is 4.76 compared to 52.28.

Barium is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- Recent samples (2016) are well below IOU background levels
- Screening level is likely overprotective

Beryllium was detected in 2 of 11 samples. Both detected samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.4 µg/L at the GOSB-53 location. The mean detected concentration was 0.65 µg/L and the EPC was 1.4 µg/L. The EPC (1.4 µg/L) exceeds the RSV of 0.66 µg/L, but the mean (0.65 µg/L) does not exceed the concentration (HQ calculated with the mean = 0.98). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community

organisms (HQ = 2.12). The mean detected concentration is within the IOU background of 0.7 µg/L. Beryllium is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The 2016 results for beryllium are all non-detects, so the screening is based solely on questionable 2009 data that has skewed high for other constituents due to high turbidity.

Beryllium is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- The mean detected concentration does not exceed the RSV
- It is within IOU background levels
- Screening level is likely overprotective
- More recent samples (2016) are all non-detects

Bismuth-214 was detected in three of four samples. All three samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 23 pCi/L at the GOSB-50 location. The mean detected concentration was 15.05 pCi/L and the EPC was 23 pCi/L. Bismuth-214 came through screening because there is no published ecological screening threshold level. There is also no background available for comparison. Bismuth-214 is a naturally-occurring radionuclide and has a very short half-life of 19.92 minutes.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. There are no results for bismuth-214 for 2016, so the screening is based solely on questionable 2009 data that has skewed high for other constituents due to high turbidity.

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- All detected samples are estimated results (J-qualified)
- The only data available for screening had very high turbidity

Cadmium was detected in 3 of 11 samples. None of the samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 23.1 µg/L at the GOSB-53 location. The mean detected concentration was 4.76 µg/L and the EPC was 10.34 µg/L, which both exceed the RSV of 0.1 µg/L (HQ calculated with the mean = 47.6). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for freshwater aquatic life (SCDHEC) (HQ = 103.4). The maximum detected concentration exceeds the IOU maximum background concentration of 4 µg/L, but the mean concentration (4.76 µg/L) is similar. Cadmium is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The 2016 results for cadmium are all non-detects.

Cadmium is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- The mean is similar to IOU background levels
- Screening level is likely overprotective
- More recent samples (2016) are all non-detects

Caprolactam was detected in 4 of 11 samples. One of the four samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 36.4 µg/L at the GOSB-53 location. The mean detected concentration was 12.61 µg/L and the EPC was 20.98 µg/L. Caprolactam came through screening because there is no published ecological screening

threshold level. There is also no background available for comparison. Caprolactam is rapidly degraded by aerobic biodegradation and chemical degradation processes in water with a half-life of 5-14 days (Howard 1989).

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The 2016 results for caprolactam are all non-detects, so the screening is based solely on questionable 2009 data.

Caprolactam is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It has no screening threshold
- ~~It has a low frequency of detection (4/11)~~
- It has a short half-life
- More recent samples (2016) are all non-detects

Chromium was detected in 8 of 11 samples. Five of eight samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 147 µg/L at the GOSB-50 location. The mean detected concentration was 29.83 µg/L and the EPC was 56.36 µg/L, which both exceed the RSV of 11 µg/L (HQ calculated with the mean = 2.71). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 5.12). While chromium is naturally-occurring, the maximum detected concentration exceeds the IOU background (2.33 µg/L).

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 1.26 µg/L, with a mean of 0.83 µg/L at the GOSB-66 location (detected in three of six samples with three J-qualified). All filtered samples in 2016 were non-detects. The 2016 values are all below the RSV (11 µg/L), there is a lower rate of detection than in the 2009 dataset with all detects estimated, and

ultimately these concentrations are even further below the IOU background maximum concentration (2.33 µg/L). The HQ calculated with the 2016 mean is 0.08.

Chromium is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The 2009 maximum that exceeded the RSV is questionable due to high turbidity
- The 2016 mean and maximum are below the RSV with the mean HQ <1
- The 2016 mean and maximum are below IOU background level
- All detected samples in 2016 unfiltered samples were estimates, and all 2016 filtered samples were non-detects

Cobalt was detected in 3 of 11 samples. One of the three samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 13.6 µg/L at the GOSB-50 location. The mean detected concentration was 3.09 µg/L and the EPC was 6.62 µg/L, which both exceed the RSV of 3 µg/L (HQ calculated with the mean = 1.03). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 2.21). The mean detected concentration is within the IOU background of 13.1 µg/L. Cobalt is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. All unfiltered 2016 samples were non-detects. The maximum detected concentration for 2016 filtered samples was 2.79 µg/L, with a mean of 1.78 µg/L (detected in four of six samples with four J-qualified). The HQ calculated with the 2016 mean is 0.17.

Cobalt is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- It is within IOU background levels

- Screening level is likely overprotective
- ~~It has a low frequency of detection (3/11) with one detection an estimate~~
- All recent unfiltered samples (2016) are non-detects
- The 2016 mean HQ is < 1

Copper was detected in 10 of 11 samples. All 10 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 805 µg/L at the GOSB-50 location. The mean detected concentration was 171.8 µg/L and the EPC was 591.6 µg/L, which both exceed the RSV of 2.9 µg/L (HQ calculated with the mean = 59.24). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for freshwater aquatic life (SCDHEC) (HQ = 204). The maximum detected concentration exceeds the IOU maximum background concentration of 70 µg/L. However, copper is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 6.38 µg/L, with a mean of 4.33 µg/L at the GOSB-64 location (detected in five of six samples with five J-qualified). All 2016 filtered samples were non-detects. Although the 2016 values still exceed the RSV (2.9 µg/L), all the detections are estimates and these concentrations are well below the IOU background maximum concentration (70 µg/L). The HQ calculated with the 2016 mean is 1.49.

Copper is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- Screening level is likely overprotective
- All sample detections are estimated results (J-qualified)
- Recent samples (2016) had lower turbidity and have far lower concentrations than the 2009 samples

- 2016 values are well within IOU background levels

DDD was detected in 3 of 11 samples. Two of the three samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.041 µg/L at the GOSB-51 location. The mean detected concentration was 0.01 µg/L and the EPC was 0.02 µg/L. The EPC exceeds the RSV of 0.011 µg/L, but the mean concentration does not (HQ calculated with the mean = 0.91). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for aquatic life (EPA) (HQ = 1.8). There is no background available for comparison.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The 2016 unfiltered results for DDD are all non-detects (with no filtered results available).

DDD is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean does not exceed the RSV (HQ = 0.9)
- Two of the three detections are estimates
- Recent samples (2016) are all non-detects

DDT was detected in 2 of 11 samples. Both detected samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.023 µg/L at the GOSB-51 location. The mean detected concentration was 0.0071 µg/L and the EPC was 0.023 µg/L, which both exceed the RSV of 0.001 µg/L (HQ calculated with the mean = 7.1). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect Aquatic community organisms (HQ = 22.8). The maximum detected concentration is within the IOU background of 0.033 µg/L.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The 2016 unfiltered results for DDT are all non-detects (with no filtered results available).

DDT is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- ~~It has a low frequency of detection (2/11)~~
- Both detections are estimates
- Recent samples (2016) are all non-detects

Gamma-chlordane was detected in 7 of 11 samples. Two of the seven samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.23 µg/L at the GOSB-51 location (see Figure 3-8). The mean detected concentration was 0.083 µg/L and the EPC was 0.14 µg/L, which both exceed the RSV of 0.0043 µg/L (HQ calculated with the mean = 19.3). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 31.63). There is no background available for comparison. Chlordane was used primarily as a pesticide for termite control and persists in the environment for years. Its use was banned by the EPA in 1988 (BCERF 1998).

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 0.21 µg/L, with a mean of 0.039 µg/L at the GOSB-64 location (detected in four of six samples with two J-qualified). There are no filtered samples for 2016. The 2016 mean and maximum exceed the RSV (0.0043 µg/L) and the HQ calculated with the 2016 mean is 9.07.

Gamma chlordane is recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean exceeds the RSV (HQ = 19)
- The 2016 mean also exceeds the RSV (HQ = 9)
- Chlordane was identified in sediment media as a RCOC

Iron was detected in 11 of 11 samples. None of the 11 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 25,500 µg/L at the GOSB-53 location. The

mean detected concentration was 8,299.09 µg/L and the EPC was 16,260 µg/L, which both exceed the RSV of 1,000 µg/L. The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 16.26) The mean detected concentration is within the IOU background of 12,400 µg/L. Iron is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 5,920 µg/L, with a mean of 4,135 µg/L at the GOSB-63 location (detected in six of six samples with none J-qualified). The maximum detected concentration for 2016 filtered samples was 6,150 µg/L, with a mean of 2,740 µg/L (detected in six of six samples with none J-qualified). While the 2016 values still exceed the RSV (1,000 µg/L), these concentrations are below the IOU background maximum concentration (12,400 µg/L). The HQ calculated with the 2016 mean is 4.14.

Iron is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- Screening level is likely overprotective
- Recent samples (2016) had lower turbidity and have far lower concentrations than the 2009 samples
- The maximum of 2016 samples is within IOU background

Lead was detected in 5 of 11 samples. Two of five samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 131 µg/L at the GOSB-53 location. The mean detected concentration was 28.7 µg/L and the EPC was 58.67 µg/L, which both exceed the RSV of 0.54 µg/L (HQ calculated with the mean = 53.15). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for freshwater aquatic life (SCDHEC) (HQ = 108.65). The maximum detected concentration exceeds the IOU maximum background

concentration of 20 µg/L. Lead is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 4.02 µg/L, with a mean of 2.05 µg/L at the GOSB-64 location (detected in one of six samples with one J detect). All 2016 filtered samples are non-detects. While the 2016 values still exceed the RSV (0.54 µg/L), there is a lower rate of detection, there is a higher rate of estimates, and these concentrations are well below the IOU background maximum concentration (20 µg/L). The HQ calculated with the 2016 mean is 3.80.

Lead is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- Screening level is likely overprotective
- Recent samples (2016) had lower turbidity and have far lower concentrations than the 2009 samples
- 2016 sample concentrations are within IOU background levels

Lead-214 was detected in two of three samples. Both sample detections were J-qualified (i.e., estimated). In 2009, the maximum detected activity was 16.1 pCi/L at the GOSB-50 location. The mean detected activity was 10.18 pCi/L and the EPC was 16.1 pCi/L. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is a naturally-occurring radionuclide and has a short half-life of 26.81 minutes.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. There are no results for lead-214 for 2016, so the screening is based solely on questionable 2009 data that skewed high for other constituents due to high turbidity.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- The two sample detections are estimates
- The only data available for screening had very high turbidity

Manganese was detected in 11 of 11 samples. None of 11 samples were J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 340 µg/L at the GOSB-63 location. The mean detected concentration was 202.46 µg/L and the EPC was 247.4 µg/L, which both exceed the RSV of 93 µg/L (HQ calculated with the mean = 2.18). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for aquatic life (EPA) (HQ = 2.66). The maximum detected concentration is within the IOU background of 2,690 µg/L. Manganese is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 340 µg/L, with a mean of 186.1 µg/L at the GOSB-63 location (detected in six of six samples with none J-qualified). The maximum detected concentration for 2016 filtered samples was 189 µg/L, with a mean of 142.48 µg/L (detected in six of six samples with none J-qualified). While the 2016 values still exceed the RSV (93 µg/L), there is a lower rate of detection and a higher rate of estimated concentrations, ultimately producing concentrations even further below the IOU background maximum concentration (2,690 µg/L). The HQ calculated with the 2016 mean is 2.0.

Manganese is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring

- It is within the IOU background level, particularly when only recent (2016) samples are considered
- Screening level is likely overprotective

Mercury was detected in 2 of 11 samples. One of the two samples were J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 0.24 µg/L at the GOSB-64 location (all filtered samples were non-detects). The mean detected concentration was 0.06 µg/L and the EPC was 0.24 µg/L, which both exceed the RSV of 0.0013 µg/L (HQ calculated with the mean = 46.2). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for aquatic life (EPA) (HQ = 182.31). The mean detected concentration is within the IOU background of 0.24 µg/L. With background levels exceeding the RSV, screening thresholds may be overprotective. Mercury is naturally-occurring and is ubiquitous in the environment due to atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring and is ubiquitous in the environment
- It is within the IOU background level
- Screening level may be overprotective
- ~~It has a low frequency of detection (2/11) with o~~One of the two detections is~~being~~ estimated (J-qualified)

Nickel was detected in 6 of 11 samples. Three of the six samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 128 µg/L at the GOSB-50 location. The mean detected concentration was 27.44 µg/L and the EPC was 56.56 µg/L, which both exceed the RSV of 16 µg/L (HQ calculated with the mean = 1.72). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for freshwater aquatic life (SCDHEC) (HQ = 3.54). The mean detected concentration is within the IOU background of 30 µg/L. Nickel is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 1.56 µg/L, with a mean of 0.89 µg/L at the GOSB-63 location (detected in one of six samples with one J detect). All 2016 filtered samples were non-detects. The 2016 values are below the RSV (16 µg/L), there is a lower rate of detection, there is a higher rate of estimated concentrations, filtered samples were all non-detects, and these concentrations are even further below the IOU background maximum concentration (30 µg/L). The HQ calculated with the 2016 mean is 0.055.

Nickel is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring
- It is within the IOU background level
- Screening level may be overprotective
- Recent samples (2016) had lower turbidity and have far lower concentrations than the 2009 samples
- ~~2016 samples have a low detection frequency (1/6)~~
- HQ calculated with 2016 mean = 0.055

Silver was detected in 9 of 11 samples. Six of the nine samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 299 µg/L at the GOSB-50 location (see Figure 3-8). The mean detected concentration was 60.15 µg/L and the EPC was 114.3 µg/L, which both exceed the RSV of 0.06 µg/L (HQ calculated with the mean = 1,002.5). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for aquatic life (EPA) (HQ = 1,905). While silver is naturally-occurring, there is no background available for comparison.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 4.33 µg/L, with a mean of

1.81 µg/L at the GOSB-64 location (detected in four of six samples with four J-qualified). All 2016 filtered samples were non-detects. The 2016 values still exceed the RSV (0.06 µg/L). The HQ calculated with the 2016 mean is 30.17.

Silver is recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean exceeds the RSV by several orders of magnitude (HQ = 1003)
- The HQ calculated with the 2016 mean = 30
- There is no background available for comparison
- Silver was identified in sediment media as a RCOC

Vanadium was detected in 11 of 11 samples. Seven of the 11 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 68.8 µg/L at the GOSB-53 location. The mean detected concentration was 16.85 µg/L and the EPC was 48.74 µg/L. The EPC (48.74 µg/L) exceeds the RSV of 19 µg/L, but the mean (16.85 µg/L) does not exceed the concentration (HQ calculated with the mean = 0.89). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for No Effect aquatic community organisms (HQ = 2.57). However, vanadium is naturally-occurring. The maximum detected concentration slightly exceeds the IOU maximum background concentration of 13.1 µg/L.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 3.95 µg/L, with a mean of 3.04 µg/L at the GOSB-66 location (detected in six of six samples with six J-detects). The maximum detected concentration for 2016 filtered samples was 3.48 µg/L, with a mean of 1.39 µg/L (detected in three of six samples with three J-detects). The 2016 values are well below the RSV (19 µg/L) and well below the IOU background maximum concentration (13.1 µg/L). The HQ calculated with the 2016 mean is 0.16.

Vanadium is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean does not exceed the RSV
- It is naturally-occurring
- The mean concentration is similar to the IOU background level and 2016 values are well within the IOU background level
- Over half of all sample detections are estimated results (J-qualified)
- HQ calculated with 2016 mean = 0.16

Zinc was detected in 11 of 11 samples. None of the 11 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 3,800 µg/L at the GOSB-53 location. The mean detected concentration was 746.25 µg/L and the EPC was 3,800 µg/L, which both exceed the RSV of 37 µg/L (HQ calculated with the mean = 20.17). The uncertainty evaluation presented in Attachment D-5, Table 1.B, shows one HQ exceedance for freshwater aquatic life (SCDHEC) (HQ = 102.7). The maximum detected concentration exceeds the IOU maximum background concentration of 166.9 µg/L. Zinc is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

The data set used for this screening includes data from both 2009 and 2016 collections, but many of the samples from 2009 had very high turbidity, potentially skewing the results high. The maximum detected concentration for 2016 unfiltered samples was 45.6 µg/L, with a mean of 35.45 µg/L at the GOSB-66 location (detected in six of six samples with none J-qualified). The maximum detected concentration for 2016 filtered samples was 12.9 µg/L, with a mean of 8.57 µg/L (detected in six of six samples with four J-detects). While the 2016 maximum still exceeds the RSV (37 µg/L), the 2016 mean is below the RSV and both the maximum and mean concentrations are below the IOU background maximum concentration (166.9 µg/L). The HQ calculated with the 2016 mean is 0.96.

Zinc is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- Screening level may be overprotective
- It is naturally-occurring

- HQ calculated with 2016 mean = 0.96
- 2016 mean and maximum are well within IOU background levels

Summary: Alpha-chlordane, gamma-chlordane, and silver are identified as RCOCs for the GOSB Interior Subunit for surface water. The RCOCs all exceed RSVs. Metals (other than silver) were screened out as they are naturally-occurring, fall within background levels, and may have overprotective screening thresholds. Bismuth-214 and lead-214 came through screening because there are no screening thresholds available, but they are naturally-occurring and have very short half-lives. The remaining organics and pesticides were screened out due to ~~low detection frequency,~~ estimated results~~,~~ and mean detections falling below screening thresholds.

D-2.3.2 GOSB Berm Subunit

Results of the ESV screening (Step D.2.1), refinement-level risk calculations (Step D.2.2), and a discussion of associated uncertainties for each constituent of potential concern for the GOSB Berm Subunit are provided below.

D-2.3.2.1 Screening Results for GOSB Berm Subunit for Soil Media (0 to 1 ft)

Using maximum detected values, Table D-5 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft soil interval evaluated for terrestrial and aquatic receptors: aluminum, arsenic, bis(2-ethylhexyl)phthalate, chromium, copper, cyanide, endrin, endrin ketone, iron, lead, lead-214, methyl acetate, aroclor 1254, potassium-40, thallium-208, and vanadium. Sampling locations described for the GOSB Berm Subunit are shown in Figure 3-1.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There also was no screening values for aluminum, iron, endrin ketone, or methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

D-2.3.2.2 Refinement Results for GOSB Berm Subunit for Soil Media (0 to 1 ft)

Using EPC values (i.e., 95% UCL on the mean), Table D-~~3~~6 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft soil interval: aluminum, endrin ketone, iron, lead, lead-214, methyl acetate, potassium-40, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There also were no screening values for aluminum, iron, endrin ketone, or methyl acetate. The COPCs are discussed further below.

D-2.3.2.3 Uncertainty Discussion for GOSB Berm Subunit for Soil Media (0 to 1 ft)

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation whether the constituent should be considered an RCOC. HQ calculations for receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5 in Table 2.A for the soil medium (0 to 1 ft interval).

Aluminum was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 11,500 mg/kg at the GOSB-37 location (see Figure 3-14). The mean detected concentration was 7,466.92 mg/kg and the EPC was 8,696.33 mg/kg. Aluminum came through screening because there is no published ecological screening threshold level. However, aluminum is naturally-occurring and the maximum detected concentration is within background, the GOSB background maximum is 18,500 mg/kg and the SRS background maximum is 23,700 mg/kg.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is within GOSB and SRS background levels
- It is naturally-occurring
- There is no screening threshold available

Endrin Ketone was detected in 1 of 13 samples. The one sample was not J-qualified (i.e., estimated). The maximum detected concentration was 0.0016 mg/kg at the GOSB-41 location in 2009. The mean detected concentration was 0.0003 mg/kg and the EPC was 0.0016 mg/kg. Endrin Ketone came through screening because there is no published ecological screening threshold level. However, endrin ketone is a breakdown product of the insecticide endrin and the RSV for endrin is 0.014 mg/kg (not exceeded). There is no background available.

Endrin ketone is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- ~~It has a low frequency of detection (1/13)~~
- There is no screening threshold available
- The maximum concentration does not exceed surrogate RSV (HQ < 1)

Iron was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 27,100 mg/kg at the GOSB-44 location. The mean detected concentration was 17,593.08 mg/kg and the EPC was 27,100 mg/kg. Iron came through screening because there is no published ecological screening threshold level. Iron is naturally-occurring and the maximum detected concentration is within background, the GOSB background maximum is 31,600 mg/kg and the SRS background maximum is 44,300 mg/kg.

Iron is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is within GOSB and SRS background levels
- It is naturally-occurring
- There is no screening threshold available

Lead was detected in 13 of 13 samples. Two of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 72.9 mg/kg at the GOSB-35 location. The mean detected concentration was 18.86 mg/kg and the EPC was 45.33 mg/kg. The EPC exceeds the RSV of 28 mg/kg, but the mean does not exceed the concentration (HQ calculated with the

mean = 0.67). The uncertainty evaluation presented in Attachment D-5, Table 2.A, shows HQ exceedances for the American robin (avian herbivore) (HQ = 1.08), American robin (avian omnivore) (HQ = 1.37), and American robin (avian insectivore) (HQ = 1.62). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: American robin (avian herbivore) (HQ = 0.0019), American robin (avian omnivore) (HQ = 0.0024), and American robin (avian insectivore) (HQ = 0.0028). Additionally, lead is naturally-occurring and the mean detected concentration (18.86 mg/kg) is within background, the GOSB background maximum is 13.5 mg/kg and the SRS background maximum is 26.6 mg/kg.

Lead is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- The mean concentration does not exceed the RSV (HQ = 0.67)
- AUF-adjusted HQs are also < 1
- The mean is within GOSB and SRS background levels
- It is naturally-occurring

Lead-214 was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.02 pCi/g at the GOSB-42 location (see Figure 3-14). The mean detected concentration was 0.9 pCi/g and the EPC was 0.95 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. However, lead-214 is a naturally-occurring nuclide and the half-life is short at 26.81 minutes. Further, the maximum is within background, the SRS background maximum for the uranium-238 decay series is 2.78 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- There is no screening threshold available

- It is a naturally-occurring radionuclide
- It has a very short half-life
- It is within background

Methyl acetate was detected in 2 of 13 samples. One of the two samples was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.013 mg/kg at the GOSB-40 location. The mean detected concentration was 0.0026 mg/kg and the EPC was also 0.013 mg/kg. Methyl acetate came through screening because there is no published ecological screening threshold level. The maximum detected concentration is within the GOSB background maximum of 0.018 mg/kg.

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- There is no screening threshold available
- ~~It has a low frequency of detection (2/13) with o~~One of two detections is an estimate
- It is within GOSB background levels

Potassium-40 was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 3.25 pCi/g at the GOSB-42 location. The mean detected concentration was 1.99 pCi/g and the EPC was 2.21 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. However, the maximum detected concentration is within the SRS background maximum of 8.53 pCi/g. Potassium-40 is a naturally-occurring radionuclide and the maximum detected concentration (3.25 pCi/g) is less than the RESRAD Biota level of 119 pCi/g.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It is within background

- It is well below the RESRAD Biota level

Thallium-208 was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.54 pCi/g at the GOSB-38 location. The mean detected concentration was 0.43 pCi/g and the EPC was 0.46 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is a naturally-occurring radionuclide and has a short half-life of 3.05 minutes. Further, the maximum is within background, the SRS background maximum for the thorium-232 decay series is 6.75 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- There is no screening threshold
- It has a very short half-life
- It is within background

Vanadium was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 66.9 mg/kg at the GOSB-40 location. The mean detected concentration was 46.23 mg/kg and the EPC was 53.78 mg/kg, which both exceed the RSV of 13 mg/kg. The uncertainty evaluation presented in Attachment D-5, Table 2.A, shows HQ exceedances for the American robin (avian herbivore) (HQ = 3.16), American robin (avian omnivore) (HQ = 3.59), and American robin (avian insectivore) (HQ = 4.14). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: American robin (avian herbivore) (HQ = 0.011), American robin (avian omnivore) (HQ = 0.013), and American robin (avian insectivore) (HQ = 0.015). The maximum detected concentration is within background, the GOSB background maximum is 74.9 mg/kg, and the

SRS background maximum is 104 mg/kg. Vanadium is naturally-occurring and, with background levels exceeding the RSV, screening thresholds may be overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is naturally-occurring
- It is within GOSB and SRS background levels
- AUF-adjusted HQs are < 1
- Screening level is likely overprotective

Summary: The inorganic constituents identified as COPCs were ultimately screened out as they are naturally-occurring and fall within background levels. The radionuclide constituents were identified as COPCs since there are no screening thresholds available, but they are all naturally-occurring and fall within background activity levels. Additionally, lead-214 and thallium-208 have very short half-lives and the potassium-40 activity level is well below the RESRAD biota level. Endrin ketone and methyl acetate came through as COPCs because there are no screening thresholds available, but both had a low detection frequency. One of the two detections of methyl acetate was an estimate and it falls within background levels. In summary, no constituents are identified as RCOCs for the GOSB Berm in the 0 to 1 ft surface soil interval.

D-2.3.2.4 Screening Results for GOSB Berm Subunit for Soil Media (1 to 4 ft)

Using maximum detected values, Table D-7 identifies the following constituents as COPECs based on ESV screening in the 1 to 4 ft soil interval evaluated for terrestrial and aquatic receptors: aluminum, arsenic, barium-133, caprolactam, chromium, iron, lead, lead-214, methyl acetate, thallium-208, and vanadium. Sampling locations described for the GOSB Berm Subunit are shown in Figure 3-1.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There also was no screening values for aluminum, iron,

caprolactam, or methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation section discussed below.

D-2.3.2.5 Refinement Results for GOSB Berm Subunit for Soil Media (1 to 4 ft)

Using EPC values (i.e., 95% UCL on the mean), Table D-8 identifies the following constituents as COPCs based on RSV screening in the 1 to 4 ft soil interval: aluminum, barium-133, caprolactam, iron, lead-214, methyl acetate, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There also were no screening values for aluminum, iron, caprolactam, or methyl acetate. The COPCs are discussed further below.

D-2.3.2.6 Uncertainty Discussion for GOSB Berm Subunit for Soil Media (1 to 4 ft)

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors, resulting in a recommendation of whether the constituent should be considered an RCOC. HQ calculations for receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5, Table 2.B, for the soil medium (1 to 4 ft interval).

Aluminum was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 18,900 mg/kg at the GOSB-37 location (see Figure 3-15). The mean detected concentration was 8,115.38 mg/kg and the EPC was 10,783.88 mg/kg. Aluminum came through screening because there is no RSV available. However, aluminum is naturally-occurring and the maximum detected concentration is within background. The GOSB background maximum is 18,500 mg/kg and the SRS background maximum is 23,700 mg/kg.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- There is no screening threshold

- It is within GOSB and SRS background levels

Barium-133 was detected in 1 of 13 samples. The one sample detection was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.025 pCi/g at the GOSB-45 location (see Figure 3-15). The mean detected concentration was 0.013 pCi/g and the EPC was 0.025 pCi/g. Barium-133 came through screening because there is no RSV available, nor is there is background data available. The half-life of barium-133 is 10.5 years.

Barium-133 is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- ~~It has a low frequency of detection (1/13)~~
- The one sample detection is an estimated result (J-qualified)
- There is no screening threshold available
- It has a relatively short half-life

Caprolactam was detected in 2 of 13 samples. Both sample detections were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.076 mg/kg at the GOSB-40 location. The mean detected concentration was 0.043 mg/kg and the EPC was 0.076 mg/kg. Caprolactam came through screening because there is no RSV available, nor is there is background data available. Caprolactam is rapidly degraded by microbial and chemical degradation processes in soil with a half-life of 5-14 days (Howard 1989).

Caprolactam is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- ~~It has a low frequency of detection (2/13)~~
- The two detections are estimated results (J-qualified)
- There is no screening threshold available
- It has a short half-life in soil

Iron was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 30,400 mg/kg at the GOSB-37 location in 2009. The mean detected concentration was 10,560.77 mg/kg and the EPC was 14,676.96 mg/kg. Iron came through screening because there is no RSV available. However, iron is naturally-occurring and the maximum detected concentration is within background levels. The GOSB background maximum is 31,600 mg/kg and the SRS background maximum 44,300 mg/kg.

Iron is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- There is no screening threshold
- It is within GOSB and SRS background levels

Lead-214 was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.27 pCi/g at the GOSB-37 location. The mean detected concentration was 0.94 pCi/g and the EPC was 1.03 pCi/g. Lead-214 came through screening because there is no RSV available, nor is there is background data available. Lead-214 is a naturally-occurring radionuclide with a short half-life of 26.81 minutes. Further, the maximum is within background. The SRS background maximum for the uranium-238 decay series is 2.78 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- There is no screening threshold available
- It has a very short half-life
- It is within background

Methyl acetate was detected in 3 of 13 samples. All three samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.02 mg/kg at the GOSB-33

location (see Figure 3-15). The mean detected concentration was 0.0036 mg/kg and the EPC was 0.0074 mg/kg. Methyl acetate came through screening because there is no RSV available. The mean detected concentration is within the GOSB background maximum of 0.018 mg/kg.

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- ~~It has low detection frequency (3/13)~~
- The 3 detections are all estimated results (J-qualified)
- It is within GOSB background levels

Thallium-208 was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.59 pCi/g at the GOSB-37 location. The mean detected concentration was 0.37 pCi/g and the EPC was 0.43 pCi/g. Thallium-208 came through screening because there is no RSV available, nor is there background data available. Thallium-208 is a naturally-occurring radionuclide and the half-life is short at 3.05 minutes. Further, the maximum is within background. The SRS background maximum for the thorium-232 decay series is 6.75 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- There is not screening threshold available
- It is within background

Vanadium was detected in 13 of 13 samples. None of the 13 samples were J-qualified (i.e., estimated). The maximum detected concentration was 78.3 mg/kg at the GOSB-37 location in 2009. The mean detected concentration was 28.55 mg/kg and the EPC was 38.84 mg/kg, which both exceed the RSV of 13 mg/kg. The uncertainty evaluation presented in Attachment D-5, Table 2.B, shows HQ exceedances for the American robin (avian herbivore)

(HQ = 2.28), American robin (avian omnivore) (HQ = 2.59), and American robin (avian insectivore) (HQ = 2.99). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: American robin (avian herbivore) (HQ = 0.007), American robin (avian omnivore) (HQ = 0.008), and American robin (avian insectivore) (HQ = 0.009). Vanadium is naturally-occurring and the maximum detected concentration is within background levels. The GOSB background maximum is 74.9 mg/kg and the SRS background maximum is 104 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- It is within GOSB and SRS background levels
- AUF-adjusted HQs are < 1
- Screening level is likely overprotective

Summary: Most constituents in this soil interval were identified as COPCs because they have no screening thresholds available. Only vanadium has a screening threshold available that was exceeded, but it is naturally-occurring and falls within background levels. All other constituents were screened out due to ~~low detection frequencies,~~ estimated results, or for falling within background levels. In summary, no constituents are identified as RCOCs for the GOSB Berm in the 1 to 4 ft subsurface soil interval.

D-2.3.3 Pipeline Subunit

No risk assessment was performed for the Pipeline Subunit. Per the CSM in Section 2.3, there are no complete exposure pathways for any ecological receptors because any potential contamination is in the subsurface soil (8-10 ft) below the pipeline. Therefore, no RCOCs are identified for this subunit.

D-2.3.4 Effluent Discharge Subunit

Results of the ESV screening (Section D.2.1), refinement-level risk calculations (Section D.2.2), and a discussion of associated uncertainties for each constituent of potential concern for the Effluent Discharge Subunit are provided below.

D-2.3.4.1 Screening Results for Effluent Discharge for Soil Media (0 to 1 ft)

Using maximum detected values, Table D-9 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft soil interval evaluated for terrestrial and aquatic receptors: alpha-chlordane, aluminum, arsenic, copper, cyanide, iron, lead, lead-214, mercury, methyl acetate, aroclor 1254, radium-228, selenium, silver, thallium-208, and vanadium. Sampling locations described for the Effluent Discharge Subunit are shown in Figure 3-1.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There also were no screening values for aluminum, iron, or methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

D-2.3.4.2 Refinement Results for Effluent Discharge for Soil Media (0 to 1 ft)

Using EPC values (i.e., 95% UCL on the mean), Table D-10 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft soil interval: aluminum, iron, lead-214, mercury, methyl acetate, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There were also no screening values for aluminum, iron, or methyl acetate. The COPCs are discussed further below.

D-2.3.4.3 Uncertainty Discussion for Effluent Discharge for Soil Media (0 to 1 ft)

An uncertainty analysis was performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation whether the constituent should be considered an RCOC. HQ calculations for

receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5 in Table 2.A for the soil medium (0 to 1 ft interval).

Aluminum was detected in six of six samples. None of the six samples were J-qualified (i.e., estimated). The maximum detected concentration was 15,300 mg/kg at the GOSB-30 location in 2009 (see Figure 3-20). The mean detected concentration was 9,073.33 mg/kg and the EPC was 12,174.23 mg/kg. Aluminum came through screening because there is no RSV available. However, aluminum is naturally-occurring and the maximum detected concentration is within background levels, the GOSB background maximum is 18,500 mg/kg and the SRS background maximum is 23,700 mg/kg.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is naturally-occurring
- There is no screening threshold
- It is within GOSB and SRS background levels

Iron was detected in six of six samples. None of the six detected samples were J-qualified (i.e., estimated). The maximum detected concentration was 30,500 mg/kg at the GOSB-30 location in 2009. The mean detected concentration was 14,716.67 mg/kg and the EPC was 22,279.57 mg/kg. Iron came through screening because there is no RSV available. However, iron is naturally-occurring, and the maximum detected concentration is within background, the GOSB background maximum is 31,600 mg/kg and the SRS background maximum is 44,300 mg/kg.

Iron is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is naturally-occurring
- There is no screening threshold
- It is within GOSB and SRS background levels

Lead-214 was detected in three of three samples. None of the three samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.22 pCi/g at the GOSB-31 location (see Figure 3-20). The mean detected concentration was 1.08 pCi/g and the EPC was 1.22 pCi/g. Lead-214 came through screening because there is no RSV available. Lead-214 is naturally-occurring and the half-life is short at 26.81 minutes. Further, the maximum is within background, the SRS background maximum for the uranium-238 decay series is 2.78 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- There is no screening threshold available
- It has a very short half-life
- It is within background

Mercury was detected in six of six samples. None of the six detected samples were J-qualified (i.e., estimated). The maximum detected concentration was 0.076 mg/kg at the GOSB-54 location in 2016. The mean detected concentration was 0.052 mg/kg and the EPC was 0.072 mg/kg, which both exceed the RSV of 0.0035 mg/kg (HQ calculated with the mean = 14.86). The uncertainty evaluation presented in Attachment D-5, Table 3.A, shows HQ exceedances for the deer mouse (mammalian omnivore) (HQ = 2.33), montane shrew (mammalian insectivore) (HQ = 4.81), American kestrel (avian intermediate carnivore) (HQ = 4.25), American robin (avian omnivore) (HQ = 10.17), and American robin (avian insectivore) (HQ = 20.62). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: deer mouse (mammalian omnivore) (HQ = 0.057), montane shrew (mammalian insectivore) (HQ = 0.023), American kestrel (avian intermediate carnivore) (HQ = 0.019), American robin (avian omnivore) (HQ = 0.044), and American robin (avian insectivore) (HQ = 0.090).

Additionally, the maximum detected concentration is within background, the GOSB background maximum is 0.067 mg/kg and the SRS background maximum is 0.3 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective. In addition, the RSV used for screening is for methylmercury (rather than total mercury), which may be overly conservative. Mercury is naturally-occurring and is ubiquitous in the environment due to atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- AUF-adjusted HQs are < 1
- It is naturally-occurring and ubiquitous in the environment
- Screening threshold may be overprotective
- The maximum is within background levels

Methyl acetate was detected in one of six samples. The one sample was J-qualified (i.e., estimated). The maximum detected concentration was 0.05 mg/kg at the GOSB-54 location in 2016 (see Figure 3-20). The mean detected concentration was 0.0092 mg/kg and the EPC was 0.05 mg/kg. Methyl acetate came through screening because there is no RSV available. However, the mean detected concentration is within the GOSB background maximum of 0.018 mg/kg.

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- There is no screening threshold available
- ~~It has a low frequency of detection (1/6) with t~~The one detection is an estimated result (J-qualified)
- The mean is within GOSB background level

Thallium-208 was detected in three of three samples. None of the three samples were J-qualified (i.e., estimated). The maximum detected concentration was 0.59 pCi/g at the GOSB-30 location

in 2009. The mean detected concentration was 0.52 pCi/g and the EPC was 0.59 pCi/g. Thallium-208 came through screening because there is no RSV available. Thallium-208 is a naturally-occurring radionuclide and the half-life is short at 3.05 minutes. Further, the maximum is within background, the SRS background maximum for the thorium-232 decay series is 6.75 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- It is within background

Vanadium was detected in six of six samples. One of the six samples were J-qualified (i.e., estimated). The maximum detected concentration was 76.1 mg/kg at the GOSB-30 location in 2009. The mean detected concentration was 35.22 mg/kg and the EPC was 53.84 mg/kg, which both exceed the RSV of 13 mg/kg (HQ calculated with the mean = 2.71). The uncertainty evaluation presented in Attachment D-5, Table 3.A, shows HQ exceedances for the American robin (avian herbivore) (HQ = 3.17), American robin (avian omnivore) (HQ = 3.59), and American robin (avian insectivore) (HQ = 4.14). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted and result in HQs as follows: American robin (avian herbivore) (HQ = 0.013), American robin (avian omnivore) (HQ = 0.014), and American robin (avian insectivore) (HQ = 0.016).

Additionally, vanadium is naturally-occurring, and the maximum detected concentration is within background, the GOSB background maximum is 74.9 mg/kg and the SRS background maximum is 104 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOC in surface soil based on the following lines of evidence:

- It is naturally-occurring
- AUF-adjusted HQs are < 1
- It is within GOSB and SRS background levels
- Screening level is likely overprotective

Summary: Most constituents in this soil interval were identified as COPCs because they have no screening thresholds available. Only mercury and vanadium had a screening threshold available that was exceeded, but both were within background levels and likely have overprotective thresholds. All other constituents were screened out due to ~~low detection frequencies,~~ estimated results, short half-lives, or for falling within background levels. In summary, no constituents are identified as RCOCs for the Effluent Discharge in the 0 to 1 ft surface soil interval.

D-2.3.4.4 Screening Results for Effluent Discharge for Soil Media (1 to 4 ft)

Using maximum detected values, Table D-~~9~~11 identifies the following constituents as COPECs based on ESV screening in the 1 to 4 ft soil interval evaluated for terrestrial and aquatic receptors: aluminum, arsenic, chloromethane (methyl chloride), iron, lead, lead-214, manganese, methyl acetate, aroclor 1254, selenium, thallium-208, and vanadium. Sampling locations described for the Effluent Discharge Subunit are shown in Figure 3-1.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There were also no screening values for aluminum, iron, or methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

D-2.3.4.5 Refinement Results for Effluent Discharge for Soil Media (1 to 4 ft)

Using EPC values (i.e., 95% UCL on the mean), Table D-~~10~~12 identifies the following constituents as COPCs based on RSV screening in the 1 to 4 ft soil interval: aluminum, chloromethane (methyl chloride), iron, lead-214, methyl acetate, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There also were no screening values for aluminum, iron, or methyl acetate. The COPCs are discussed further below.

D-2.3.4.6 Uncertainty Discussion for Effluent Discharge for Soil Media (1 to 4 ft)

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors, resulting in a recommendation whether the constituent should be considered an RCOC. HQ calculations for receptors that pertain to RSV exceedance from Section D.2.2 are referred to in this discussion and can be found in Attachment D-5, Table 3.B, for the subsurface soil medium (1 to 4 ft interval).

Aluminum was detected in six of six samples. None of the six detected samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 14,700 mg/kg at the GOSB-32 location (see Figure 3-21). The mean detected concentration was 9,831.67 mg/kg and the EPC was 13,258.44 mg/kg. Aluminum came through screening because there is no RSV available. However, aluminum is naturally-occurring and the maximum detected concentration is within background levels, the GOSB background maximum is 18,500 mg/kg and the SRS background maximum 23,700 mg/kg.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- There is no screening threshold
- It is within GOSB and SRS background levels

Chloromethane (methyl chloride) was detected in one of six samples. The one sample was J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.00053 mg/kg at the GOSB-30 location. The mean detected concentration was 0.00023 mg/kg and the EPC was 0.00053 mg/kg. Chloromethane (methyl chloride) came through screening because there is no RSV available. The mean detected concentration is within the GOSB background maximum of

0.00047 mg/kg. Ninety-nine percent of the chloromethane in the environment is from natural sources and is always present in the air at very low levels, it does not concentrate in sediments (ATSDR 1998).

Chloromethane is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- Most chloromethane in the environment is from natural sources
- The mean is within GOSB background levels
- ~~It has a low frequency of detection (1/6), and t~~The one detection is an estimated result (J-qualified)
- There is no screening threshold available

Iron was detected in six of six samples. None of the samples were J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 34,300 mg/kg at the GOSB-54 location. The mean detected concentration was 17,500 mg/kg and the EPC was 25,636.57 mg/kg. Iron came through screening because there is no RSV available. The maximum detected concentration is within background, the GOSB background maximum is 31,600 mg/kg and the SRS background maximum is 44,300 mg/kg.

Iron is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- It is within GOSB and SRS background levels
- There is no screening threshold available

Lead-214 was detected in three of three samples. None of the samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 1.05 pCi/g at the GOSB-31 location (see Figure 3-21). The mean detected concentration was 0.99 pCi/g and the EPC was 1.05 pCi/g. Lead-214 came through screening because there is no RSV available. The half-life of

lead-214 is 26.81 minutes. The maximum concentration is within background; the SRS background maximum concentration for the uranium-238 decay series is 2.78 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- There is no screening threshold available
- It has a very short half-life
- It is within background

Methyl acetate was detected in one of six samples. The one detected sample was not J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.014 mg/kg at the GOSB-32 location (see Figure 3-21). The mean detected concentration was 0.0031 mg/kg and the EPC was 0.014 mg/kg. Methyl acetate came through screening because there is no RSV available. The maximum detected concentration is within the GOSB background maximum of 0.018 mg/kg.

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- ~~It has a low frequency of detection (1/6)~~
- It is within GOSB background levels
- There is no screening threshold available

Thallium-208 was detected in three of three samples. None of the detected samples were J-qualified (i.e., estimated). In 2009, the maximum detected concentration was 0.55 pCi/g at the GOSB-31 location. The mean detected concentration was 0.49 pCi/g and the EPC was 0.55 pCi/g. Thallium-208 came through screening because there is no RSV available. The half-life of thallium-208 is 3.05 minutes. Further, the maximum concentration is within background; the SRS background maximum for the thorium-232 decay series is 6.75 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is a naturally-occurring radionuclide
- It has a very short half-life
- It is within background

Vanadium was detected in six of six samples. None of the detected samples were J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 57.1 mg/kg at the GOSB-54 location. The mean detected concentration was 39.5 mg/kg and the EPC was 53.17 mg/kg. The EPC and mean exceeded the RSV of 13 mg/kg. The uncertainty evaluation presented in Attachment D-5, Table 3.A, shows HQ exceedances for the American robin (avian herbivore) (HQ = 3.13), American robin (avian omnivore) (HQ = 3.54), and American robin (avian insectivore) (HQ = 4.09). As a protective assumption appropriate for ecological risk screening, the AUF is set to 1 to indicate the animal receives all of its exposure from the contaminated site. When the AUF is adjusted to a unit-specific PAUF (Mirenda 2012) using the mean, the receptor-specific screening values are concomitantly adjusted resulting in HQs as follows: American robin (avian herbivore) (HQ = 0.014), American robin (avian omnivore) (HQ = 0.016), and American robin (avian insectivore) (HQ = 0.018).

Additionally, vanadium is naturally-occurring and the maximum detected concentration is well within the GOSB background maximum level of 74.9 mg/kg and the SRS background maximum level of 104 mg/kg. With background levels exceeding the RSV, screening thresholds may be overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOC in subsurface soil based on the following lines of evidence:

- It is naturally-occurring
- It is within GOSB and SRS background levels
- AUF-adjusted HQs are < 1

- Screening level is likely overprotective

Summary: Most constituents in this soil interval were identified as COPCs because they have no screening thresholds available. Only vanadium has a screening threshold available that was exceeded, but it is naturally-occurring and falls within background levels. All other constituents were screened out due to ~~low detection frequencies,~~ estimated results, or short half-lives, or for falling within background levels. In summary, no constituents are identified as RCOCs for the Effluent Discharge in the 1 to 4 ft subsurface soil interval.

D-2.3.5 Screening Level Effects Conclusion

The following three possible decisions can be made upon completion of the screening level evaluation:

- There are adequate data to conclude that ecological risks are negligible, therefore, there is no need for remediation on the basis of ecological risk
- The information indicates a potential for adverse ecological effects and a more thorough assessment is not warranted
- The information is not adequate to make a decision at this point and the ecological risk assessment process will continue to address data gaps

The screening level ecological effects evaluation for the GOSB OU indicates that more information is not needed to make remedial decision recommendations for the protection of ecological receptors. Site-specific biological sampling or additional studies are not warranted. Problems warranting action for the Basin Interior subunit, both for sediment and surface water media, are identified.

D-2.4 Summary/Conclusion of Ecological Risk Assessment

The following table presents the overall summary of the ERA by subunit. The revised CSM is presented in Chapter 3.

Subunit	ERA Sediment RCOCs	ERA Surface Water RCOCs	ERA Soil 0 to 1 ft RCOCs	ERA Soil 1 to 4 ft RCOCs
GOSB Interior Subunit	Benthic Organisms - Alpha-chlordane (HQ = 100) - DDD (HQ = 50) - DDE (HQ = 278) - Dieldrin (HQ = 12) - Gamma-chlordane (HQ = 148) - Heptachlor epoxide (HQ = 12) - Silver (HQ = 40)	Aquatic Organisms - Alpha-chlordane (HQ = 9) - Gamma-chlordane (HQ = 9) - Silver (HQ = 30)	NA	NA
GOSB Berm Subunit	NA	NA	None	None
Pipeline Subunit	NA	NA	NA	NA
Effluent Discharge	NA	NA	None	None

ERA = ecological risk assessment
GOSB = G-Area Seepage Basin
HQ = hazard quotient
NA = not applicable
RCOC = refined constituent of concern

D-3. REFERENCES

ANL, 2006. RESRAD BIOTA (v.1.8), Argonne National Laboratory, Argonne, IL

ATSDR, 1998. *Toxicological Profile for Chloromethane*, Public Health Service U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry, Atlanta, GA

ATSDR, 2002. *Toxicological profile for Aldrin and Dieldrin*, Public Health Service U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry, Atlanta, GA

ATSDR, 2005. *Toxicological Profile for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthlene*, Public Health Service U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry, Atlanta, GA

BCERF, 1998. *Pesticides and breast cancer risk, an evaluation of chlordane,* Cornell University Program on Breast Cancer and Environmental Risk Factors, Ithaca, NY

Howard, 1989. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. 1*, Phillip H. Howard, CRC Press

LANL, 2014. *Toxicity Reference Value Development Methods for the Los Alamos National Laboratory*, Rev.1, Los Alamos National Laboratory Environmental Programs Directorate, Los Alamos, NM

LANL, 2015. *Ecorisk Database*, *Release 3.3,* Los Alamos National Laboratory, Los Alamos, NM

Mirenda, 2012. *Screening-Level Ecological Risk Assessment Methods*, Rev 3, Richard J. Mirenda, Los Alamos National Laboratory, Los Alamos, NM

SCDHEC, 2014. *R. 61-68, Water Classifications & Standards*, South Carolina Department of Health and Environmental Control, Columbia, SC

SRNS, 2017. *Remedial Investigation/Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U),* SRNS-RP-2017-00139, Revision 0, Savannah River Nuclear Solutions LLC, Savannah River, Aiken, SC.

Suter and Tsao, 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota,* 1996 Revision, G.W. Suter II and C.L. Tsao, Risk Assessment Program, Health Sciences Research Division, Oak Ridge, TN

USEPA, 2015. *Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft.* U.S. Environmental Protection Agency, Scientific Support Section, Superfund Division, Atlanta, GA

WSRC, 1991. *RCRA Facility Investigation/Remedial Investigation Plan for the G-Area Oil Seepage Basin (U)*, WRSC-RP-91-200, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Background Soils Statistical Summary Report for the Savannah River Site.* ERD-EN-2005-0223 Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

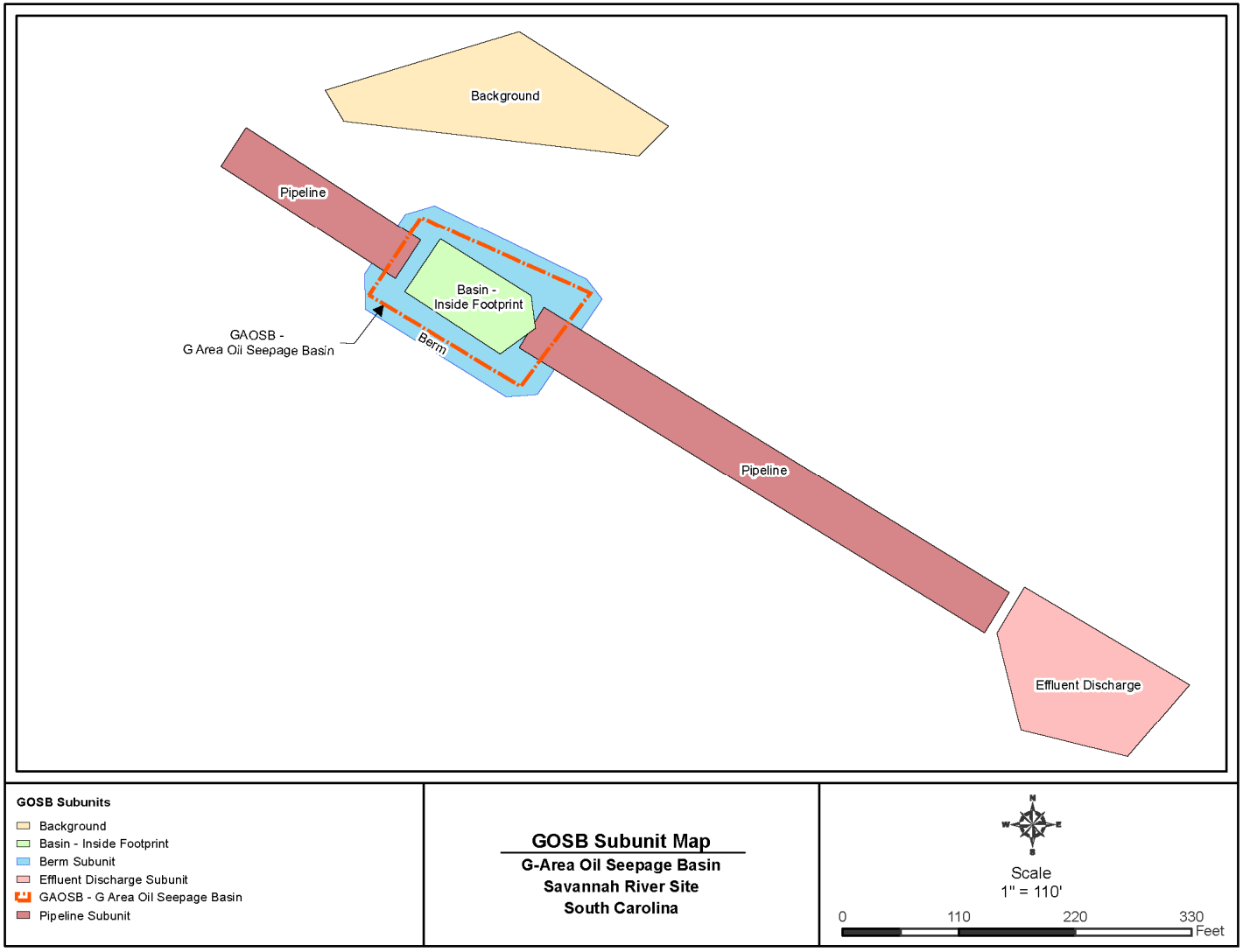

Figure D-1. G-Area Oil Seepage Basin and Associated Subunits

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Table D-1. Screening Level Evaluation for GOSB Interior Subunit (Sediment)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics (mg/kg)								
Aluminum	5.72E+03	2.50E+04	a	2.29E-01	no	1.05E+04	no	no
Antimony	2.93E+00	2.70E-01	b	1.09E+01	YES	2.69E+00	YES	YES
Arsenic	2.90E+00	6.80E+00	d	4.26E-01	no	4.28E+00	no	no
Barium	9.20E+01	2.00E+01	a	4.60E+00	YES	3.91E+01	YES	YES
Cadmium	4.19E+00	2.70E-01	d	1.55E+01	YES	4.83E-01	YES	YES
Calcium	1.57E+04	EN[7]	---	---	---	4.76E+02	YES	no
Chromium	5.12E+01	2.80E+01	bd	1.83E+00	YES	1.54E+01	YES	YES
Cobalt	2.98E+00	1.30E+01	bd	2.29E-01	no	1.55E+00	YES	no
Copper	4.81E+01	1.50E+01	d	3.21E+00	YES	4.34E+00	YES	YES
Cyanide	8.10E-01	1.00E-01	bcd	8.10E+00	YES	---	---	YES
Iron	9.07E+03	2.00E+04	ac	4.54E-01	no	1.27E+04	no	no
Lead	5.20E+01	1.10E+01	b	4.73E+00	YES	1.03E+01	YES	YES
Magnesium	3.68E+02	EN[7]	---	---	---	2.75E+02	YES	no
Manganese	2.77E+01	2.20E+02	bd	1.26E-01	no	1.53E+02	no	no
Mercury	5.78E-01	3.50E-04	d	1.65E+03	YES	7.10E-02	YES	YES
Nickel	2.49E+01	9.70E+00	d	2.57E+00	YES	3.48E+00	YES	YES
Potassium	1.40E+02	EN[7]	---	---	---	2.16E+02	no	no
Silver	3.14E+02	5.00E-01	c	6.28E+02	YES	7.28E-01	YES	YES
Sodium	3.88E+01	EN[7]	---	---	---	4.02E+01	no	no
Thallium	4.64E+00	5.00E-02	d	9.28E+01	YES	3.12E+00	YES	YES
Vanadium	3.80E+01	6.70E+00	d	5.67E+00	YES	3.91E+01	no	no
Zinc	4.49E+02	4.60E+01	b	9.76E+00	YES	9.47E+00	YES	YES

Table D-1. Screening Level Evaluation for GOSB Interior Subunit (Sediment) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Organics (mg/kg)								
1,3-Dichlorobenzene	8.24E-03	8.30E-02	a	9.93E-02	no	---	---	no
1,4-Dichlorobenzene	3.44E-02	3.00E-02	c	1.15E+00	YES	---	---	YES
2-Methylnaphthalene	2.58E+00	7.60E-02	c	3.39E+01	YES	---	---	YES
Acetone	2.84E-02	4.00E-02	a	7.10E-01	no	---	---	no
Anthracene	1.85E-02	5.70E-02	c	3.25E-01	no	---	---	no
Benzo(g,h,i)perylene	6.70E-02	1.70E-01	c	3.94E-01	no	---	---	no
Benzo[a]anthracene	1.95E-01	1.00E-01	c	1.95E+00	YES	---	---	YES
Benzo[a]pyrene	1.38E-01	1.50E-01	c	9.20E-01	no	---	---	no
Benzo[b]fluoranthene	2.47E-01	1.90E-01	c	1.30E+00	YES	---	---	YES
Caprolactam	1.42E+01	---	---	---	---	---	---	YES
Carbon Disulfide	1.62E-03	3.60E-03	a	4.50E-01	no	---	---	no
Chlorobenzene	2.18E-02	5.80E-02	a	3.76E-01	no	---	---	no
Chrysene	1.67E-01	1.60E-01	c	1.04E+00	YES	---	---	YES
Cumene (Isopropylbenzene)	4.00E-04	3.30E-02	a	1.21E-02	no	---	---	no
Ethylbenzene	5.10E-04	2.70E-01	b	1.89E-03	no	---	---	no
Fluoranthene	9.93E-01	4.20E-01	c	2.36E+00	YES	---	---	YES
Fluorene	1.59E+00	7.70E-02	c	2.06E+01	YES	---	---	YES
Indeno[1,2,3-cd]pyrene	6.47E-02	2.00E-01	c	3.24E-01	no	---	---	no
m,p-Xylene	6.40E-04	1.00E-01	b	6.40E-03	no	---	---	no
Methyl Ethyl Ketone	1.61E-03	9.92E-01	a	1.62E-03	no	---	---	no
Methylcyclohexane	4.40E-04	---	---	---	---	---	---	YES
Phenanthrene	3.91E+00	2.00E-01	c	1.96E+01	YES	---	---	YES
Pyrene	6.83E-01	1.90E-01	c	3.59E+00	YES	---	---	YES

Table D-1. Screening Level Evaluation for GOSB Interior Subunit (Sediment) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Toluene	1.00E-03	1.00E-02	c	1.00E-01	no	---	---	no
Pesticides/PCBs (mg/kg)								
Alpha-Chlordane	7.32E+00	3.20E-03	c	2.29E+03	YES	---	---	YES
DDD	1.80E+00	1.22E-03	a	1.48E+03	YES	---	---	YES
DDE	4.50E+00	2.07E-03	a	2.17E+03	YES	---	---	YES
Dieldrin	5.00E-01	3.00E-04	a	1.67E+03	YES	---	---	YES
Gamma-Chlordane	1.09E+01	3.20E-03	c	3.41E+03	YES	---	---	YES
Heptachlor	8.97E-03	1.90E-03	a	4.72E+00	YES	---	---	YES
Heptachlor Epoxide	9.45E-01	4.00E-04	b	2.36E+03	YES	---	---	YES
Radionuclides (pCi/g)								
Actinium-228	1.38E+00	---	---	---	---	1.95E+00	no	no
Bismuth-214	8.82E-01	---	---	---	---	2.24E+00	no	no
Cesium-137	4.99E-02	7.20E+02	c	6.93E-05	no	2.84E-01	no	no
Lead-212	1.33E+00	---	---	---	---	2.19E+00	no	no
Lead-214	1.01E+00	---	---	---	---	---	---	YES
Potassium-40	2.96E+00	---	---	---	---	2.33E+00	YES	YES
Thallium-208	4.31E-01	---	---	---	---	---	---	YES

1 - Maximum detected concentration from Appendix A Table A.1.1 Sediment Media (0-1 ft)
2 - GOSB ESV from attachment D-1 Table I.A.
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: c = Los Alamos National Laboratory No Effect ESL for Sediment Media
3: d = Los Alamos National Laboratory No Effect ESL for Soil Media
4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5 - Background screening values obtained from the Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).
6 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1), if available, and exceeds 2X average background concentration
7 - Essential nutrient, not subject to further evaluation

Table D-2. Refinement Level Evaluation for GOSB Interior Subunit (Sediment)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (mg/kg)						
Antimony	2.93E+00	2.40E+01	d	1.22E-01	no	no
Barium	9.20E+01	6.00E+01	a	1.53E+00	YES	YES
Cadmium	3.26E+00	2.70E+00	d	1.21E+00	YES	YES
Chromium	4.25E+01	1.10E+02	c	3.86E-01	no	no
Copper	4.81E+01	4.60E+01	d	1.05E+00	YES	YES
Cyanide	8.10E-01	1.00E+00	cd	8.10E-01	no	no
Lead	4.31E+01	2.80E+01	d	1.54E+00	YES	YES
Mercury	5.78E-01	3.50E-03	d	1.65E+02	YES	YES
Nickel	1.82E+01	1.90E+01	d	9.60E-01	no	no
Silver	3.14E+02	2.20E+00	a	1.43E+02	YES	YES
Thallium	4.64E+00	5.00E-01	d	9.28E+00	YES	YES
Zinc	4.31E+02	4.59E+02	a	9.39E-01	no	no
Organics (mg/kg)						
1,4-Dichlorobenzene	2.75E-02	3.00E-01	c	9.16E-02	no	no
2-Methylnaphthalene	2.58E+00	4.47E-01	a	5.77E+00	YES	YES
Benzo[a]anthracene	1.95E-01	8.41E-01	a	2.32E-01	no	no
Benzo[b]fluoranthene	2.47E-01	9.79E-01	a	2.52E-01	no	no
Caprolactam	1.42E+01	---	---	---	---	YES
Chrysene	1.67E-01	8.44E-01	a	1.98E-01	no	no
Fluoranthene	9.93E-01	7.07E-01	a	1.40E+00	YES	YES
Fluorene	1.59E+00	5.30E-01	c	3.00E+00	YES	YES
Methylcyclohexane	4.40E-04	---	---	---	---	YES
Phenanthrene	3.91E+00	5.96E-01	a	6.56E+00	YES	YES
Pyrene	4.64E-01	6.97E-01	a	6.66E-01	no	no

Table D-2. Refinement Level Evaluation for GOSB Interior Subunit (Sediment) (cont.)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Pesticides/PCBs (mg/kg)						
Alpha-Chlordane	4.49E+00	1.70E-02	c	2.64E+02	YES	YES
DDD	1.80E+00	7.81E-03	a	2.30E+02	YES	YES
DDE	4.50E+00	3.74E-03	a	1.20E+03	YES	YES
Dieldrin	3.40E-01	9.00E-03	d	3.78E+01	YES	YES
Gamma-Chlordane	1.09E+01	1.70E-02	c	6.41E+02	YES	YES
Heptachlor	8.35E-03	1.60E-02	c	5.22E-01	no	no
Heptachlor Epoxide	6.35E-01	1.60E-02	a	3.97E+01	YES	YES
Radionuclides (pCi/g)						
Lead-214	9.34E-01	---	---	---	---	YES
Potassium-40	2.96E+00	---	---	---	---	YES
Thallium-208	4.31E-01	---	---	---	---	YES

1 - Analytes identified as COPECs from Table D-1
2 - EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.1.1 GOSB Interior Subunit Sediment (0-1 ft)
3 - GOSB RSV from Attachment D-1 Table I.B
4: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
4: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
4: c = Los Alamos National Laboratory Low Effect ESL for Sediment Media
4: d = Los Alamos National Laboratory Low Effect ESL for Soil Media
5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV
6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

Table D-3. Screening Level Evaluation for GOSB Interior Subunit (Surface Water)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	COPEC?[5]
Inorganics (µg/L)						
Aluminum	3.32E+04	8.70E+01	b	3.82E+02	YES	YES
Antimony	3.62E+00	3.00E+01	c	1.21E-01	no	no
Barium	3.05E+02	3.90E+00	c	7.82E+01	YES	YES
Beryllium	1.40E+00	6.60E-01	c	2.12E+00	YES	YES
Cadmium	2.31E+01	1.00E-01	a	2.31E+02	YES	YES
Calcium	1.35E+04	1.16E+05	b	1.16E-01	no	no
Chromium	1.47E+02	1.10E+01	abc	1.34E+01	YES	YES
Cobalt	1.36E+01	3.00E+00	c	4.53E+00	YES	YES
Copper	8.05E+02	2.90E+00	a	2.78E+02	YES	YES
Cyanide	5.27E+00	5.20E+00	abc	1.01E+00	YES	YES
Iron	2.55E+04	1.00E+03	bc	2.55E+01	YES	YES
Lead	1.31E+02	5.40E-01	a	2.43E+02	YES	YES
Magnesium	2.08E+03	8.20E+04	b	2.54E-02	no	no
Manganese	3.40E+02	9.30E+01	b	3.66E+00	YES	YES
Mercury	2.37E-01	1.30E-03	b	1.82E+02	YES	YES
Nickel	1.28E+02	1.60E+01	a	8.00E+00	YES	YES
Potassium	5.53E+03	5.30E+04	b	1.04E-01	no	no
Silver	2.99E+02	6.00E-02	b	4.98E+03	YES	YES
Sodium	8.70E+03	6.80E+05	b	1.28E-02	no	no
Vanadium	6.88E+01	1.90E+01	c	3.62E+00	YES	YES
Zinc	3.80E+03	3.70E+01	a	1.03E+02	YES	YES

Table D-3. Screening Level Evaluation for GOSB Interior Subunit (Surface Water) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	COPEC?[5]
Organics (µg/L)						
Acetone	4.02E+00	1.50E+03	c	2.68E-03	no	no
Caprolactam	3.64E+01	---	---	---	---	YES
Toluene	5.06E+00	9.80E+00	c	5.16E-01	no	no
Pesticides/PCBs (µg/L)						
Alpha-Chlordane	2.22E-01	4.30E-03	abc	5.16E+01	YES	YES
DDD	4.08E-02	1.10E-02	b	3.71E+00	YES	YES
DDE	8.04E-02	4.10E-01	b	1.96E-01	no	no
DDT	2.28E-02	1.00E-03	ac	2.28E+01	YES	YES
Dieldrin	1.16E-02	5.60E-02	abc	2.07E-01	no	no
Gamma-Chlordane	2.34E-01	4.30E-03	abc	5.44E+01	YES	YES
Alpha-Benzene Hexachloride (BHC)	1.23E-02	---	---	---	---	YES
Beta-Benzene Hexachloride (BHC)	3.48E-02	4.60E-02	b	7.57E-01	no	no
Radionuclides (pCi/L)						
Bismuth-214	2.30E+01	---	---	---	---	YES
Lead-214	1.61E+01	---	---	---	---	YES
Tritium	1.37E+03	1.60E+08	c	8.56E-06	no	no

1 - Maximum detected concentration from Appendix A Table A.1.2 Surface Water
2 - GOSB ESV from attachment D-1 Table III.A
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014)
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015)
4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1); a background screen was not performed for surface water media

Table D-4. Refinement Level Evaluation for GOSB Interior Subunit (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (µg/L)						
Aluminum	2.41E+04	8.70E+01	b	2.77E+02	YES	YES
Barium	2.04E+02	3.90E+00	c	5.23E+01	YES	YES
Beryllium	1.40E+00	6.60E-01	c	2.12E+00	YES	YES
Cadmium	1.03E+01	1.00E-01	a	1.03E+02	YES	YES
Chromium	5.64E+01	1.10E+01	abc	5.12E+00	YES	YES
Cobalt	6.62E+00	3.00E+00	c	2.21E+00	YES	YES
Copper	5.92E+02	2.90E+00	a	2.04E+02	YES	YES
Cyanide	2.82E+00	5.20E+00	abc	5.43E-01	no	no
Iron	1.63E+04	1.00E+03	bc	1.63E+01	YES	YES
Lead	5.87E+01	5.40E-01	a	1.09E+02	YES	YES
Manganese	2.47E+02	9.30E+01	b	2.66E+00	YES	YES
Mercury	2.37E-01	1.30E-03	b	1.82E+02	YES	YES
Nickel	5.66E+01	1.60E+01	a	3.54E+00	YES	YES
Silver	1.14E+02	6.00E-02	b	1.91E+03	YES	YES
Vanadium	4.87E+01	1.90E+01	c	2.57E+00	YES	YES
Zinc	3.80E+03	3.70E+01	a	1.03E+02	YES	YES
Organics (µg/L)						
Caprolactam	2.10E+01	---	---	---	---	YES
Pesticides/PCBs (µg/L)						
Alpha-Benzene Hexachloride (BHC)	1.23E-02	---	---	---	---	YES
Alpha-Chlordane	1.15E-01	4.30E-03	abc	2.67E+01	YES	YES
DDD	1.98E-02	1.10E-02	b	1.80E+00	YES	YES
DDT	2.28E-02	1.00E-03	ac	2.28E+01	YES	YES
Gamma-Chlordane	1.36E-01	4.30E-03	abc	3.16E+01	YES	YES

Table D-4. Refinement Level Evaluation for GOSB Interior Subunit (Surface Water) (cont.)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Radionuclides (pCi/L)						
Bismuth-214	2.30E+01	---	---	---	---	YES
Lead-214	1.61E+01	---	---	---	---	YES

1 - Analytes identified as COPECs from Table D-3
2 - EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.1.2 Surface Water
3 - GOSB RSV from Attachment D-1 Table III.B
4: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014)
4: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
4: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015)
5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV
6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

Table D-5. Screening Level Evaluation for GOSB Berm Subunit (Soil 0-1 ft)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics (mg/kg)								
Aluminum	1.15E+04	---	---	---	---	1.05E+04	YES	YES
Arsenic	1.58E+01	6.80E+00	b	2.32E+00	YES	4.28E+00	YES	YES
Barium	2.23E+01	1.10E+02	b	2.03E-01	no	3.91E+01	no	no
Beryllium	1.94E-01	2.50E+00	b	7.76E-02	no	2.89E-01	no	no
Cadmium	1.68E-01	2.70E-01	b	6.22E-01	no	4.83E-01	no	no
Calcium	4.82E+02	EN[7]	---	---	---	4.76E+02	YES	no
Chromium	3.27E+01	2.80E+01	ab	1.17E+00	YES	1.54E+01	YES	YES
Cobalt	7.30E-01	1.30E+01	ab	5.62E-02	no	1.55E+00	no	no
Copper	1.71E+01	1.50E+01	b	1.14E+00	YES	4.34E+00	YES	YES
Cyanide	1.67E-01	1.00E-01	ab	1.67E+00	YES	---	---	YES
Iron	2.71E+04	---	---	---	---	1.27E+04	YES	YES
Lead	7.29E+01	1.10E+01	a	6.63E+00	YES	1.03E+01	YES	YES
Magnesium	3.56E+02	EN[7]	---	---	---	2.75E+02	YES	no
Manganese	8.55E+01	2.20E+02	ab	3.89E-01	no	1.53E+02	no	no
Mercury	4.70E-02	3.50E-04	b	1.34E+02	YES	7.10E-02	no	no
Nickel	2.55E+00	9.70E+00	b	2.63E-01	no	3.48E+00	no	no
Potassium	3.80E+02	EN[7]	---	---	---	2.16E+02	YES	no
Silver	4.96E-01	2.60E+00	b	1.91E-01	no	7.28E-01	no	no
Sodium	6.19E+01	EN[7]	---	---	---	4.02E+01	YES	no
Thallium	1.30E+00	5.00E-02	b	2.60E+01	YES	3.12E+00	no	no
Vanadium	6.69E+01	6.70E+00	b	9.99E+00	YES	3.91E+01	YES	YES
Zinc	1.39E+01	4.60E+01	a	3.02E-01	no	9.47E+00	YES	no

Table D-5. Screening Level Evaluation for GOSB Berm Subunit (Soil 0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Organics (mg/kg)								
Acenaphthene	1.78E-02	2.50E-01	b	7.12E-02	no	---	---	no
Acetone	7.02E-02	1.20E+00	ab	5.85E-02	no	---	---	no
Anthracene	2.80E-02	6.80E+00	b	4.12E-03	no	---	---	no
Benzo(g,h,i)perylene	5.79E-02	1.10E+00	a	5.26E-02	no	---	---	no
Benzo[a]anthracene	1.01E-01	8.00E-01	b	1.26E-01	no	---	---	no
Benzo[a]pyrene	9.15E-02	1.10E+00	a	8.32E-02	no	---	---	no
Benzo[b]fluoranthene	1.87E-01	1.10E+00	a	1.70E-01	no	---	---	no
Bis(2-ethylhexyl)phthalate	7.68E-02	2.00E-02	ab	3.84E+00	YES	---	---	YES
Carbazole	2.64E-02	1.60E-01	a	1.65E-01	no	---	---	no
Chrysene	1.12E-01	1.10E+00	a	1.02E-01	no	---	---	no
Fluoranthene	2.45E-01	1.10E+00	a	2.23E-01	no	---	---	no
Indeno[1,2,3-cd]pyrene	5.06E-02	1.10E+00	a	4.60E-02	no	---	---	no
Methyl Acetate	1.30E-02	---	---	---	---	---	---	YES
Methyl Ethyl Ketone	2.60E-03	1.00E+00	a	2.60E-03	no	---	---	no
Phenanthrene	1.32E-01	5.50E+00	b	2.40E-02	no	---	---	no
Pyrene	1.79E-01	1.10E+00	a	1.63E-01	no	---	---	no
Styrene	1.73E-03	1.20E+00	ab	1.44E-03	no	---	---	no
Toluene	3.90E-04	1.50E-01	a	2.60E-03	no	---	---	no
Pesticides/PCBs (mg/kg)								
Alpha-Chlordane	1.23E-02	2.70E-01	ab	4.56E-02	no	---	---	no
DDD	5.32E-03	6.30E-03	ab	8.44E-01	no	---	---	no
DDE	2.85E-02	1.10E-01	ab	2.59E-01	no	---	---	no
DDT	1.94E-02	4.40E-02	ab	4.41E-01	no	---	---	no
Dieldrin	1.70E-03	4.50E-03	b	3.78E-01	no	---	---	no

Table D-5. Screening Level Evaluation for GOSB Berm Subunit (Soil 0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Endosulfan Sulfate	7.13E-04	6.50E-03	a	1.10E-01	no	---	---	no
Endrin	1.45E-03	1.40E-03	ab	1.04E+00	YES	---	---	YES
Endrin Ketone	1.61E-03	---	---	---	---	---	---	YES
Gamma-Chlordane	4.80E-03	2.20E+00	ab	2.18E-03	no	---	---	no
Aroclor 1254	2.06E-02	1.40E-02	a	1.47E+00	YES	---	---	YES
Aroclor 1260	1.36E-02	8.80E-01	ab	1.55E-02	no	---	---	no
Radionuclides (pCi/g)								
Actinium-228	1.62E+00	---	---	---	---	1.95E+00	no	no
Bismuth-214	9.92E-01	---	---	---	---	2.24E+00	no	no
Cesium-137	2.78E-01	1.20E+03	b	2.32E-04	no	2.84E-01	no	no
Lead-212	1.68E+00	---	---	---	---	2.19E+00	no	no
Lead-214	1.02E+00	---	---	---	---	---	---	YES
Potassium-40	3.25E+00	---	---	---	---	2.33E+00	YES	YES
Thallium-208	5.42E-01	---	---	---	---	---	---	YES

1 - Maximum detected concentration from Appendix A Table A.2.1.1 GOSB Berm Subunit Soil (0-1 ft)
2 - GOSB ESV from attachment D-1 Table II.A.
3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Los Alamos National Laboratory No Effect ESL for Soil Media
4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5 - Background screening values obtained from the Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).
6 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1), if available, and exceeds 2X average background concentration
7 - Essential nutrient, not subject to further evaluation

Table D-6. Refinement Level Evaluation for GOSB Berm Subunit (Soil 0-1 ft)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (mg/kg)						
Aluminum	8.70E+03	---	---	---	---	YES
Arsenic	7.42E+00	6.80E+01	b	1.09E-01	no	no
Chromium	2.14E+01	2.80E+02	b	7.66E-02	no	no
Copper	7.42E+00	4.60E+01	b	1.61E-01	no	no
Cyanide	9.53E-02	1.00E+00	b	9.53E-02	no	no
Iron	2.71E+04	---	---	---	---	YES
Lead	4.53E+01	2.80E+01	b	1.62E+00	YES	YES
Vanadium	5.38E+01	1.30E+01	b	4.14E+00	YES	YES
Organics (mg/kg)						
Bis(2-ethylhexyl)phthalate	7.68E-02	2.00E-01	b	3.84E-01	no	no
Methyl Acetate	1.30E-02	---	---	---	---	YES
Pesticides/PCBs (mg/kg)						
Endrin	1.45E-03	1.40E-02	b	1.04E-01	no	no
Endrin Ketone	1.61E-03	---	---	---	---	YES
Aroclor 1254	2.06E-02	4.10E-01	b	5.02E-02	no	no
Radionuclides (pCi/g)						
Lead-214	9.53E-01	---	---	---	---	YES
Potassium-40	2.21E+00	---	---	---	---	YES
Thallium-208	4.59E-01	---	---	---	---	YES

1 - Analytes identified as COPECs from Table D-5

2 - EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.2.1.2 GOSB Berm Subunit (1-4 ft)

3 - GOSB RSV from Attachment D-1 Table II.B

4: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

4: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV

6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

Table D-7. Screening Level Evaluation for GOSB Berm Subunit (Soil 1-4 ft)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics (mg/kg)								
Aluminum	1.89E+04	---	---	---	---	1.05E+04	YES	YES
Arsenic	1.41E+01	6.80E+00	b	2.07E+00	YES	4.28E+00	YES	YES
Barium	3.49E+01	1.10E+02	b	3.17E-01	no	3.91E+01	no	no
Beryllium	2.64E-01	2.50E+00	b	1.06E-01	no	2.89E-01	no	no
Calcium	2.35E+02	EN[7]	---	---	---	4.76E+02	no	no
Chromium	3.30E+01	2.80E+01	ab	1.18E+00	YES	1.54E+01	YES	YES
Cobalt	8.88E-01	1.30E+01	ab	6.83E-02	no	1.55E+00	no	no
Copper	5.51E+00	1.50E+01	b	3.67E-01	no	4.34E+00	YES	no
Iron	3.04E+04	---	---	---	---	1.27E+04	YES	YES
Lead	1.43E+01	1.10E+01	a	1.30E+00	YES	1.03E+01	YES	YES
Magnesium	1.39E+02	EN[7]	---	---	---	2.75E+02	no	no
Manganese	1.42E+02	2.20E+02	ab	6.45E-01	no	1.53E+02	no	no
Mercury	6.18E-02	3.50E-04	b	1.77E+02	YES	7.10E-02	no	no
Nickel	2.82E+00	9.70E+00	b	2.91E-01	no	3.48E+00	no	no
Potassium	1.34E+02	EN[7]	---	---	---	2.16E+02	no	no
Silver	4.25E-01	2.60E+00	b	1.63E-01	no	7.28E-01	no	no
Sodium	1.65E+02	EN[7]	---	---	---	4.02E+01	YES	no
Vanadium	7.83E+01	6.70E+00	b	1.17E+01	YES	3.91E+01	YES	YES
Zinc	5.27E+00	4.60E+01	a	1.15E-01	no	9.47E+00	no	no
Organics (mg/kg)								
Acetone	6.20E-02	1.20E+00	ab	5.17E-02	no	---	---	no
Caprolactam	7.57E-02	---	---	---	---	---	---	YES
Carbon Disulfide	2.27E-03	5.00E-03	a	4.54E-01	no	---	---	no
Methyl Acetate	2.04E-02	---	---	---	---	---	---	YES

Table D-7. Screening Level Evaluation for GOSB Berm Subunit (Soil 1-4 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Methyl Ethyl Ketone	2.57E-03	1.00E+00	a	2.57E-03	no	---	---	no
Pesticides/PCBs (mg/kg)								
Alpha-Chlordane	1.00E-03	2.70E-01	ab	3.70E-03	no	---	---	no
DDD	1.34E-03	6.30E-03	ab	2.13E-01	no	---	---	no
DDE	9.75E-03	1.10E-01	ab	8.86E-02	no	---	---	no
DDT	1.63E-03	4.40E-02	ab	3.70E-02	no	---	---	no
Gamma-Chlordane	1.20E-03	2.20E+00	ab	5.45E-04	no	---	---	no
Radionuclides (pCi/g)								
Actinium-228	1.94E+00	---	---	---	---	1.95E+00	no	no
Barium-133	2.47E-02	---	---	---	---	---	---	YES
Bismuth-214	1.11E+00	---	---	---	---	2.24E+00	no	no
Cesium-137	5.96E-02	1.20E+03	b	4.97E-05	no	2.84E-01	no	no
Lead-212	2.00E+00	---	---	---	---	2.19E+00	no	no
Lead-214	1.27E+00	---	---	---	---	---	---	YES
Potassium-40	1.67E+00	---	---	---	---	2.33E+00	no	no
Thallium-208	5.93E-01	---	---	---	---	---	---	YES

1 - Maximum detected concentration from Appendix A Table A.2.1.2 GOSB Berm Subunit Soil (1-4 ft)

2 - GOSB ESV from Attachment D-1, Table II.A.

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory No Effect ESL for Soil Media

4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV

5 - Background screening values obtained from the Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).

6 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1), if available, and exceeds 2X average background concentration

7 - Essential nutrient, not subject to further evaluation

Table D-8. Refinement Level Evaluation for GOSB Berm Subunit (Soil 1-4 ft)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (mg/kg)						
Aluminum	1.08E+04	---	---	---	---	YES
Arsenic	6.62E+00	6.80E+01	b	9.73E-02	no	no
Chromium	1.65E+01	2.80E+02	b	5.91E-02	no	no
Iron	1.47E+04	---	---	---	---	YES
Lead	9.56E+00	2.80E+01	b	3.41E-01	no	no
Vanadium	3.88E+01	1.30E+01	b	2.99E+00	YES	YES
Organics (mg/kg)						
Caprolactam	7.57E-02	---	---	---	---	YES
Methyl Acetate	7.40E-03	---	---	---	---	YES
Radionuclides (pCi/g)						
Lead-214	1.03E+00	---	---	---	---	YES
Thallium-208	4.26E-01	---	---	---	---	YES
Barium-133	2.47E-02	---	---	---	---	YES

1 - Analytes identified as COPECs from Table D-7

2 - EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.2.1.2 GOSB Berm Subunit (1-4 ft)

3 - GOSB RSV from Attachment D-1 Table II.B

4: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

4: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV

6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

Table D-9. Screening Level Evaluation for Effluent Discharge Subunit (Soil 0-1 ft)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics (mg/kg)								
Aluminum	1.53E+04	---	---	---	---	1.05E+04	YES	YES
Arsenic	8.55E+00	6.80E+00	b	1.26E+00	YES	4.28E+00	YES	YES
Barium	4.20E+01	1.10E+02	b	3.82E-01	no	3.91E+01	YES	no
Beryllium	2.95E-01	2.50E+00	b	1.18E-01	no	2.89E-01	YES	no
Cadmium	1.34E-01	2.70E-01	b	4.96E-01	no	4.83E-01	no	no
Calcium	6.84E+02	EN[7]	---	---	---	4.76E+02	YES	no
Chromium	2.07E+01	2.80E+01	ab	7.39E-01	no	1.54E+01	YES	no
Cobalt	2.48E+00	1.30E+01	ab	1.91E-01	no	1.55E+00	YES	no
Copper	2.06E+01	1.50E+01	b	1.37E+00	YES	4.34E+00	YES	YES
Cyanide	4.96E-01	1.00E-01	ab	4.96E+00	YES	---	---	YES
Iron	3.05E+04	---	---	---	---	1.27E+04	YES	YES
Lead	1.72E+01	1.10E+01	a	1.56E+00	YES	1.03E+01	YES	YES
Magnesium	2.47E+02	EN[7]	---	---	---	2.75E+02	no	no
Manganese	1.15E+02	2.20E+02	ab	5.23E-01	no	1.53E+02	no	no
Mercury	7.64E-02	3.50E-04	b	2.18E+02	YES	7.10E-02	YES	YES
Nickel	4.84E+00	9.70E+00	b	4.99E-01	no	3.48E+00	YES	no
Potassium	1.78E+02	EN[7]	---	---	---	2.16E+02	no	no
Selenium	3.27E+00	5.20E-01	ab	6.29E+00	YES	2.99E+00	YES	YES
Silver	1.19E+01	2.60E+00	b	4.58E+00	YES	7.28E-01	YES	YES
Sodium	5.97E+01	EN[7]	---	---	---	4.02E+01	YES	no
Vanadium	7.61E+01	6.70E+00	b	1.14E+01	YES	3.91E+01	YES	YES

Table D-9. Screening Level Evaluation for Effluent Discharge Subunit (Soil 0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Zinc	3.65E+01	4.60E+01	a	7.93E-01	no	9.47E+00	YES	no
Organics (mg/kg)								
Acetone	1.73E-01	1.20E+00	ab	1.44E-01	no	---	---	no
Benzo(g,h,i)perylene	1.90E-02	1.10E+00	a	1.73E-02	no	---	---	no
Benzo[a]pyrene	2.73E-02	1.10E+00	a	2.48E-02	no	---	---	no
Benzo[b]fluoranthene	4.22E-02	1.10E+00	a	3.84E-02	no	---	---	no
Benzo[k]fluoranthene	1.92E-02	1.10E+00	a	1.75E-02	no	---	---	no
Chrysene	4.15E-02	1.10E+00	a	3.77E-02	no	---	---	no
Cumene (Isopropylbenzene)	4.25E-03	4.00E-02	a	1.06E-01	no	---	---	no
Fluoranthene	6.09E-02	1.10E+00	a	5.54E-02	no	---	---	no
Indeno[1,2,3-cd]pyrene	1.75E-02	1.10E+00	a	1.59E-02	no	---	---	no
Methyl Acetate	5.03E-02	---	---	---	---	---	---	YES
Methyl Ethyl Ketone	6.13E-02	1.00E+00	a	6.13E-02	no	---	---	no
Phenanthrene	3.26E-02	5.50E+00	b	5.93E-03	no	---	---	no
Pyrene	4.27E-02	1.10E+00	a	3.88E-02	no	---	---	no
Styrene	6.22E-03	1.20E+00	ab	5.18E-03	no	---	---	no
Pesticides/PCBs (mg/kg)								
Alpha-Chlordane	3.86E-01	2.70E-01	ab	1.43E+00	YES	---	---	YES
DDE	1.45E-02	1.10E-01	ab	1.32E-01	no	---	---	no
DDT	1.60E-02	4.40E-02	ab	3.64E-01	no	---	---	no
Gamma-Chlordane	2.77E-01	2.20E+00	ab	1.26E-01	no	---	---	no
Heptachlor Epoxide	2.50E-04	4.00E-04	a	6.25E-01	no	---	---	no
Aroclor 1254	3.66E-02	1.40E-02	a	2.61E+00	YES	---	---	YES

Table D-9. Screening Level Evaluation for Effluent Discharge Subunit (Soil 0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Aroclor 1260	3.57E-02	8.80E-01	ab	4.06E-02	no	---	---	no
Radionuclides (pCi/g)								
Actinium-228	1.86E+00	---	---	---	---	1.95E+00	no	no
Bismuth-214	1.10E+00	---	---	---	---	2.24E+00	no	no
Cesium-137	2.84E-01	1.20E+03	b	2.37E-04	no	2.84E-01	no	no
Lead-212	1.88E+00	---	---	---	---	2.19E+00	no	no
Lead-214	1.22E+00	---	---	---	---	---	---	YES
Potassium-40	1.95E+00	---	---	---	---	2.33E+00	no	no
Thallium-208	5.90E-01	---	---	---	---	---	---	YES
Radium-226	1.37E+00	1.50E+00	b	9.13E-01	no	1.37E+00	YES	no
Radium-228	2.47E+00	1.20E+00	b	2.06E+00	YES	1.92E+00	YES	YES
Thorium-228	2.75E+00	4.30E+01	b	6.40E-02	no	1.97E+00	YES	no
Thorium-230	1.47E+00	5.20E+01	b	2.83E-02	no	1.13E+00	YES	no
Thorium-232	2.40E+00	6.20E+00	b	3.87E-01	no	1.80E+00	YES	no
Uranium-233 / -234	1.19E+00	4.40E+02	b	2.70E-03	no	1.15E+00	YES	no
Uranium-238	1.01E+00	4.00E+02	b	2.53E-03	no	1.01E+00	YES	no

Table D-9. Screening Level Evaluation for Effluent Discharge Subunit (Soil 0-1 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]

1 - Maximum detected concentration from Appendix A Table A.4.1 Effluent Discharge Subunit (0-1 ft)
2 - GOSB ESV from attachment D-1 Table II.A.
3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Los Alamos National Laboratory No Effect ESL for Soil Media
4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5 - Background screening values obtained from the Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).
6 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1), if available, and exceeds 2X average background concentration
7 - Essential nutrient, not subject to further evaluation

Table D-10. Refinement Level Evaluation for Effluent Discharge Subunit (Soil 0-1 ft)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (mg/kg)						
Aluminum	1.22E+04	---	---	---	---	YES
Arsenic	6.21E+00	6.80E+01	b	9.13E-02	no	no
Copper	1.44E+01	4.60E+01	b	3.12E-01	no	no
Cyanide	3.11E-01	1.00E+00	b	3.11E-01	no	no
Iron	2.23E+04	---	---	---	---	YES
Lead	1.32E+01	2.80E+01	b	4.73E-01	no	no
Mercury	7.22E-02	3.50E-03	b	2.06E+01	YES	YES
Selenium	2.47E+00	3.00E+00	b	8.22E-01	no	no
Silver	8.02E+00	2.60E+01	b	3.08E-01	no	no
Vanadium	5.38E+01	1.30E+01	b	4.14E+00	YES	YES
Organics (mg/kg)						
Methyl Acetate	5.03E-02	---	---	---	---	YES
Pesticides/PCBs (mg/kg)						
Alpha-Chlordane	2.53E-01	2.70E+00	b	9.39E-02	no	no
Aroclor 1254	3.66E-02	4.10E-01	b	8.93E-02	no	no
Radionuclides (pCi/g)						
Lead-214	1.22E+00	---	---	---	---	YES
Thallium-208	5.90E-01	---	---	---	---	YES
Radium-228	2.47E+00	1.20E+01	b	2.06E-01	no	no

1 - Analytes identified as COPECs from Table D-9

2 - EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.4.1 Effluent Discharge Subunit (0-1 ft)

3 - GOSB RSV from Attachment D-1 Table II.B

4: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

4: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV

6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

Table D-11. Screening Level Evaluation for Effluent Discharge Subunit (Soil 1-4 ft)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics (mg/kg)								
Aluminum	1.47E+04	---	---	---	---	1.05E+04	YES	YES
Arsenic	9.84E+00	6.80E+00	b	1.45E+00	YES	4.28E+00	YES	YES
Barium	6.06E+01	1.10E+02	b	5.51E-01	no	3.91E+01	YES	no
Beryllium	8.11E-01	2.50E+00	b	3.24E-01	no	2.89E-01	YES	no
Calcium	7.80E+02	EN[7]	---	---	---	4.76E+02	YES	no
Chromium	2.13E+01	2.80E+01	ab	7.61E-01	no	1.54E+01	YES	no
Cobalt	3.96E+00	1.30E+01	ab	3.05E-01	no	1.55E+00	YES	no
Copper	5.40E+00	1.50E+01	b	3.60E-01	no	4.34E+00	YES	no
Iron	3.43E+04	---	---	---	---	1.27E+04	YES	YES
Lead	1.55E+01	1.10E+01	a	1.41E+00	YES	1.03E+01	YES	YES
Magnesium	2.50E+02	EN[7]	---	---	---	2.75E+02	no	no
Manganese	5.37E+02	2.20E+02	ab	2.44E+00	YES	1.53E+02	YES	YES
Mercury	3.67E-02	3.50E-04	b	1.05E+02	YES	7.10E-02	no	no
Nickel	5.40E+00	9.70E+00	b	5.57E-01	no	3.48E+00	YES	no
Potassium	2.17E+02	EN[7]	---	---	---	2.16E+02	YES	no
Selenium	3.72E+00	5.20E-01	ab	7.15E+00	YES	2.99E+00	YES	YES
Silver	1.72E+00	2.60E+00	b	6.62E-01	no	7.28E-01	YES	no
Sodium	5.42E+01	EN[7]	---	---	---	4.02E+01	YES	no
Vanadium	5.71E+01	6.70E+00	b	8.52E+00	YES	3.91E+01	YES	YES
Zinc	1.07E+01	4.60E+01	a	2.33E-01	no	9.47E+00	YES	no
Organics (mg/kg)								
Acetone	6.87E-02	1.20E+00	ab	5.73E-02	no	---	---	no

Table D-11. Screening Level Evaluation for Effluent Discharge Subunit (Soil 1-4 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Chloromethane (Methyl Chloride)	5.30E-04	---	---	---	---	---	---	YES
m,p-Xylene	6.34E-04	1.03E-01	a	6.16E-03	no	---	---	no
Methyl Acetate	1.40E-02	---	---	---	---	---	---	YES
Methyl Ethyl Ketone	2.79E-03	1.00E+00	a	2.79E-03	no	---	---	no
Pesticides/PCBs (mg/kg)								
Alpha-Chlordane	9.14E-02	2.70E-01	ab	3.39E-01	no	---	---	no
DDE	5.05E-04	1.10E-01	ab	4.59E-03	no	---	---	no
Gamma-Chlordane	6.43E-02	2.20E+00	ab	2.92E-02	no	---	---	no
Aroclor 1242	3.02E-02	4.10E-02	ab	7.37E-01	no	---	---	no
Aroclor 1254	2.70E-02	1.40E-02	a	1.93E+00	YES	---	---	YES
Aroclor 1260	5.80E-03	8.80E-01	ab	6.59E-03	no	---	---	no
Radionuclides (pCi/g)								
Actinium-228	1.86E+00	---	---	---	---	1.95E+00	no	no
Bismuth-214	9.05E-01	---	---	---	---	2.24E+00	no	no
Lead-212	1.69E+00	---	---	---	---	2.19E+00	no	no
Lead-214	1.05E+00	---	---	---	---	---	---	YES
Potassium-40	2.07E+00	---	---	---	---	2.33E+00	no	no
Thallium-208	5.49E-01	---	---	---	---	---	---	YES
Tritium	1.11E+01	3.60E+04	b	3.08E-04	no	---	---	no
Radium-226	1.05E+00	1.50E+00	b	7.00E-01	no	1.37E+00	no	no
Radium-228	1.74E+00	1.20E+00	b	1.45E+00	YES	1.92E+00	no	no
Thorium-228	1.51E+00	4.30E+01	b	3.51E-02	no	1.97E+00	no	no
Thorium-230	8.35E-01	5.20E+01	b	1.61E-02	no	1.13E+00	no	no
Thorium-232	1.54E+00	6.20E+00	b	2.48E-01	no	1.80E+00	no	no

Table D-11. Screening Level Evaluation for Effluent Discharge Subunit (Soil 1-4 ft) (cont.)

Analyte	Detected Maximum Concentration[1]	GOSB ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ>1)?	2x Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Uranium-233/-234	9.52E-01	4.40E+02	b	2.16E-03	no	1.15E+00	no	no
Uranium-235	1.69E-01	4.40E+02	b	3.84E-04	no	7.98E-02	YES	no
Uranium-238	8.10E-01	4.00E+02	b	2.03E-03	no	1.01E+00	no	no

1 - Maximum detected concentration from Appendix A Table A.4.2 Effluent Discharge Subunit (1-4 ft)
2 - GOSB ESV from attachment D-1 Table II.A.
3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Los Alamos National Laboratory No Effect ESL for Soil Media
4 - Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5 - Background screening values obtained from the Background Soils Statistical Summary Report for the Savannah River Site, ERD-EN-2005-0223, Rev. 1, October 2006 Appendix B-1 (0-1 ft interval).
6 - COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ>1), if available, and exceeds 2X average background concentration
7 - Essential nutrient, not subject to further evaluation

Table D-12. Refinement Level Evaluation for Effluent Discharge Subunit (Soil 1-4 ft)

Analyte[1]	Exposure Point Concentration[2]	GOSB RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ>1)?	COPC?[6]
Inorganics (mg/kg)						
Aluminum	1.33E+04	---	---	---	---	YES
Arsenic	8.51E+00	6.80E+01	b	1.25E-01	no	no
Iron	2.56E+04	---	---	---	---	YES
Lead	1.40E+01	2.80E+01	b	5.01E-01	no	no
Manganese	5.37E+02	1.10E+03	b	4.88E-01	no	no
Selenium	2.38E+00	3.00E+00	b	7.93E-01	no	no
Vanadium	5.32E+01	1.30E+01	b	4.09E+00	YES	YES
Organics (mg/kg)						
Methyl Acetate	1.40E-02	---	---	---	---	YES
Chloromethane (Methyl Chloride)	5.30E-04	---	---	---	---	YES
Pesticides/PCBs (mg/kg)						
Aroclor 1254	2.70E-02	4.10E-01	b	6.59E-02	no	no
Radionuclides (pCi/g)						
Lead-214	1.05E+00	---	---	---	---	YES
Thallium-208	5.49E-01	---	---	---	---	YES

1 - Analytes identified as COPECs from Table D-11

2 - EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A Table A.4.2 Effluent Discharge Subunit (1-4 ft)

3 - GOSB RSV from Attachment D-1 Table II.B

4: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

4: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

5 - Refinement Level Hazard Quotient (HQ) = EPC / RSV

6 - COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ>1

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Attachment D-1.

Derivation of GOSB ESVs and RSVs

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Derivation of GOSB ESVs and RSVs
I. SEDIMENT MEDIA
A. Screening Level (No Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Sediment[1]	EPA R4 Soil[2]	LANL Sediment[3]	LANL Soil[4]	GOSB ESV[5]
1,2-Dichlorobenzene	8.80E-02	9.00E-02	---	9.20E-01	8.80E-02
1,3-Dichlorobenzene	8.30E-02	1.00E-01	---	7.30E-01	8.30E-02
1,4-Dichlorobenzene	3.50E-02	8.80E-01	3.00E-02	8.80E-01	3.00E-02
2-Methylnaphthalene[6]	1.61E+00	2.90E+01	7.60E-02	1.60E+01	7.60E-02
Acetone	4.00E-02	1.20E+00	6.50E-02	1.20E+00	4.00E-02
Actinium-228	---	---	---	---	---
Aldrin	2.90E-02	3.70E-02	---	3.70E-02	2.90E-02
Alpha-chlordane[7]	3.24E-03	2.70E+00	3.20E-03	2.70E-01	3.20E-03
Aluminum	2.50E+04	---	---	---	2.50E+04
Anthracene[6]	1.61E+00	2.90E+01	5.70E-02	6.80E+00	5.70E-02
Antimony	2.00E+00	2.70E-01	5.00E+01	2.40E+00	2.70E-01
Arsenic	9.80E+00	1.80E+01	9.70E+00	6.80E+00	6.80E+00
Barium	2.00E+01	3.30E+02	1.50E+02	1.10E+02	2.00E+01
Benzo(g,h,i)perylene[8]	1.61E+00	1.10E+00	1.70E-01	2.40E+01	1.70E-01
Benzo[a]anthracene[8]	1.61E+00	1.10E+00	1.00E-01	8.00E-01	1.00E-01
Benzo[a]pyrene[8]	1.61E+00	1.10E+00	1.50E-01	5.30E+01	1.50E-01
Benzo[b]fluoranthene[8]	1.61E+00	1.10E+00	1.90E-01	1.80E+01	1.90E-01
Bismuth-214	---	---	---	---	---
Cadmium	1.00E+00	3.60E-01	3.30E-01	2.70E-01	2.70E-01
Calcium	---	---	---	---	---
Caprolactam	---	---	---	---	---
Carbon Disulfide	3.60E-03	5.00E-03	---	8.20E-01	3.60E-03
Cesium-137[9]	---	---	7.20E+02	1.20E+03	7.20E+02
Chlorobenzene	5.80E-02	2.40E+00	---	---	5.80E-02
Chromium	4.34E+01	2.80E+01	4.30E+01	2.80E+01	2.80E+01
Chrysene[8]	1.61E+00	1.10E+00	1.60E-01	2.40E+00	1.60E-01
Cobalt	5.00E+01	1.30E+01	2.30E+02	1.30E+01	1.30E+01
Copper	3.16E+01	2.80E+01	2.30E+01	1.50E+01	1.50E+01
Cumene (Isopropylbenzene)	3.30E-02	4.00E-02	---	---	3.30E-02
Cyanide	---	1.00E-01	1.00E-01	1.00E-01	1.00E-01
DDD	1.22E-03	6.30E-03	---	6.30E-03	1.22E-03
DDE	2.07E-03	1.10E-01	3.10E-03	1.10E-01	2.07E-03
DDT	1.19E-03	4.40E-02	4.10E-03	4.40E-02	1.19E-03
Dieldrin	3.00E-04	4.90E-03	1.90E-03	4.50E-03	3.00E-04
Ethylbenzene	2.72E-01	2.70E-01	---	---	2.70E-01
Fluoranthene[8]	1.61E+00	1.10E+00	4.20E-01	1.00E+01	4.20E-01
Fluorene[6]	1.61E+00	2.90E+01	7.70E-02	3.70E+00	7.70E-02

Derivation of GOSB ESVs and RSVs
I. SEDIMENT MEDIA
A. Screening Level (No Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Sediment[1]	EPA R4 Soil[2]	LANL Sediment[3]	LANL Soil[4]	GOSB ESV[5]
Gamma-chlordane	3.24E-03[7]	2.20E+00	3.20E-03	2.20E+00	3.20E-03
Heptachlor	1.90E-03	5.90E-02	2.40E-03	5.90E-02	1.90E-03
Heptachlor epoxide	2.47E-03	4.00E-04	---	---	4.00E-04
Indeno[1,2,3-cd]pyrene[8]	1.61E+00	1.10E+00	2.00E-01	6.20E+01	2.00E-01
Iron	2.00E+04	---	2.00E+04	---	2.00E+04
Lead	3.58E+01	1.10E+01	2.70E+01	1.40E+01	1.10E+01
Lead-212	---	---	---	---	---
Lead-214	---	---	---	---	---
m,p-Xylene[10]	1.03E-01	1.00E-01	1.30E-01	1.40E+00	1.00E-01
Magnesium	---	---	---	---	---
Manganese	4.60E+02	2.20E+02	4.60E+02	2.20E+02	2.20E+02
Mercury	1.80E-01	5.10E-04[11]	4.60E-04[11]	3.50E-04[11]	3.50E-04[11]
Methyl ethyl ketone	9.92E-01	1.00E+00	3.30E+03	3.60E+02	9.92E-01
Methylcyclohexane	---	---	---	---	---
Nickel	2.27E+01	3.80E+01	1.30E+01	9.70E+00	9.70E+00
Phenanthrene[6]	1.61E+00	2.90E+01	2.00E-01	5.50E+00	2.00E-01
Potassium	---	---	---	---	---
Potassium-40	---	---	---	---	---
Pyrene[8]	1.61E+00	1.10E+00	1.90E-01	1.00E+01	1.90E-01
Silver	1.00E+00	4.20E+00	5.00E-01	2.60E+00	5.00E-01
Sodium	---	---	---	---	---
Thallium	---	2.20E-01	8.20E-01	5.00E-02	5.00E-02
Thallium-208	---	---	---	---	---
Toluene	1.45E-01	1.50E-01	1.00E-02	2.30E+01	1.00E-02
Vanadium	---	7.80E+00	3.00E+01	6.70E+00	6.70E+00
Zinc	1.21E+02	4.60E+01	6.50E+01	4.80E+01	4.60E+01

1 - Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (ESV, Attachment D-2)
2 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)
3 - Los Alamos National Laboratory No Effect ESL for Sediment Media (Attachment D-3)
4 - Los Alamos National Laboratory No Effect ESL for Soil Media (Attachment D-3)
5 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
6 - Values for EPA Region 4 sediment are for total PAHs; values for EPA Region 4 soil are for total Low Molecular Weight PAHs
7 – Value is for "Chlordane" (not specified as Alpha or Gamma)
8 - Values for EPA Region 4 sediment are for total PAHs; values for EPA Region 4 soil are for total High Molecular Weight PAHs
9 – Screening value is for Cesium-137 + Barium-137
10 – Values are for "Xylenes"
11 – Value is the lowest of the available mercury screening values (methylmercury)

Derivation of GOSB ESVs and RSVs
I. SEDIMENT MEDIA
B. Refinement Level (Low Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Sediment[1]	EPA R4 Soil[2]	LANL Sediment[3]	LANL Soil[4]	GOSB RSV[5]
1,2-Dichlorobenzene	---	NA	---	9.20E+00	9.20E+00
1,3-Dichlorobenzene	---	NA	---	7.30E+00	7.30E+00
1,4-Dichlorobenzene	---	NA	3.00E-01	3.50E+00	3.00E-01
2-Methylnaphthalene	4.47E-01	NA	7.60E-01	1.60E+02	4.47E-01
Acetone	---	NA	6.50E-01	6.30E+00	6.50E-01
Actinium-228	---	---	---	---	---
Aldrin	---	NA	---	1.80E-01	1.80E-01
Alpha-chlordane	1.76E-02[6]	NA	1.70E-02	2.70E+00	1.70E-02
Aluminum	5.80E+04	---	---	---	5.80E+04
Anthracene	5.94E-01	NA	5.70E-01	9.00E+00	5.70E-01
Antimony	2.50E+01	NA	5.00E+02	2.40E+01	2.40E+01
Arsenic	3.30E+01	NA	3.30E+01	6.80E+01	3.30E+01
Barium	6.00E+01	NA	3.00E+02	2.60E+02	6.00E+01
Benzo(g,h,i)perylene	1.10E+00	NA	1.70E+00	2.40E+02	1.10E+00
Benzo[a]anthracene	8.41E-01	NA	1.00E+00	8.00E+00	8.41E-01
Benzo[a]pyrene	9.65E-01	NA	1.40E+00	1.70E+02	9.65E-01
Benzo[b]fluoranthene	9.79E-01	NA	1.90E+00	1.80E+02	9.79E-01
Bismuth-214	---	---	---	---	---
Cadmium	5.00E+00	NA	3.30E+00	2.70E+00	2.70E+00
Calcium	---	---	---	---	---
Caprolactam	---	---	---	---	---
Carbon Disulfide	---	NA	---	8.20E+00	8.20E+00
Cesium-137[7]	---	---	7.20E+03	1.20E+04	7.20E+03
Chlorobenzene	---	NA	3.00E-01	2.40E+01	3.00E-01
Chromium	1.11E+02	NA	1.10E+02	2.80E+02	1.10E+02
Chrysene	8.44E-01	NA	1.20E+00	2.40E+01	8.44E-01
Cobalt	---	NA	2.30E+03	1.30E+02	1.30E+02
Copper	1.49E+02	NA	7.00E+01	4.60E+01	4.60E+01
Cumene (Isopropylbenzene)	---	NA	---	---	---
Cyanide	---	---	1.00E+00	1.00E+00	1.00E+00
DDD	7.81E-03	NA	---	3.30E-02	7.81E-03
DDE	3.74E-03	NA	3.10E-02	5.50E-01	3.74E-03
DDT	4.77E-03	NA	4.10E-02	2.20E-01	4.77E-03
Dieldrin	9.30E-03	NA	1.90E-02	9.00E-03	9.00E-03
Ethylbenzene	---	NA	---	---	---
Fluoranthene	7.07E-01	NA	2.20E+00	2.30E+01	7.07E-01
Fluorene	5.38E-01	NA	5.30E-01	1.90E+01	5.30E-01

Derivation of GOSB ESVs and RSVs
I. SEDIMENT MEDIA
B. Refinement Level (Low Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Sediment[1]	EPA R4 Soil[2]	LANL Sediment[3]	LANL Soil[4]	GOSB RSV[5]
Gamma-chlordane	1.76E-02[6]	NA	1.70E-02	2.20E+01	1.70E-02
Heptachlor	---	NA	1.60E-02	5.90E-01	1.60E-02
Heptachlor epoxide	1.60E-02	NA	---	---	1.60E-02
Indeno[1,2,3-cd]pyrene	1.12E+00	NA	2.00E+00	6.20E+02	1.12E+00
Iron	4.00E+04	---	4.00E+04	---	4.00E+04
Lead	1.28E+02	NA	5.40E+01	2.80E+01	2.80E+01
Lead-212	---	---	---	---	---
Lead-214	---	---	---	---	---
m,p-Xylene	---	NA	1.30E+00	1.70E+00	1.30E+00
Magnesium	---	---	---	---	---
Manganese	1.10E+03	NA	1.10E+03	1.10E+03	1.10E+03
Mercury	1.10E+00	NA	4.60E-03[8]	3.50E-03[8]	3.50E-03[8]
Methyl ethyl ketone	---	NA	8.70E+03	9.30E+02	9.30E+02
Methylcyclohexane	---	---	---	---	---
Nickel	4.86E+01	NA	2.70E+01	1.90E+01	1.90E+01
Phenanthrene	5.96E-01	NA	1.10E+00	1.20E+01	5.96E-01
Potassium	---	---	---	---	---
Potassium-40	---	---	---	---	---
Pyrene	6.97E-01	NA	1.50E+00	2.00E+01	6.97E-01
Silver	2.20E+00	NA	5.00E+00	2.60E+01	2.20E+00
Sodium	---	---	---	---	---
Thallium	---	NA	8.20E+00	5.00E-01	5.00E-01
Thallium-208	---	---	---	---	---
Toluene	---	NA	1.00E-01	2.30E+02	1.00E-01
Vanadium	---	NA	6.10E+01	1.30E+01	1.30E+01
Zinc	4.59E+02	NA	6.50E+02	4.80E+02	4.59E+02

1 - Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (RSV, Attachment D-2)
2 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)
3 - Los Alamos National Laboratory No Effect ESL for Sediment Media (Attachment D-3)
4 - Los Alamos National Laboratory No Effect ESL for Soil Media (Attachment D-3)
5 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
6 – Value is for "Chlordane" (not specified as Alpha or Gamma)
7 – Screening value is for Cesium-137 + Barium-137
8 – Value is the lowest of the available mercury screening values (methylmercury)

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA
A. Screening Level (No Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB ESV[3]
Acenaphthene[4]	2.90E+01	2.50E-01	2.50E-01
Acenaphthylene[4]	2.90E+01	1.20E+02	2.90E+01
Acetone	1.20E+00	1.20E+00	1.20E+00
Actinium-228	---	---	---
Alpha-benzene hexachloride (BHC)	3.40E-01	5.80E+01	3.40E-01
Alpha-chlordane	2.70E-01	2.70E+00	2.70E-01
Aluminum	---	---	---
Anthracene[4]	2.90E+01	6.80E+00	6.80E+00
Aroclor 1242	4.10E-02	4.10E-02	4.10E-02
Aroclor 1254	1.40E-02	4.10E-02	1.40E-02
Aroclor 1260	8.80E-01	8.80E-01	8.80E-01
Arsenic	1.80E+01	6.80E+00	6.80E+00
Barium	3.30E+02	1.10E+02	1.10E+02
Barium-133	---	---	---
Benzene	1.20E-01	2.40E+01	1.20E-01
Benzo(g,h,i)perylene[5]	1.10E+00	2.40E+01	1.10E+00
Benzo[a]anthracene[5]	1.10E+00	8.00E-01	8.00E-01
Benzo[a]pyrene[5]	1.10E+00	5.30E+01	1.10E+00
Benzo[b]fluoranthene[5]	1.10E+00	1.80E+01	1.10E+00
Benzo[k]fluoranthene[5]	1.10E+00	6.20E+01	1.10E+00
Beryllium	1.00E+01	2.50E+00	2.50E+00
Beta-benzene hexachloride (BHC)	2.70E-01	2.70E-01	2.70E-01
Bis(2-ethylhexyl)phthalate	2.00E-02	2.00E-02	2.00E-02
Bismuth-214	---	---	---
Cadmium	3.60E-01	2.70E-01	2.70E-01
Calcium	---	---	---
Caprolactam	---	---	---
Carbazole	1.60E-01	8.00E+01	1.60E-01
Carbon Disulfide	5.00E-03	8.20E-01	5.00E-03
Cesium-137[6]	---	1.20E+03	1.20E+03
Chloroform	5.00E-02	8.00E+00	5.00E-02
Chloromethane (Methyl Chloride)	---	---	---
Chromium	2.80E+01	2.80E+01	2.80E+01
Chrysene	1.10E+00	2.40E+00	1.10E+00
Cobalt	1.30E+01	1.30E+01	1.30E+01
Copper	2.80E+01	1.50E+01	1.50E+01

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA
A. Screening Level (No Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB ESV[3]
Cumene (Isopropylbenzene)	4.00E-02	---	4.00E-02
Cyanide	1.00E-01	1.00E-01	1.00E-01
DDD	6.30E-03	6.30E-03	6.30E-03
DDE	1.10E-01	1.10E-01	1.10E-01
DDT	4.40E-02	4.40E-02	4.40E-02
Dieldrin	4.90E-03	4.50E-03	4.50E-03
Endosulfan sulfate	6.50E-03	---	6.50E-03
Endrin	1.40E-03	1.40E-03	1.40E-03
Endrin ketone	---	---	---
Fluoranthene	1.10E+00	1.00E+01	1.10E+00
Gamma-chlordane	2.20E+00	2.20E+00	2.20E+00
Heptachlor epoxide	4.00E-04	---	4.00E-04
Indeno[1,2,3-cd]pyrene[5]	1.10E+00	6.20E+01	1.10E+00
Iron	---	---	---
Lead	1.10E+01	1.40E+01	1.10E+01
Lead-212	---	---	---
Lead-214	---	---	---
m,p-Xylene[7]	1.00E-01	1.40E+00	1.00E-01
Magnesium	---	---	---
Manganese	2.20E+02	2.20E+02	2.20E+02
Mercury	5.10E-04[8]	3.50E-04[8]	3.50E-04[8]
Methyl acetate	---	---	---
Methyl ethyl ketone	1.00E+00	3.60E+02	1.00E+00
Nickel	3.80E+01	9.70E+00	9.70E+00
Phenanthrene	2.90E+01	5.50E+00	5.50E+00
Potassium	---	---	---
Potassium-40	---	---	---
Pyrene	1.10E+00	1.00E+01	1.10E+00
Radium-226	---	1.50E+00	1.50E+00
Radium-228	---	1.20E+00	1.20E+00
Selenium	5.20E-01	5.20E-01	5.20E-01
Silver	4.20E+00	2.60E+00	2.60E+00
Sodium	---	---	---
Styrene	1.20E+00	1.20E+00	1.20E+00
Thallium	2.20E-01	5.00E-02	5.00E-02
Thallium-208	---	---	---

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA

A. Screening Level (No Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB ESV[3]
Thorium-228	---	4.30E+01	4.30E+01
Thorium-230	---	5.20E+01	5.20E+01
Thorium-232	---	6.20E+00	6.20E+00
Toluene	1.50E-01	2.30E+01	1.50E-01
Tritium	---	3.60E+04	3.60E+04
Uranium-233 and Uranium-234[9]	---	4.40E+02	4.40E+02
Uranium-235	---	4.40E+02	4.40E+02
Uranium-238	---	4.00E+02	4.00E+02
Vanadium	7.80E+00	6.70E+00	6.70E+00
Zinc	4.60E+01	4.80E+01	4.60E+01

1 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)

2 - Los Alamos National Laboratory No Effect ESL for Soil Media (Attachment D-3)

3 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow

4 - Values for EPA Region 4 soil are for total Low Molecular Weight PAHs

5 - Values for EPA Region 4 soil are for total High Molecular Weight PAHs

6 – Screening value is for Cesium-137 + Barium-137

7 – Values are for “Xylenes”

8 – Value is the lowest of the available mercury screening values (methylmercury)

9 – Screening value is for Uranium-234.

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA
B. Refinement Level (Low Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB RSV[3]
Acenaphthene	---	---	---
Acenaphthylene	---	---	---
Acetone	NA	6.30E+00	6.30E+00
Actinium-228	---	---	---
Alpha-benzene hexachloride (BHC)	---	5.80E+02	5.80E+02
Alpha-chlordane	---	2.70E+00	2.70E+00
Aluminum	---	---	---
Anthracene	NA	9.00E+00	9.00E+00
Aroclor 1242	NA	4.10E-01	4.10E-01
Aroclor 1254	NA	4.10E-01	4.10E-01
Aroclor 1260	NA	1.20E+00	1.20E+00
Arsenic	NA	6.80E+01	6.80E+01
Barium	NA	2.60E+02	2.60E+02
Barium-133	---	---	---
Benzene	NA	2.40E+02	2.40E+02
Benzo(g,h,i)perylene	---	2.40E+02	2.40E+02
Benzo[a]anthracene	NA	8.00E+00	8.00E+00
Benzo[a]pyrene	NA	1.70E+02	1.70E+02
Benzo[b]fluoranthene	NA	1.80E+02	1.80E+02
Benzo[k]fluoranthene	---	6.20E+02	6.20E+02
Beryllium	NA	2.50E+01	2.50E+01
Beta-benzene hexachloride (BHC)	---	1.30E+00	1.30E+00
Bis(2-ethylhexyl)phthalate	---	2.00E-01	2.00E-01
Bismuth-214	---	---	---
Cadmium	NA	2.70E+00	2.70E+00
Calcium	---	---	---
Caprolactam	---	---	---
Carbazole	---	8.00E+02	8.00E+02
Carbon Disulfide	NA	8.20E+00	8.20E+00
Cesium-137[4]	---	1.20E+04	1.20E+04
Chloroform	NA	2.20E+01	2.20E+01
Chloromethane (Methyl Chloride)	---	---	---
Chromium	NA	2.80E+02	2.80E+02
Chrysene	NA	2.40E+01	2.40E+01
Cobalt	NA	1.30E+02	1.30E+02
Copper	NA	4.60E+01	4.60E+01
Cumene (Isopropylbenzene)	NA	---	---

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA
B. Refinement Level (Low Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB RSV[3]
Cyanide	NA	1.00E+00	1.00E+00
DDD	NA	3.30E-02	3.30E-02
DDE	NA	5.50E-01	5.50E-01
DDT	NA	2.20E-01	2.20E-01
Dieldrin	NA	9.00E-03	9.00E-03
Endosulfan sulfate	---	---	---
Endrin	---	1.40E-02	1.40E-02
Endrin ketone	---	---	---
Fluoranthene	NA	2.30E+01	2.30E+01
Gamma-chlordane	NA	2.20E+01	2.20E+01
Heptachlor epoxide	NA	---	---
Indeno[1,2,3-cd]pyrene	NA	6.20E+02	6.20E+02
Iron	---	---	---
Lead	NA	2.80E+01	2.80E+01
Lead-212	---	---	---
Lead-214	---	---	---
m,p-Xylene[5]	NA	1.70E+00	1.70E+00
Magnesium	---	---	---
Manganese	NA	1.10E+03	1.10E+03
Mercury	NA	3.50E-03[6]	3.50E-03[6]
Methyl acetate	---	---	---
Methyl ethyl ketone	NA	9.00E+02	9.00E+02
Nickel	NA	1.90E+01	1.90E+01
Phenanthrene	NA	1.20E+01	1.20E+01
Potassium	---	---	---
Potassium-40	---	---	---
Pyrene	NA	2.00E+01	2.00E+01
Radium-226	---	1.50E+01	1.50E+01
Radium-228	---	1.20E+01	1.20E+01
Selenium	NA	3.00E+00	3.00E+00
Silver	NA	2.60E+01	2.60E+01
Sodium	---	---	---
Styrene	NA	1.20E+01	1.20E+01
Thallium	NA	5.00E-01	5.00E-01
Thallium-208	---	---	---
Thorium-228	---	4.30E+02	4.30E+02

Derivation of GOSB ESVs and RSVs
II. SOIL MEDIA
B. Refinement Level (Low Effect Screening Level)

Analyte (mg/kg, pCi/g)	EPA R4 Soil[1]	LANL Soil[2]	GOSB RSV[3]
Thorium-230	---	5.20E+02	5.20E+02
Thorium-232	---	6.20E+01	6.20E+01
Toluene	NA	2.30E+02	2.30E+02
Tritium	---	3.60E+05	3.60E+05
Uranium-233 and Uranium-234[7]	---	4.40E+03	4.40E+03
Uranium-235	---	4.40E+03	4.40E+03
Uranium-238	---	4.00E+03	4.00E+03
Vanadium	NA	1.30E+01	1.30E+01
Zinc	NA	4.80E+02	4.80E+02

1 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)

2 - Los Alamos National Laboratory Low Effect ESL for Soil Media (Attachment D-3)

3 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow

4 – Screening value is for Cesium-137 + Barium-137

5 – Values are for "Xylenes"

6 – Value is the lowest of the available mercury screening values (methylmercury)

7 – Screening value is for Uranium-234.

Derivation of GOSB ESVs and RSVs
III. SURFACE WATER MEDIA
A. Screening Level (Chronic/No Effect Screening Level)

Analyte (µg/L, pCi/L)	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	GOSB ESV[4]
Acetone	---	1.70E+03	1.50E+03	1.50E+03
Alpha-Benzene Hexachloride (BHC)	---	---	---	---
Alpha-chlordane	4.30E-03[5]	4.30E-03[5]	4.30E-03	4.30E-03
Aluminum	---	8.70E+01	5.30E+02	8.70E+01
Antimony	---	1.90E+02	3.00E+01	3.00E+01
Barium	---	2.20E+02	3.90E+00	3.90E+00
Beryllium	---	1.10E+01	6.60E-01	6.60E-01
Beta-Benzene Hexachloride (BHC)	---	4.60E-02	2.20E+00	4.60E-02
Bismuth-214	---	---	---	---
Cadmium	1.00E-01	2.50E-01	2.80E-01	1.00E-01
Calcium	---	1.16E+05	---	1.16E+05
Caprolactam	---	---	---	---
Chromium	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Cobalt	---	1.90E+01	3.00E+00	3.00E+00
Copper	2.90E+00	9.00E+00	5.00E+00	2.90E+00
Cyanide	5.20E+00	5.20E+00	5.20E+00	5.20E+00
DDD	---	1.10E-02	---	1.10E-02
DDE	---	4.10E-01	1.00E+02	4.10E-01
DDT	1.00E-03	3.20E-03	1.00E-03	1.00E-03
Dieldrin	5.60E-02	5.60E-02	5.60E-02	5.60E-02
Gamma-chlordane	4.30E-03[5]	4.30E-03[5]	4.30E-03	4.30E-03
Iron	---	1.00E+03	1.00E+03	1.00E+03
Lead	5.40E-01	2.50E+00	1.00E+00	5.40E-01
Lead-214	---	---	---	---
Magnesium	---	8.20E+04	---	8.20E+04
Manganese	---	9.30E+01	1.30E+03	9.30E+01
Mercury	9.10E-01	1.30E-03[6]	2.80E-03[7]	1.30E-03[6]
Nickel	1.60E+01	5.20E+01	2.90E+01	1.60E+01
Potassium	---	5.30E+04	---	5.30E+04
Silver	---	6.00E-02	1.00E-01	6.00E-02

Derivation of GOSB ESVs and RSVs
III. SURFACE WATER MEDIA

A. Screening Level (Chronic/No Effect Screening Level)

Analyte (µg/L, pCi/L)	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	GOSB ESV[4]
Sodium	---	6.80E+05	---	6.80E+05
Toluene	---	6.20E+01	9.80E+00	9.80E+00
Tritium	---	---	1.60E+08	1.60E+08
Vanadium	---	2.70E+01	1.90E+01	1.90E+01
Zinc	3.70E+01	1.20E+02	6.50E+01	3.70E+01

1 - SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014) (Attachment D-4)
2 - Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)
3 - Los Alamos National Laboratory for No Effect ESL for Surface Water Media (Attachment D-3)
4 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
5 - Value is for chlordane (gamma chlordane not specified)
6 - Value is the lowest of the available mercury screening values (wildlife based)
7 - Value is the lowest of the available mercury screening values (methylmercury)

Derivation of GOSB ESVs and RSVs
III. SURFACE WATER MEDIA
B. Refinement Level (Chronic/Low Effect Screening Level)

Analyte (µg/L, pCi/L)	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	GOSB RSV[4]
Acetone	---	1.70E+03	1.50E+03	1.50E+03
Alpha-Benzene Hexachloride (BHC)	---	---	---	---
Alpha-chlordane	4.30E-03[5]	4.30E-03[5]	4.30E-03	4.30E-03
Aluminum	---	8.70E+01	5.30E+02	8.70E+01
Antimony	---	1.90E+02	3.00E+01	3.00E+01
Barium	---	2.20E+02	3.90E+00	3.90E+00
Beryllium	---	1.10E+01	6.60E-01	6.60E-01
Beta-Benzene Hexachloride (BHC)	---	4.60E-02	2.20E+00	4.60E-02
Bismuth-214	---	---	---	---
Cadmium	1.00E-01	2.50E-01	2.80E-01	1.00E-01
Calcium	---	1.16E+05	---	1.16E+05
Caprolactam	---	---	---	---
Chromium	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Cobalt	---	1.90E+01	3.00E+00	3.00E+00
Copper	2.90E+00	9.00E+00	5.00E+00	2.90E+00
Cyanide	5.20E+00	5.20E+00	5.20E+00	5.20E+00
DDD	---	1.10E-02	---	1.10E-02
DDE	---	4.10E-01	1.00E+02	4.10E-01
DDT	1.00E-03	3.20E-03	1.00E-03	1.00E-03
Dieldrin	5.60E-02	5.60E-02	5.60E-02	5.60E-02
Gamma-chlordane	4.30E-03[5]	4.30E-03[5]	4.30E-03	4.30E-03
Iron	---	1.00E+03	1.00E+03	1.00E+03
Lead	5.40E-01	2.50E+00	1.00E+00	5.40E-01
Lead-214	---	---	---	---
Magnesium	---	8.20E+04	---	8.20E+04
Manganese	---	9.30E+01	1.30E+03	9.30E+01
Mercury	9.10E-01	1.30E-03[6]	2.80E-03[7]	1.30E-03[6]
Nickel	1.60E+01	5.20E+01	2.90E+01	1.60E+01
Potassium	---	5.30E+04	---	5.30E+04
Silver	---	6.00E-02	1.00E-01	6.00E-02

Derivation of GOSB ESVs and RSVs
III. SURFACE WATER MEDIA
B. Refinement Level (Chronic/Low Effect Screening Level)

Analyte (µg/L, pCi/L)	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	GOSB RSV[4]
Sodium	---	6.80E+05	---	6.80E+05
Toluene	---	6.20E+01	9.80E+00	9.80E+00
Tritium	---	---	1.60E+09	1.60E+09
Vanadium	---	2.70E+01	1.90E+01	1.90E+01
Zinc	3.70E+01	1.20E+02	6.50E+01	3.70E+01

1 - SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014) (Attachment D-4)
2 - Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015) (Attachment D-2)
3 - Los Alamos National Laboratory for No Effect ESL for Surface Water Media (Attachment D-3)
4 - G-Area Oil Seepage Basin Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
5 - Value is for "Chlordane" (not specified as Gamma)
6 - Value is the lowest of the available mercury screening values (wildlife based)
7 - Value is the lowest of the available mercury screening values (methylmercury)

Attachment D-2.

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

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EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Inorganic Compounds							
Metals							
Aluminum (pH 6.5 -9.0)	7429-90-5	87	750	a	1,900	3,288	c
Antimony	7440-36-0	190	900	b	30	180	c
Arsenic (unfiltered) ^	7440-38-2	150	340	a	36	69	a
Arsenic III (unfiltered) ^	22541-54-4	148	340	b	36	69	f
Barium	7440-39-3	220	2,000	b			
Beryllium	7440-41-7	11	93	b	0.66	35	c
Boron	7440-42-8	7,200	34,000	b	1,000		l
Cadmium (unfiltered) ^ *	7740-43-9	0.25	2	a	8.8	40	a
Calcium	7440-70-2	116,000	-	c	116,000		c
Chromium III (unfiltered) ^ *	16065-83-1	74	570	a	20		e
Chromium VI (unfiltered) ^	18540-29-9	11	16	a	50	1,100	a
Cobalt	7440-48-4	19	120	b	23	1,500	c
Copper (unfiltered) ^ *	7740-50-8	9	13	a	3.1	4.8	a
Iron	7439-89-6	1,000		a			
Lead (unfiltered) ^ *	7439-92-1	2.5	65	a	8.1	210	a
Lithium	7439-93-2	440	910	b	14	260	c
Magnesium	7439-95-4	82,000		c	82,000		c
Manganese	7439-96-5	93	1,680	b	120	2,300	d, c
Mercury (unfiltered) ^ (aquatic)	7439-97-6	0.77	1.4	a	0.94	1.8	a
Mercury (wildlife based)	7439-97-6	0.0013	0.012	b, a	0.00053	0.025	a
Methylmercury (aquatic life)	22967-92-6	0.0028	0.099	c	0.0028	0.099	c
Molybdenum	7439-98-7	800	7,200	b	370	16,000	c
Nickel (unfiltered) ^ *	7440-02-0	52	470	a	8.2	74	a
Phosphorus (elemental)	7723-14-0	1,000		m	100		d
Potassium	7440-09-7	53,000		c	53,000		c
Selenium (unfiltered) ^ (aquatic)	7782-49-2	5	20	a	71	290	a
Silver (unfiltered) ^ *	7740-22-4	0.06	3.2	b	0.1	1.9	e, a
Sodium	7440-23-5	680,000		c	680,000		c
Strontium	7440-24-6	5,300	48,000	b	1,500	15,000	c
Thallium	7740-28-0	6	54	b	12	110	c
Tin	7440-31-5	180	1,600	b	73	2,700	c
Uranium	7440-61-1	2.6	46	c	2.6	46	c
Vanadium	7440-62-2	27	79	b	20	280	c
Zinc (unfiltered) ^ *	7740-66-6	120	120	a	81	90	a
Zirconium	7440-67-7	17	310	c	17	310	c
Other Inorganics							
Chloride	16887-00-6	230,000	860,000	a			
Chlorine	7782-50-5	11	19	a	7.5	13	a
Cyanide (free)	57-12-5	5.2	22	a	1	1	a
Fluorides	16984-48-8	2,700	9,800	b	5,000		d
Hydrogen sulfide (S^{2-}, HS^-)	7783-06-4	2	3.2	a	2		a
Sulfite	14265-45-3	200		b			
Volatile Organic Compounds (VOCs)							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	85	770	b	10.8		d
1,1,2,2-Tetrachloroethane	79-34-5	200	910	b	610	2,100	c
1,1,1-Trichloroethane	71-55-6	76	690	b	11	200	c
1,1,2-Trichloroethane	79-00-5	730	3,200	b	1,200	5,200	c
1,1-Dichloroethane	75-34-3	410	3,700	b	47	830	c
1,2-Dichloroethane	107-06-2	2,000	8,200	b	910	8,800	c
1,2-Dichloropropane	78-87-5	520	3,300	b		3,400	g
Dichloromethane (Methylene chloride)	75-09-2	1,500	8,500	b	2,200	26,000	c
Trichloromethane (Chloroform)	67-66-3	140	1,300	b	28	490	c
Tetrachloromethane (Carbon tetrachloride)	56-23-5	77	690	b	9.8	180	c

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	130	1,200	b	25	450	c
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	970	8,800	b	590	1,100	c
1,2-cis-Dichloroethyene	156-59-2	620	5,500	b			
1,2-trans-Dichloroethylene	156-60-5	558	10,046	b			
1,3-Dichloropropene (cis and trans)	542-75-6	1.7	15	b	0.06	0.99	c
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	53	430	b	98	830	c
1,1,2-Trichloroethylene (TCE)	79-01-6	200	2,000	b	47	440	c
Chloroethene (Vill chloride)	75-01-4	930	8,400	b			
Chlorobenzenes							
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
1,2-Dichlorobenzene	95-50-1	23	130	b	14	260	c
1,3-Dichlorobenzene	541-73-1	22	79	b	71	630	c
1,4-Dichlorobenzene	106-46-7	9.4	57	b	15	180	c
1,2,3-Trichlorobenzene	87-61-6	5	195	l, i	5		l
1,2,4-Trichlorobenzene	120-82-1	130	420	b	110	700	c
1,3,5-Trichlorobenzene	108-70-3	5	195	l, i	5		l
Trichlorobenzene (mixed isomers)	12002-48-1	5	555	b, i	5		l
Monoaromatic hydrocarbons							
1,2,4-Trimethylbenzene	95-63-6	15	140	b			
1,3,5-Trimethylbenzene	108-67-8	26	230	b			
Benzene	71-43-2	160	700	b	71.3		d
Cymene, p- (4-Isopropyltoluene)	99-87-6	16	150	b			
Ethylbenzene	100-41-4	61	550	b	7.3	130	c
Isopropylbenzene (Cumene)	98-82-8	4.8	43	b			
Styrene (vinyl benzene)	100-42-5	32	290	b			
Toluene	108-88-3	62	560	b	9.8	120	c
Xylenes (total)	1330-20-7	27	240	b	13	230	c
Energetic VOAs							
Acetonitrile	75-05-8	12,000	100,000	b			
Acrylonitrile	107-13-1	78	650	b			
1,2-Diphenylhydrazine	122-66-7	1.1	9.6	b			
Hydrazine	302-01-2	2	16	b			
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	22,000	200,000	b	14,000	240,000	c
2-Hexanone (methyl butyl ketone)	591-78-6	99	1,800	c	99	1,800	c
2-Octanone (methyl hexyl ketone)	111-13-7	8.3	150	c	8.3	150	c
4-Methyl-2-pentanone (MIBK)	108-10-1	170	2,200	c	170	2,200	c
Acetone	67-64-1	1,700	15,000	b	1,500	28,000	c
Other VOCs							
1-Pentanol	71-41-0	110	2,000	c	110	2,000	c
2-Propanol	67-63-0	7.5	130	c	7.5	130	c
Acetaldehyde	75-07-0	130	1,200	b	1.4		e
Acrolein	107-02-8	3	3	a			
Bromoform (tribromomethane)	75-25-2	230	1,100	b	320	2,300	c
Bromomethane (methyl bromide)	74-83-9	16	38	b			
Carbon disulfide	75-15-0	15	130	b	0.92	17	c
Cyclohexane	110-82-7	230		e	120		e
Dibromochloromethane	124-48-1	320	2,900	b	34		d
Dichlorobromomethane	75-27-4	340	3,100	b			
Ethylene glycol	107-21-1	140,000	1,300,000	b			
Hexane	110-54-3	0.58	10	c	0.58	10	c
Hexachloroethane	67-72-1	12	210	c	12	210	c
Methanol	67-56-1	330	3,000	b			
Methylamine	74-89-5	860	7,700	b			

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a

Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Other VOCs							
Methyl tert-butyl ether (MTBE)	1634-04-4	730	6,500	b	18,000	53,000	m
Propylene glycol	57-55-6	71	640	b			
Tetrahydrofuran	109-99-9	11,000	74,000	b			
Vinyl acetate	108-05-4	16	280	c	16	280	c
Semivolatile Organic Compounds							
Chloroanilines							
4-Chloroaniline	106-47-8	19	459	j			
2,4-Dichloroaniline	554-00-7	15	575	j			
Pentachloroaniline	527-20-8	5	429	j			
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	3.4	18	n			
1,2,4,5-Tetrachlorobenzene	95-94-3	8.3	75	b			
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
Hexachlorobenzene (wildlife based)	118-74-1	0.0003		n			
Pentachlorobenzene (aquatic only)	608-93-5	3.1	16	b	0.47	8.4	c
Pentachlorobenzene (wildlife based)	608-93-5	0.019		n			
Chlorophenols							
2-Chlorophenol	95-57-8	32	290	b	400		d
2,4-Dichlorophenol	120-83-2	11	110	b	790		d
2,4,5-Trichlorophenol	95-95-4	1.9	17	b	12	259	o
2,4,6-Trichlorophenol	88-06-2	4.9	39	b	6.5		d
2,3,4,6-Tetrachlorophenol	58-90-2	1.2	11	n			
3-Methyl-4-Chlorophenol	59-50-7	7.4	67	n			
Other Phenols							
2-Methylphenol (Cresol, o-)	95-48-7	67	600	b	13	230	c
3-Methylphenol (Cresol, m-)	108-39-4	62	560	b			
4-Methylphenol (Cresol, p-)	106-44-5	53	480	b			
2,3-Dimethylphenol	526-75-0	120	1,100	n			
2,4-Dimethylphenol	105-67-9	15	140	b			
2-Nitrophenol	88-75-5	73	650	b			
4-Nitrophenol	100-02-7	58	530	b	300	1,200	c
2,4-Dinitrophenol	51-28-5	71	379	b	14.3		d
2,4,6-Tribromophenol	118-79-6	5.6	50	b			
Nonylphenol	84852-15-3	6.6	28	o	1.7	7	o
Pentachlorophenol # (aquatic)	87-86-5	15	19	a	7.9	13	a
Phenol	108-95-2	160	4,700	b	58	300	p
Semivolatile Organic Compounds							
Energetic SVOAs							
2-Amino-4,6-dinitrotoluene	35572-78-2	18	160	b	20	180	k
4-Amino-2,6-dinitrotoluene	19406-51-0	11	98	b			
1,3-Dinitrobenzene (DNB)	99-65-0	22	100	b	20	110	k
2,3-Dinitrotoluene	602-01-7	2.3	21	b			
2,4-Dinitrotoluene	121-14-2	44	390	b	9.1	200	d, g
2,5-Dinitrotoluene	619-15-8	5.6	50	b			
2,6-Dinitrotoluene	606-20-2	81	730	b		200	g
3,5-Dinitrotoluene	618-85-9	95	860	b			
3,5-Dinitroanaline (DNA)	618-87-1	60	230	k	60	230	k
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	220	1,200	b	330	1,880	k
Nitroglycerine	55-63-0	18	160	b			
2-Nitrotoluene	88-72-2	71	640	b			
3-Nitrotoluene	99-08-1	42	380	b			
4-Nitrotoluene	99-99-0	46	410	b			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	79	520	b	190	700	k
1,3,5-Trinitrobenzene (TNB)	99-35-4	11	27	b	10	30	k
2,4,6-Trinitrotoluene (TNT)	118-96-7	13	120	b	90	570	k

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Semivolatile Organic Compounds							
Phthalates							
bis(2-Ethylhexyl) Phthalate	117-81-7	3	27	c	3	27	c
Butylbenzyl Phthalate	85-68-7	23	130	b	19		c
Diethyl Phthalate	84-66-2	220	980	b	210	1,800	c
Dimethyl Phthalate	131-11-3	1,100	3,200	b	2,900		e
Di-n-Butyl Phthalate	84-74-2	19	34	b	35	190	c
Polycyclic Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	90-12-0	2.1	37	c	2.1	37	c
2-Methylnaphthalene	91-57-6	4.7	42	b	72	86, i	q
Acenaphthene	83-32-9	15	19	b	20	86, i	l
Acenaphthylene	208-96-8	13	120	b	307	582, i	q
Anthracene	120-12-7	0.02	0.18	b	0.73	13	c
Benz(a)anthracene	56-55-3	4.7	42	b	0.027	0.49	c
Benzo(a)pyrene	50-32-8	0.060	0.54	b	0.3	2, i	c
Benzo(b)fluoranthene	205-99-2	2.6	23	b	0.68	2, i	q
Benzo(g,h,i)perylene	191-24-2	0.44	6	q, j	0.44	0.5, i	q
Benzo(k)fluoranthene	207-08-9	0.64	2	q, i	0.64	2, i	q
Chrysene	218-01-9	4.7	42	b	2	6.5, i	q
Dibenz(a,h)anthracene	53-70-3	0.28	6	q, j	0.28	1.2 i	q
Fluoranthene	206-44-0	0.8	3.7	b	7.1	21, i	q
Fluorene	86-73-7	19	110	b	3.9	70	c
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	6	q, j	0.28	0.5, i	q
Naphthalene	91-20-3	21	170	b	12	190	c
Phenanthrene	85-01-8	2.3	31	b	4.6	7.7	o
Pyrene	129-00-0	4.6	42	b	10	21, i	q
Other SVOCs							
1,1-Biphenyl	92-52-4	6.5	26	b	14		c
2,2-Dibromo-3-nitrilopropionamide	10222-01-2	20	50	b			
3,3'-Dichlorobenzidine	91-94-1	4.5	41	n			
4-Bromophenyl Phenyl Ether	101-55-3	1.5	0	c	1.5		c
Aniline	62-53-3	4.1	30	b			
Benzaldehyde	100-52-7	57	547	j			
Benzidine	92-87-5	1.5	14	b	3.9	70	c
Benzoic Acid	65-85-0	42	740	c	42	740	c
Benzyl alcohol	100-51-6	8.6	150	c	8.6	150	c
Decane	124-18-5	49	880	c	49	880	c
Dibenzofuran	132-64-9	4	36	b	3.7	66	c
Hexachlorobutadiene (Aquatic Life)	87-68-3	1	10	b	0.3	3	l
Hexachlorobutadiene (Wildlife Based)	87-68-3	0.053		n			
Hexachlorocyclopentadiene	77-47-4	0.45	4.5	b	0.07	0.7	l
Hydroquinone	123-31-9	2.2	4.4	b			
Isodecyl diphenyl phosphate	29761-21-5	1.73	22	b			
Isophorone	78-59-1	920	7,500	b		4,300	g
N-Nitrosodiphenylamine	86-30-6	25	220	b	210	3,800	c
Nitrobenzene	98-95-3	380	2,000	b		2,000	g
Propylene glycol	57-55-6	71	640	b			
Quinoline	91-22-5	3.4		h			
Triphenyl phosphate	115-86-6	4	40	b			
Pesticides, Herbicides, Fungicides							
2,4-D	94-75-7	79.2	130	r	70		d
4,4'-DDT (Aquatic Life Only)	50-29-3	0.0032	1.1	a	0.001	0.13	a
4,4'-DDE	72-55-9	0.41	7	j			
4,4'-DDD	72-54-8	0.011	0.19	c	0.011	0.19	c
Acephate	30560-19-1	150	550	r			
Aldrin	309-00-2	0.035	3.0	b	0.00014	1.3	d
Atrazine	1912-24-9	12	330	b			
Azinphos-methyl (Guthion)	86-50-0	0.01	0.08	a, r	0.01		a

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Pesticides, Herbicides, Fungicides							
BHC (beta)	319-84-6	0.046		d	0.046		d
BHC-gamma (Lindane) (Aquatic Life)	58-89-9	0.11	0.95	b, a	0.063	0.16	d, a
BHC-gamma (Lindane) (Wildlife Based)	58-89-9	0.026		n			
Carbaryl	63-25-2	0.5	0.85	r		1.6	a
Carbofuran	1563-66-2	0.75	1.12	r			
Captan	133-06-2		13.1	r			
Chlordane	57-74-9	0.0043	2.4	a	0.00059	0.004	d
Chlorothalonil	1897-45-6	0.6	1.8	r			
Chloropyrifos	2921-88-2	0.041	0.05	a, r	0.0056	0.011	a
Cyanazine	21725-46-2	270	2420	b			
Demeton	8065-48-3	0.1	-	b, a	0.1		a
Diazinon	333-41-5	0.17	0.17	a	0.82	0.82	a
Dicamba	1918-00-9	3,898	216	b			
Dieldrin	60-57-1	0.056	0.24	a	0.0019	0.71	a
Dimethoate	60-51-5	0.5	21.5	r			
Dinoseb	88-85-7	0.48	9.5	n			
Diquat	2764-72-9	6	54	b			
Endosulfan-alpha	959-98-8	0.01	0.11	r	0.0087	0.034	a
Endosulfan-beta	33213-65-9	0.01	0.11	r	0.0087	0.034	a
Endosulfan Sulfate	1031-07-8	0.056	0.22	p	0.0087	0.034	p
Endrin	72-20-8	0.036	0.086	a	0.0023	0.037	a
Heptachlor	76-44-8	0.0038	0.52	a	0.0036	0.053	a
Heptachlor Epoxide	1024-57-3	0.0038	0.52	a	0.0036	0.053	a
Malathion	121-75-5	0.035	0.295	r	0.1		a
MCPA (2-methyl-4-chlorophenoxyacetic acid)	94-74-6	2.6		h	4.2		h
Pesticides, Herbicides, Fungicides							
Methoxychlor	72-43-5	0.03	0.7	a	0.019		c
Metolachlor	51218-45-2	15	110	n			
Mirex (Aquatic Life)	2385-85-5	0.001	0.001	a	0.001	0.001	a
Mirex (Wildlife Based)	2385-85-5	0.000016	-	n			
Parathion	56-38-2	0.013	0.065	a	0.04		d
Silvex (2,4,5-TP)	93-72-1	30	270	n	50		f
Simazine	122-34-9	9	80	b			
Toxaphene	8001-35-2	0.0002	0.73	a	0.0002	0.21	a
Trifluralin	1582-09-8	1.14	20.5	r			
Polychlorinated Biphenyls (PCBs) and Dioxin/Furans							
2,3,7,8-TCDD (Dioxin)	1746-01-6	3.10E-09		b			
Dioxins (TEQ)			0.003	g			
Total PCBs (Wildlife Based)	1336-36-3	0.000074	0.014	b	0.000072	0.03	m
Other							
Alkalinity	-	20,000		a			
Ammonia ^^	7664-41-7	Varies	Varies	a	0.024	0.094	m
Formaldehyde	50-00-0	74	660	b			
Nitrite (warm water)	14797-65-0	20	100	b			
pH	-	6.5 - 9.0		a	6.5 - 8.5		a
Selenate	14124-68-6	9.5	12.5	b			
Selenite	14124-67-5	27.6	186	b			
Tributyltin	688-73-3	0.072	0.46	a	0.0074	0.42	a
Urea	57-13-6	17,000	150,000	b			

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source

Table 1a Notes:

Red font indicates a bioaccumulative chemical.

- Chemical that should be evaluated with the SUM Toxic Unit Approach as discussed in Text Section 3.1.5.

^ - Screening value is for total metals. A conversion factor (CF) was used to convert the screening value for total metals in surface water to a screening value for dissolved metals in surface water. CMC (dissolved) = CMC (total) × CF. See Table 1b for screening values for dissolved metals.

* - The freshwater screening value is hardness dependent. The screening value shown in Table 1a is for total metals assuming a hardness of 50 mg/L as $CaCO_3$. A correction for site-specific hardness was based on equations listed in Tables 1b and 1c. If hardness data are unavailable hardness may be estimated as: H = 2.497 × Ca (mg/L) + 4.118 × Mg (mg/L).

- Freshwater criteria for pentachlorophenol are pH Dependent. Values displayed are for a pH of 7.8.

^^ - Criteria for ammonia are pH, temperature, and lifestage dependent.

Table 1a Sources:

a - National Recommended Water Quality Criteria http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

b - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013 http://www.epa.gov/gliclearinghouse/

c - Suter, G.W. II, and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 Revision. ES/ER/TM-96/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf

d - Florida State Criteria for Surface Water Quality Classifications http://www.dep.state.fl.us/legal/Rules/shared/62-302/302-Table.pdf

e - North Carolina Department of Natural Resources (NCDNR) Surface Water Standards http://portal.ncdenr.org/web/wq/ps/csu/swstandards

f - Georgia Department of Natural Resources (GADNR) Water Use Classifications and Water Quality Standards http://rules.sos.state.ga.us/docs/391/3/6/03.pdf

g - Hawaii Department of Health (HDOH) Environmental Action Levels, Chronic and Acute Surface Water (Aquatic Habitat) Standards http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/environmental-hazard-evaluation-and-environmental-action-levels

h - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at: http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html

i - Region 4 Surface Water Model - See text Section 6.1.4 Equation 1.

j - ECOSAR program predicted lowest chronic or acute value. See Section 6.1.4 in text.

k - Talmadge et al. (1999)

l - New York Ambient Water Quality Criteria and Guidance Values: http://www.dec.ny.gov/docs/water_pdf/togs111.pdf

m - New Jersey Department of Environmental Protection (NJDEP) Ecological Screening Criteria http://www.nj.gov/dep/srp/guidance/ecoscreening/esc_table.pdf

n - Michican Water Quality Values - Rule 57: http://www.michigan.gov/deq/0,4561,7-135-3313_3686_3728-11383--,00.html

o - Texas Surface Water Quality Standards: https://www.tceq.texas.gov/waterquality/standards/2014standards.html

p - Mississippi Water Quality Standards: http://www.deq.state.ms.us/mdeq.nsf/page/WQSB_Water_Quality_Standards

q - EPA. 2003. Equilibrium Partitioning Sediment Benchmarks for Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. http://www.epa.gov/nheerl/download_files/publications/PAHESB.pdf

r - Office of Pesticide Programs (OPP) Aquatic Life Benchmarks: http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Inorganic Compounds mg/kg dry weight								
Metals mg/kg dw								
Aluminum		7429-90-5	25,000	58,000	i			
Antimony		7440-36-0	2	25	a	2	25	a
Arsenic		7440-38-2	9.8	33	b	7.24	41.6	c
Barium		7440-39-3	20	60	b	-	-	-
Cadmium		7440-43-9	1	5	b	0.68	4.21	c
Chromium (Total)		7440-47-3	43.4	111	b	52.3	160	c
Cobalt		7440-48-4	50		g			
Copper		7440-50-8	31.6	149	b	18.7	108	c
Iron		7439-89-6	20,000	40,000	g			
Lead		7439-92-1	35.8	128	b	30.2	112	c
Manganese		7439-96-5	460	1,100	h			
Mercury		7439-97-6	0.18	1.1	b	0.13	0.7	c
Nickel		7440-02-0	22.7	48.6	b	15.9	42.8	c
Selenium		7782-49-2	11	20	h			
Silver		7440-22-4	1	2.2	b	0.73	1.77	c
Uranium		7440-61-1	100	1,000	i			
Zinc		7440-66-6	121	459	b	124	271	c
Other Inorganics mg/kg								
Ammonia		7664-41-7	230	300	h			
Sulfides (Total)		18946-25-8	39	61	h			
Volatile Organic Compounds (VOCs) µg/kg @1% OC								
Acetaldehyde	R	75-07-0	1.6	12	d	342		e
Acrylonitrile	R	107-13-1	6.9	55	d			
1,2-Diphenylhydrazine	R	122-66-7	3.8	31	d			
Methylamine	R	74-89-5	34	298	d			
Vinyl acetate	N3	108-05-4	1.2	16	d	1.2	16	d
Semivolatile Organic Compounds (SVOCs)								
Phenols µg/kg @1% OC unles denoted by shading								
2-Chlorophenol	N2	95-57-8	61		d	764		d
2-Methylphenol (o-cresol)	N2	95-48-7	100		d	19	63	d, h
2,3-Dimethylphenol	N2	526-75-0	349		d			
2,4-Dimethylphenol	N2	105-67-9	35		c	29	29	h
3-Methylphenol (Cresol, m-)	N2	108-39-4	93		d			
4-Methylphenol (p-Cresol)	N2	106-44-5	78	260	d, h	670	670	h
2-Nitrophenol	N2	88-75-5	146		d			
4-Nitrophenol	N2	100-02-7	135		d	699		d
2,4-Dinitrophenol	U	51-28-5	202		d	41		d
2-Methyl-4,6-Dinitrophenol	U	534-52-1	2,477		e			
2,4,5-Trichlorophenol	N2	95-95-4	34		d	213		d
2,4,6-Trichlorophenol	N2	88-06-2	87		d	116		d
3-Methyl-4-Chlorophenol	N2	59-50-7	37		d			
Pentachlorophenol	U	87-86-5	744	1,200	d, h	360	690	h
Phenol	N2	108-95-2	120	120	h	420	1,200	h
Energetic SVOAs µg/kg @ 1% OC								
2-Amino-4,6-dinitrotoluene	U	35572-78-2	41		d			
4-Amino-2,6-dinitrotoluene	U	19406-51-0	25		d			
1,3-Dinitrobenzene	U	99-65-0	34		d	795		e
2,3-Dinitrotoluene	R	602-01-7	8.8		d	1,168		e
2,4-Dinitrotoluene	R	121-14-2	127		d	26		d
2,5-Dinitrotoluene	R	619-15-8	21		d	1,168		e
2,6-Dinitrotoluene	R	606-20-2	271		d	1,084		e
3,5-Dinitrotoluene	R	618-85-9	353		d	1,168		e
HMX (Octahydro-tetranitro-1,3,5...)	C	2691-41-0	42		d			
Nitroglycerine	R	55-63-0	4.9		d			
RDX (Hexahydro-1,3,5-trinitro-1,3,5...)	R	121-82-4	41		d			
1,3,5-Trinitrobenzene	R	99-35-4	12		d	782		e
2,4,6-Trinitrotoluene (TNT)	R	118-96-7	23		d	888		e

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Semivolatile Organic Compounds (SVOCs)								
Other SVOCs µg/kg @ 1% OC								
4-Chloroaniline	N2	106-47-8	316		d			
2,4-Dichloroaniline	N2	554-00-7	328		d			
Pentachloroaniline	U	527-20-8	920		d			
2,2-Dibromo-3-nitrilopropionamide	R	10222-01-2	1.4		d	304		e
3,3'-Dichlorobenzidine	N2	91-94-1	30		d			
Aniline	N2	62-53-3	1.3		d			
Benzaldehyde	R	100-52-7	462		e			
Benzidine	N2	92-87-5	0.9		d	1.6		d
bis(2-Chloroethyl) Ether	R	111-44-4	4,761		e			
Decane	N2	124-18-5	491		e	308		d
Hexachlorobutadiene (aquatic life)	R	87-68-3	8.8		d	2.5		d
Hexachlorobutadiene (wildlife-based)	R	87-68-3	0.7		d			
Hexachlorocyclopentadiene	R	77-47-4	6.6		d	1.0		d
Hydroquinone	R	123-31-9	1.1		d			
Pesticides µg/kg @ 1% OC unless denoted by shading								
2,4-D	H	94-75-7	24		d			
4,4'-DDD	C	72-54-8	1.22	7.81	c	1.22	7.81	c
Total DDD	C	-	4.88	28	b	2	20	a
4,4'-DDE	C	72-55-9	2.07	3.74	c	2.07	3.74	c
Total DDE	C	-	3.16	31.3	b	2	15	a
4,4'-DDT (aquatic life)	C	50-29-3	5.7		d	1.7		d
4,4'-DDT (wildlife-based)	C	50-29-3	0.32		d	0.01		d
4,4'-DDT	C	50-29-3	1.19	4.77	c	1.19	4.77	c
Total DDT	C	-	4.16	62.9	b	3.89	51.7	c
DDT/DDE/DDD (total)	C	-	5.28	572	b			
Acephate	A	30560-19-1	5.7		d	300		d
Acrolein	R	107-02-8	0.33		d			
Aldrin	C	309-00-2	29		d	0.11		d
Atrazine	H	1912-24-9	18		d	1,289		e
BHC (alpha)	C	319-84-6	1.6		d	1.3		d
BHC (beta)	C	319-85-7	6,665		f			
BHC-gamma (Lindane)	C	58-89-9	2.37	4.99	b	0.32	0.99	c
BHC-gamma (Lindane) (aquatic life)	C	58-89-9	3.4		d			
BHC-gamma (Lindane) (wildlife-based)	C	58-89-9	1.0		d			
Carbaryl	A	63-25-2	1.0		d			
Carbofuran	A	1563-66-2	1.0		d			
Captan	F	133-06-2	346		d			
Chlordane	C	57-74-9	3.24	17.6	b	2.26	4.79	c
Chlorothalonil	R	1897-45-6	6.5		d	301		f
Chloropyrifos	A	2921-88-2	3.3		d	0.41		d
Cyanazine	H	21725-46-2	362		d	2,790		e
Demeton	A	126-75-0	0.44		d	300		e
Diazinon	A	333-41-5	4.0		d	18		d
Dicamba	H	1918-00-9	1,060		d			
Dieldrin	C	60-57-1	1.9	9.3	b, h	0.715	4.3	c
Dieldrin (aquatic life)	C	60-57-1	3.2		d	0.1		d
Dieldrin (wildlife-based)	C	60-57-1	0.3		d			
Dimethoate	A	60-51-5	0.36		d			
Dinoseb	H	88-85-7	15		d			
Diquat	H	2764-72-9	23		d			
Endosulfan-alpha	C	959-98-8	0.46		d	0.14		d
Endosulfan-beta	C	33213-65-9	0.46		d	0.14		d
Endosulfan Sulfate	C	1031-07-8	1.0		d	0.11		d
Endrin	C	72-20-8	2.22	207	b	2.67	62	j
Guthion	A	86-50-0	0.31		d	0.005		d
Heptachlor	C	76-44-8	1.9		d	1.5		d
Heptachlor epoxide	C	1024-57-3	2.47	16	b	0.6	2.7	j
Malathion	A	121-75-5	0.31		d	0.03		d

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Pesticides µg/kg @ 1% OC								
MCPA (2-methyl-4-chlorophenoxyacetic acid)	H	94-74-6	1,000		f	1,000		f
Methoxychlor	C	72-43-5	2.4		d	1.34		d
Metolachlor	H	51218-45-2	37		d	3,840		f
Mirex (aquatic life)	C	2385-85-5	3.9		d	3.6		d
Mirex (wildlife-based)	C	2385-85-5	0.36		d			
Parathion	A	56-38-2	0.5		d	0.6		d
Silvex (2,4,5-TP)	H	93-72-1	53		d	88		d
Simazine	H	122-34-9	7.8		d			
Toxaphene	C	8001-35-2	0.45		d	0.15		d
Trifluralin	H	1582-09-8	187		d			
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans µg/kg @ 1% OC unless denoted by shading								
Total PCBs	E	1336-36-3	59.8	676	b	21.6	12	c, h
Total PCBs (wildlife-based)	E	1336-36-3	0.33		d	0.025		d
Dioxins/Furans	E	1746-01-6	0.0025	0.025	k	0.0025	0.025	k
2,3,7,8-TCDD (Dioxin) (wildlife-based)	E	1746-01-6	0.3		d			
Other mg/kg dw								
Butyl tins mg/kg dw								
Monobutyltin		78763-54 -9	0.54	4.8	h			
Dibutyltin		818-08-6	0.91	130	h			
Tributyltin		688-73-3	0.047	0.32	h			
Tetrabutyltin		1461-25-2	0.097	0.097	h			
Bulk Petroleum Hydrocarbons mg/kg dw								
Total Petroleum Hydrocarbons - Diesel		68334-30-5	340	510	h			
Total Petroleum Hydrocarbons - Residual		68476-53-9	3,600	4,400	h			

Table 2 Notes:
Red font indicates a bioaccumulative chemical.
Shaded gray cells indicate units in µg/kg dry weight.
CAS = chemical abstract service registry number
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
R - Reactive electrophiles/proelectrophiles
N2 - Polar Narcosis
N3 - Diesters
U - Oxidative phosphorylation uncouplers
H - Herbicides
C - Central nervous system seizure agents
A - Acetylcholinesterase inhibitors
F - Fungicide
E - Endocrine disrupters or reproductive and developmental toxicants

Table 2a Sources:

a - Long, Edward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

b - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

c - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.

d - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a. See Equation 3 in text Section 6.2.2.

e - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.

f - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.

g - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario.

h - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

i - Los Alamos National Laboratory ECORISK Database. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

j - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at http://www.ccme.ca/publications/ceqg_rcqe.html

k - USEPA. 1993. Interim Report on Data and Methods for Assessment of 2,3,7,8 - Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. EPA/600/R-93/055. Available from the National Service Center for Environmental Publications (NSCEP) Document Number 600R93055. http://www.epa.gov/nscep/

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites
for Narcotic Mode of Action

Chemical	*CAS*	*Freshwater Sediment Screening Value (µg/kg 1% OC)*		*Source*	*Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)*		*Source*
		ESV	*RSV*		*ESV*	*RSV*	
Other VOCs							
Ethylene glycol	107-21-1	314		a	1,921		b
Hexachloroethane	67-72-1	24		a	24		a
Methanol	67-56-1	3.6		a	1,941		b
Methyl tert-butyl ether (MTBE)	1634-04-4	84		a	2,911		b
Propylene glycol	57-55-6	0.6		a	2,199		b
Tetrahydrofuran	109-99-9	1,183		a	4,372		b
Semivolatile Organic Compounds (SVOCs) µg/kg @ 1% OC							
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	77		a	436		c
1,2,4,5-Tetrachlorobenzene	95-94-3	185		a	434		c
Hexachlorobenzene	118-74-1	0.32		a	310		c
Pentachlorobenzene	608-93-5	115		a	18		a
Phenols							
2,4-Dichlorophenol	120-83-2	54		a	3,885		b
2,4,6-Tribromophenol	118-79-6	45		a			
2,3,4,6-Tetrachlorophenol	58-90-2	36		a			
Nonylphenol	25154-52-3	1,268		a	327		a
Energetic SVOAs							
2-Nitrotoluene	88-72-2	185		a	8,315		b
3-Nitrotoluene	99-08-1	133		a	10,000		b
4-Nitrotoluene	99-99-0	131		a	9,065		b
Phthalates µg/kg @ 1% OC unless denoted by shading							
Bis(2-ethylhexyl)phthalate	117-81-7	182	2,647	d	182	2,647	d
Butyl benzyl phthalate	85-68-7	592		a	489		a
Diethyl phthalate	84-66-2	231		a	221		a
Dimethyl phthalate	131-11-3	348		a	3,000		b
Di-n-butyl phthalate	84-74-2	220	1,000	a, e	405		a
Di-n-octyl phthalate	117-84-0	513	1,100	e	300		b
PAHs µg/kg dw							
Low molecular weight PAHs (LMW-PAHs)							
1-Methylnaphthalene	90-12-0	*			*		
2-Methylnaphthalene	91-57-6	*			*		
Acenaphthene	83-32-9	*			*		
Acenaphthylene	208-96-8	*			*		
Anthracene	120-12-7	*			*		
Fluorene	86-73-7	*			*		
Naphthalene	91-20-3	*			*		
Phenanthrene	85-01-8	*			*		
Total LMW-PAHs		*			**312**		d
High molecular weight PAHs (HMW-PAHs)							
Benz(a)anthracene	56-55-3	*			*		
Benzo(a)pyrene	50-32-8	*			*		
Benzo(b)fluoranthene	205-99-2	*			*		
Benzo(g,h,i)perylene	191-24-2	*			*		
Benzo(k)fluoranthene	207-08-9	*			*		
Chrysene	218-01-9	*			*		
Dibenz(a,h)anthracene	53-70-3	*			*		
Fluoranthene	206-44-0	*			*		
Indeno(1,2,3-cd)pyrene	193-39-5	*			*		
Phenanthrene	85-01-8	*			*		
Pyrene	129-00-0	*			*		
Total HMW-PAHs		*		d	**655**		d
Total PAHs		**1,610**		f	**1,684**		d

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites
for Narcotic Mode of Action

Chemical	*CAS*	*Freshwater Sediment Screening Value (µg/kg 1% OC)*		*Source*	*Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)*		*Source*
		ESV	*RSV*		*ESV*	*RSV*	
Volatile Organic Compounds (VOCs) - µg/kg @ 1% OC							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	73		a	9.6		a
1,1,2,2-Tetrachloroethane	79-34-5	190		a	579		a
1,1,1-Trichloroethane	71-55-6	34		a	5.1		a
1,1,2-Trichloroethane	79-00-5	319		a	524		a
1,1-Dichloroethane	75-34-3	131		a	15		a
1,2-Dichloroethane	107-06-2	385		a	175		a
1,2-Dichloropropane	78-87-5	272		a	1,900		b
Dichloromethane (methylene chloride)	75-09-2	183		a	268		a
Trichloromethane (Chloroform)	67-66-3	45		a	9.2		a
Tetrachloromethane (Carbon tetrachloride)	56-23-5	34		a	4.6		a
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	41		a	8.3		a
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	338		a	234		a
1,2-cis-Dichloroethyene	156-59-2	246		a			-
1,2-trans-Dichloroethylene	156-60-5	221		a			-
1,3-Dichloropropene	542-75-6	1.0		a	0.33		a
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	50		a	93		a
1,1,2-Trichloroethylene (TCE)	79-01-6	134		a	29		a
chloroethene (Vinyl chloride)	75-01-4	202		a			-
Chlorobenzenes							
Chlorobenzene	108-90-7	58		a	150		a
1,2-Dichlorobenzene	95-50-1	88		a	54		a
1,3-Dichlorobenzene	541-73-1	83		a	267		a
1,4-Dichlorobenzene	106-46-7	35		a	57		a
1,2,3-Trichlorobenzene	87-61-6	69		a	70		a
1,2,4-Trichlorobenzene	120-82-1	1,700		c	775		b
1,3,5-Trichlorobenzene	108-70-3	66		a	67		a
Trichlorobenzene (mixed isomers)	12002-48-1	66		a	67		a
Monoaromatic hydrocarbons							
1,2,3-Trimethylbenzene	526-73-8	2,074		c	652		b
1,2,4-Trimethylbenzene	95-63-6	92		a	645		b
1,3,5-Trimethylbenzene	108-67-8	157		a	638		b
Benzene	71-43-2	113		a	4,038		b
Cymene, p- (4-Isopropyltoluene)	99-87-6	179		a	536		b
Ethylbenzene	100-41-4	272		a	33		a
Isopropylbenzene (Cumene)	98-82-8	33		a	984		b
Styrene (Vinyl benzene)	100-42-5	116		a	1,959		b
Toluene	108-88-3	145		a	23		a
Xylenes (total)	1330-20-7	103		a	50		a
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	992		a	631		a
2-Hexanone (methyl butyl ketone)	591-78-6	2,828		b	15		a
2-Octanone (methyl hexyl ketone)	111-13-7	4.1		a	4.4		a
4-Methyl-2-pentanone (MIBK)	108-10-1	2,712		b	22		a
Acetone	67-64-1	40		a	36		a
Other VOCs							
1-Pentanol	71-41-0	7.3		a	7.3		a
2-Propanol	67-63-0	0.42		a	0.42		a
Acetonitrile	75-05-8	561		a	5,144		b
4-Bromophenyl phenyl ether	101-55-3	46		a	46		a
Bromoform (Tribromomethane)	75-25-2	73		a	102		a
Bromomethane (methyl bromide)	74-83-9	2.0		a	3,107		b
Carbon disulfide	75-15-0	3.6		a	0.5		a
Dibromochloromethane	124-48-1	102		a	11.1		a
Dichlorobromomethane	75-27-4	108		a	5,915		b

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites
for Narcotic Mode of Action

Chemical	*CAS*	*Freshwater Sediment Screening Value (µg/kg 1% OC)*		*Source*	*Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)*		*Source*
		ESV	*RSV*		*ESV*	*RSV*	
Other SVOCs µg/kg @ 1% OC unless denoted by shading							
1,1-Biphenyl	92-52-4	197		a	423		a
4-Bromophenyl Phenyl Ether	101-55-3	46		a	46		a
Benzoic Acid	65-85-0	2,900	3,800	e	650	650	e
Benzyl alcohol	100-51-6	1.4		a	57	73	e
Carbazole	86-74-8	900	1,100	e			-
Dibenzofuran	132-64-9	151	680	a, e	139		a
Isodecyl diphenyl phosphate	29761-21-5	89		a	301		b
Isophorone	78-59-1	600		a	2,177		b
N-Nitrosodiphenylamine	86-30-6	35		a	295		a
Nitrobenzene	98-95-3	559		a	21,670		b
Propylene glycol	57-55-6	0.6		a	2,198		b
Quinoline	91-22-5	2,774		c	2,774		c
Triphenyl phosphate	115-86-6	69		a	301		b

Table 2 Notes:
* see Total below.
Red font indicates a bioaccumulative chemical.
Gray shaded cells indicate concentration in µg/kg dry weight
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
CAS = chemical abstract service registry number

Table 2a Sources:
a - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a See Equation 3 in text Section 6.2.2.
b - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.
c - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.
d - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.
e - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm
f - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for ESV.

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 2c

Region 4 Step 3a Sediment Screening Values

for Polycyclic Aromatic Hydrocarbons (PAHs) at Hazardous Waste Sites

Chemical	*CAS*	*Freshwater Sediment Screening Values (µg/kg OC)*	*Source*	*Marine/Estuarine Sediment Screening Values (µg/kg OC)*	*Source*
		RSV		RSV	
Low Molecular Weight PAHs (LMW-PAHs)					
Acenaphthene	83-32-9	491	a	16	c
Acenaphthylene	208-96-8	452	a	66	c
Anthracene	120-12-7	594	a	220	c
Fluorene	86-73-7	538	a	23	c
C1-Fluorenes	-	611	a	-	-
C2-Fluorenes	-	686	a	-	-
C3-Fluorenes	-	769	a	-	-
1-Methyl naphthalene	90-12-0	446	a	131	b
2-Methyl naphthalene	91-57-6	447	a	116	b
2,6-Dimethyl naphthalene	581-42-0	513	a	44	b
2,3,5-Trimethylnaphthalene	2245-38-7	584	a	13	b
Naphthalene	91-20-3	385	a	99	c
C1-Naphthalenes	-	444	a	-	-
C2-Naphthalenes	-	510	a	-	-
C3-Naphthalenes	-	581	a	-	-
C4-Naphthalenes	-	657	a	-	-
1-Methyl phenanthrene	832-69-9	670	a	50	b
Phenanthrene	85-01-8	596	a	100	c
C1-Phenatherene/anthracenes	-	670	a	-	-
C2-Phenatherene/anthracenes	-	746	a	-	-
C3-Phenatherene/anthracenes	-	829	a	-	-
C4-Phenatherene/anthracenes	-	913	a	-	-
Thiophenes					
Benzothiophene	11095-43-5	569	b	226	b
Dibenzothiophene	132-65-0	1,860	b	156	b
C1-Dibenzothiophenes	-	1,146	b	-	-
C2-Dibenzothiophenes	-	898	b	-	-
C3-Dibenzothiophenes	-	664	b	-	-
C4-Dibenzothiophenes	-	466	b	-	-
Naphthothiophene	233-02-3	1,803	b	151	b
High Molecular Weight PAHs (HMW-PAHs)					
Benzo(a)anthracene	56-55-3	841	a	110	c
C1-Benzanthracene/chrysenes	-	929	a	-	-
C2-Benzanthracene/chrysenes	-	1,008	a	-	-
C3-Benzanthracene/chrysenes	-	1,112	a	-	-
C4-Benzanthracene/chrysenes	-	1,214	a	-	-
Benzo(b)fluoranthene	205-99-2	979	a	38	b
Benzo(k)fluoranthene	-	981	a	38	b
Benzo(g,h,i)perylene	191-24-2	1,095	a	230	c
Benzo(a)pyrene	50-32-8	965	a	31	c
Benzo(e)pyrene	192-97-2	967	a	99	b
Chrysene	218-01-9	844	a	25	c
Dibenz(a,h) anthracene	53-70-3	1,123	a	12	c
Fluoranthene	206-44-0	707	a	160	c
C1-Fluoranthene/pyrenes	-	770	a	-	-
Indeno(1,2,3-cd)pyrene	193-39-5	1,115	a	34	c
Perylene	198-55-0	967	a	17	b
Pyrene	129-00-0	697	a	1,000	c

Notes:
RSV - Refinement Screening Value

a - EPA (2003). Procedures for the Derivation of Equlibrium Partitioning Sediment Benchmarks(ESBs) for the Protection of Benthic Orgamisms: PAH Mixtures. EPA/600/R-02/013. The value listed represents the C_{OC},PAH_i,FCV_i from the document. See text section 6.2.4.

b - Region 4 Sediment model using ECOSAR.

c - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Inorganic Compounds												
Metals												
Aluminum	7429-90-5	Narrative	a	All			Narrative	a				
Antimony	7440-36-0	0.27	a	All	11	c	78	a	0.27	a		
Arsenic	7440-38-2	18	a	All	18	a	60	b	46	a	43	a
Barium	7440-39-3	330	a	All	110	c	330	a	2,000	a	1,000	c
Beryllium	7440-41-7	10	b	All	10	b	40	a	18	c		
Boron	7440-42-8	7.5	c	All	36	c			56	c	7.5	c
Cadmium	7440-43-9	0.36	a	All	32	a	140	a	0.36	a	0.77	a
Chromium - Total	7440-47-3	28	c	All					45	c	28	c
Chromium III	16065-83-1	18	a	All			18	a	34	a	26	a
Chromium VI	18540-29-9	0.35	c	All	0.35	c	7.8	a	81	a	190	c
Cobalt	7440-48-4	13	a	All	13	a			230	a	120	a
Copper	7440-50-8	28	a	All	70	a	80	a	49	a	28	a
Iron	7439-89-6	Narrative	a	All			Narrative	a				
Lead	7439-92-1	11	a	All	120	a	1,700	a	56	a	11	a
Lithium	7439-93-2	2	b	P, M	2	b			38	c		
Manganese	7439-96-5	220	a	All	220	a	450	a	4,000	a	4,300	a
Mercury (total)	7439-97-6	0.1	b	All	0.3	b	0.1	b	1.7	c	0.013	c
Methylmercury	22967-92-6	0.00051	b	All	0.3	b	0.1	b	0.0031	c	0.00035	c
Molybdenum	7439-98-7	2	b	All	2	b			4.8	b	17	c
Nickel	7440-02-0	38	a	All	38	a	280	a	130	a	210	a
Selenium	7782-49-2	0.52	a	All	0.52	a	4.1	a	0.63	a	1.2	a
Silver	7440-22-4	4.2	a	All	560	a			14	a	4.2	a
Strontium	7440-24-6	96	c	M					96	c		
Thallium	7440-28-0	0.22	c	All	1	b			0.22	c	6.3	c
Tin	7440-31-5	50	b	P	50	b						
Uranium	7440-61-1	25	c	All	25	c			220	c	1,600	c
Vanadium	7440-62-2	7.8	a	All	60	c			280	a	7.8	a
Zinc	7440-66-6	46	a	All	160	a			79	a	46	a
Other Inorganics												
Ammonia	7664-41-7											
Bromine (total)	7726-95-6	10	b	P	10	b						
Cyanide (free)	57-12-5	0.1	c	SI, A			0.9	f			0.1	c
Fluoride	16984-48-8	32	c	M, A					580	c	32	c
Fluorine[†]	7782-41-4	200	b	P	200	b						
Iodine	7553-56-2	4	b	P	4	b						

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3

Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Chlorinated Alkanes												
1,1,1,2-Tetrachloroethane	630-20-6	0.07	d	SI			0.07	d				
1,1,2,2-Tetrachloroethane	79-34-5	0.19	d	SI			0.19	d				
1,1,1-Trichloroethane	71-55-6	0.04	d	All			0.04	d	260	c		
1,1,2-Trichloroethane	79-00-5	0.32	d	All			0.32	d				
1,1-Dichloroethane	75-34-3	0.14	d	All			0.14	d	210	c		
1,2-Dichloroethane	107-06-2	0.4	d	All			0.40	d	27	c	1.4	c
1,2-Dichloropropane	78-87-5	0.28	d	All			0.28	d				
Dichloromethane (Methylene chloride)	75-09-2	0.21	d	All	1,600	c	0.21	d	2.6	c		
Trichloromethane (chloroform)	67-66-3	0.05	d	All			0.05	d	8	c		
Tetrachloromethane (Carbon tetrachloride)	56-23-5	0.05	d	All			0.05	d				
Chlorinated Alkenes												
1,1-Dichloroethene/ethylene	75-35-4	0.04	d	All			0.04	d	11	c		
1,2-Dichloroethene (cis and trans)	540-59-0	0.04	d	All			0.04	d	23	c		
1,2-cis-Dichloroethyene	156-59-2	0.04	d	All			0.04	d				
1,2-trans-Dichloroethylene	156-60-5	0.04	d	All			0.04	d				
1,3-Dichloropropene	542-75-6	0.0	d	All			0.001	d				
Tetrachloroethene	127-18-4	0.06	d	All	10	c	0.06	d	0.18	c		
1,1,2-Trichloroethylene (TCE)	79-01-6	0.06	d	All			0.06	d	42	c		
Vinyl chloride	75-01-4	0.03	d	All			0.03	d	0.12	c		
Chlorobenzenes												
Chlorobenzene	108-90-7	2.4	c	All			2.4	c	43	c		
1,2-Dichlorobenzene	95-50-1	0.09	d	All			0.09	d	0.92	c		
1,3-Dichlorobenzene	541-73-1	0.1	d	All			0.08	d	0.73	c		
1,4-Dichlorobenzene	106-46-7	0.88	c	SI, M			1.2	c	0.88	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,4-Trichlorobenzene	120-82-1	0.27	c	All			1.2	c	0.27	c		
1,3,5-Trichlorobenzene	108-70-3	0.07	d	All			0.07	d				
Monoaromatic Hydrocarbons												
1,2,4-Trimethylbenzene	95-63-6	0.09	d	All			0.09	d				
1,3,5-Trimethylbenzene	108-67-8	0.16	d	All			0.16	d				
Benzene	71-43-2	0.12	d	All			0.12	d	24	c		
Cymene, p- (4-Isopropyltoluene)	99-87-6	0.18	d	All			0.18	d				
Ethylbenzene	100-41-4	0.27	d	All			0.27	d				
Isopropylbenzene (Cumene)	98-82-8	0.04	d	All			0.04	d				
Styrene (Vinyl benzene)	100-42-5	1.2	c	All	3.2	c	1.2	c				
Toluene	108-88-3	0.15	d	All	200	c	0.15	d	23	c		
Xylenes (total)	1330-20-7	0.1	d	All	100	c	0.1	d	1.4	c	41	c

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Ketones												
2-Butanone (Methyl Ethyl Ketone)	78-93-3	1.0	d	All			1.0	d	360	c		
2-Hexanone	591-78-6	0.36	c	SI, M, A			2.5	d	5.4	c	0.36	c
Acetone	67-64-1	1.2	c	M, A			0.04	d	1.2	c	14	c
Other VOCs												
Tribromomethane (Bromoform)	75-25-2	0.07	d	All			0.07	d				
Bromomethane (methyl bromide)	74-83-9	0.002	d	All			0.002	d				
Carbon Disulfide	75-15-0	0.005	d	All			0.005	d	0.82	c		
Ethylene glycol	107-21-1	0.31	d	All			0.31	d				
Hexachloroethane	67-72-1	0.024	d	All			0.024	d				
Hexane	110-54-3	0.007	d	All			0.007	d				
Tert-butyl methyl ether (MTBE)	1634-04-4	12.5	c	SI			12.5	c				
Semivolatile Organic Compounds (SVOCs)												
Chloroanilines												
3-Chloroaniline	108-42-9	20	b	P, SI	20	b	30	b				
4-Chloroaniline	106-47-8	1.0	c	P, SI	1	c	1.8	c				
3,4-Dichloroaniline	95-76-1	20	b	SI			20	b				
2,4,5-Trichloroaniline	636-30-6	20	b	P, SI	20	b	20	b				
Pentachloroaniline	527-20-8	0.62	d	SI			0.62	d				
Chlorobenzenes												
1,3-Dichlorobenzene	99-65-0	0.08	d	All			0.08	d	0.73	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,3,4-Tetrachlorobenzene	634-66-2	0.08	d	All			0.08	d				
1,2,4,5-Tetrachlorobenzene	95-94-3	0.18	d	All			0.18	d				
Hexachlorobenzene	118-74-1	0.079	c	All	10	c	10	c	0.2	c	0.079	c
Pentachlorobenzene	608-93-5	0.11	d	All			0.11	d				
Dichlorophenols												
Dichlorophenols (2,3-), (2,4-), (2,5-), (2,6-)	120-83-2	0.05	d	All			0.05	d				
3,4-Dichlorophenols (3,4-), (3,5-)	95-77-2	20	b	P, SI	20	b	20	b				
Trichlorophenols												
2,4,5-Trichlorophenol	95-95-4	0.03	d	All	4	b	0.03	d				
2,4,6-Trichlorophenol	88-06-2	0.09	d	All			0.09	d				
Tetrachlorophenols												
2,3,4,5-Tetrachlorophenol	4901-51-3	20	b	SI			20	b				
Tetrachlorophenols (2,3,4,6-), (2,3,5,6-)	58-90-2	0.04	d	All			0.04	d				

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Other Phenols												
Chlorophenols (2-), (4-)	95-57-8	0.06	d	All			0.06	d	0.54	c	0.69	c
3-Chlorophenol	108-43-0	7	b	P, SI	7	b	10	b				
2,4-Dimethylphenol	105-67-9	0.04	d	SI			0.04	d				
2,4-Dinitrophenol	51-28-5	0.15	d	All	20	b	0.15	d				
4-Nitrophenol	100-02-7	7	b	SI			7	b				
2-Methylphenol (Cresol, o-)	95-48-7	0.1	d	All	0.67	c	0.1	d	590	c		
3-Methylphenol (Cresol, m-)	108-39-4	0.09	d	All	0.69	c	0.09	d				
4-Methylphenol (Cresol, p-)	106-44-5	0.08	d	All			0.08	d				
Nonylphenol	25154-52-3	1.27	d	SI			1.27	d				
Pentachlorophenol (PCP)	87-86-5	2.1	a	All	5	a	31	a	2.8	a	2.1	a
Phenol	108-95-2	0.79	c	All	0.79	c	1.8	c	38	c		
Energetic SVOCs												
2-Amino-4,6-dinitrotoluene	35572-78-2	14	c	SI, M, P	14	c	43	c	15	c		
4-Amino-2,6-dinitrotoluene	19406-51-0	12	c	SI, M, P	33	c	18	c	12	c		
1,3- Dinitrobenzene	99-65-0	0.073	d	All			0.034	d	0.073	c	0.15	c
2,4-Dinitrotoluene	121-14-2	6	c	SI, M, P	6	c	18	c	13	c		
2,6-Dinitrotoluene	606-20-2	4.1	c	All			30	c	4.1	c	52	c
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	16	c	SI, M, P	2,700	c	16	c	300	c		
Nitroglycerine	55-63-0	13	c	SI, M			13	c	71	c		
2-Nitrotoluene	88-72-2	0.19	d	All			0.19	d	9.9	c		
3-Nitrotoluene	99-08-1	0.13	d	All			0.13	d	12	c		
4-Nitrotoluene	99-99-0	0.14	d	All			0.14	d	22	c		
PETN (Pentaerythrite-tetranitrate)	78-11-5	100	c	M					100	c		
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	2.3	c	All			8.4	c	16	c	2.3	c
Tetryl (Methyl-2,4,6-trinitrophenylnitroamine)	479-45-8	1.5	c	M					1.5	c		
1,3,5-Trinitrobenzene	99-35-4	10	c	SI, M			10	c	120	c		
2,4,6-Trinitrotoluene (TNT)	118-96-7	7.6	c	All	62	c	32	c	96	c	7.6	c
Other SVOCs												
1,1'-Biphenyl	92-52-4	0.2	d	All	60	b	0.2	d				
3,3'- Dichlorobenzidine	91-94-1	0.03	d	All			0.03	d				
Benzoic acid	65-85-0	0.01	d	All			0.01	d	1	c		
Benzyl Alcohol	100-51-6	0.001	d	All			0.001	d	120	c		
Carbazole	86-74-8	0.16	d	All			0.16	d	80	c		
Dibenzofuran	132-64-9	0.15	d	All	6.1	c	0.15	d				
Hexachlorobutadiene	87-68-3	0.1	d	SI			0.1	d				
Hexachlorocyclopentadiene	77-47-4	0.001	d	All	10	b	0.001	d				
N-Nitrosodiphenylamine	86-30-6	0.12	d	All			0.12	d				
Nitrobenzene	98-95-3	2.2	c	SI, M			2.2	c	4.9	c		
Pentachloronitrobenzene	82-68-8	0.7	c	M, A					11	c	0.7	c

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Phthalates												
Bis(2-ethylhexyl) phthalate	117-81-7	0.02	c	All			0.23	d	0.59	c	0.02	c
Butylbenzyl phthalate	85-68-7	0.59	d	All			0.59	d	90	c		
Diethylphthalate	84-66-2	0.23	d	All	100	c	0.23	d	3,600	c		
Dimethylphthalate	131-11-3	0.35	d	All			10	c	38	c		
Di-n-butyl phthalate	84-74-2	0.011	c	All	160	c	0.22	d	180	c	0.011	c
Di-n-octyl phthalate	117-84-0	0.21	c	All			0.21	d	0.91	c		
Polycyclic Aromatic Hydrocarbons (PAHs)												
Low Molecular Weight PAHs												
Acenaphthene	83-32-9	See Total			0.25	c			120	c		
Acenaphthylene	208-96-8	See Total							120	c		
Anthracene	120-12-7	See Total			6.8	c			210	c		
Fluorene	86-73-7	See Total					3.7	c	250	c		
1-Methyl naphthalene	90-12-0	See Total										
2-Methylnaphthalene	91-57-6	See Total							16	c		
2,6-Dimethyl naphthalene	581-42-0	See Total										
2,3,5-Trimethylnaphthalene	2245-38-7	See Total										
Naphthalene	91-20-3	See Total			1.0	c			9.7	c	5.7	c
1-Methyl phenanthrene	832-69-9	See Total										
Phenanthrene	85-01-8	See Total					5.5	c	10	c		
Total LMWPAHs	-	**29**	a	All			29	a	100	a		
High Molecular Weight PAHs												
Benzo(a)anthracene	56-55-3	See Total			18	c			3	c	1	c
Benzo(b)fluoranthene	205-99-2	See Total			18	c			38	c		
Benzo(k)fluoranthene	207-08-9	See Total							62	c		
Benzo(ghi)perylene	191-24-2	See Total							24	c		
Benzo(a)pyrene	50-32-8	See Total							53	c		
Benzo(e)pyrene	192-97-2	See Total										
Chrysene	218-01-9	See Total							2.4	c		
Dibenzo(a,h)anthracene	53-70-3	See Total							12	c		
Fluoranthene	206-44-0	See Total					10	c	22	c		
Indeno(1,2,3-cd)pyrene	193-39-5	See Total							62	c		
Perylene	198-55-0	See Total										
Pyrene	129-00-0	See Total					10	c	22	c	34	c
Total HMWPAHs	-	1.1	a	M			18	a	1.1	a		

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Pesticides/Herbicides												
Acrolein	107-02-8	0.0001	d	All			0.0001	d				
Aldrin	309-00-2	0.037	c	SI, M			0.048	d	0.037	c		
Atrazine	1912-24-9	0.073	d	SI			0.073	d				
BHC - alpha	319-84-6	0.34	d	SI, M			0.34	d	58	c		
BHC - beta	319-85-7	0.27	c	M, A			0.0003	d	0.27	c	14	c
BHC - gamma (Lindane)	58-89-9	0.0094	c	P, M, A	0.1	c	0.0013	d	0.0094	c	0.21	c
Carbaryl	63-25-2	0.0025	d	All			0.0025	d				
Carbofuran	1563-66-2	0.0001	d	All			0.0001	d				
Chlordane - alpha	5103-71-9	0.27	c	P, M, A	2.2	c	0.17	d	0.27	c	0.28	c
Chlordane - gamma	12789-03-6	2.2	c	P, M, A	2.2	c	0.17	d	2.2	c	2.3	c
Chloropyrifos	2921-88-2	0.0035	d	All			0.0035	d				
Dinoseb	88-85-7	0.0054	d	All			0.0054	d				
DDD (sum 4,4- & 2,4-DDD)	50-29-3	0.0063	c	M, A			0.0001	d	4.1	c	0.0063	c
DDE (sum 4,4- & 2,4-DDE)	72-55-9	0.11	c	M, A			0.0038	d	3.7	c	0.11	c
DDT (sum 4,4- & 2,4-DDT)	72-54-8	0.044	c	All	4.1	c	3.37	d	0.044	c	0.36	c
DDT/DDE/DDD (total)	--	0.021	a	All					0.021	a	0.093	a
Diazinon	333-41-5	0.002	d	All			0.002	d				
Dieldrin	60-57-1	0.0049	a	All	10	c	0.1	d	0.0049	a	0.021	a
Endosulfan - alpha	959-98-8	0.64	c	M, A			0.0009	d	0.64	c	22	c
Endosulfan (alpha and beta)	115-29-7	0.0009	d	All			0.0009	d				
Endosulfan sulfate	1031-07-8	0.0065	d	All			0.0065	d				
Endrin	72-20-8	0.0014	c	All	0.0034	c	0.025	d	0.023	c	0.0014	c
Guthion	86-50-0	0.0006	d	All			0.0006	d				
Heptachlor	76-44-8	0.059	c	All	0.4	c	0.29	d	0.059	c	0.3	c
Heptachlor epoxide	1024-57-3	0.0004	d	All			0.0004	d				
Hexachlorocyclopentadiene	77-47-4	0.0008	d	All			0.0008	d				
Kepone (Chlordecone)	143-50-0	0.021	c	All			17	d	0.021	c	1.3	c
Malathion	121-75-5	0.0001	d	All			0.0001	d				
Methoxychlor	72-43-5	5	c	M, A			0.0025	d	5	c	18	c
Mirex	2385-85-5	0.014	d	All			0.014	d				
Parathion	56-38-2	0.0005	d	All			0.0005	d				
2,4,5-TP (Silvex)	93-72-1	12	d	SI			12	d				
Simazine	122-34-9	0.0001	d	All			0.0001	d				
Toxaphene	8001-35-2	4.1	d	M, A			0.38	d	5.9	c	4.1	c
Trifluralin	1582-09-8	0.0002	d	All			0.0002	d				

EPA Region 4 Screening Tables for Soil, Sediment, and Surface Water

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans												
PCDDs, PCDFs (TEQ)	1746-01-6	0.0088	d	All			0.0088	d				
PCBs (sum) (Wildlife Based)	1336-36-3	0.33	d	All	40	b	0.33	d				
Aroclor-1016	12674-11-2	1	c	All					1	c		
Aroclor-1242	53469-21-9	0.041	c	All					0.38	c	0.041	c
Aroclor-1248	12672-29-6	0.0072	c	All					0.0072	c	0.041	c
Aroclor-1254	11097-69-1	0.014	c	All	160	c			0.44	c	0.041	c
Aroclor-1260	11096-82-5	0.88	c	All					10	c	0.88	c
Other												
2-Nitroaniline	88-74-4	5.4	c	M					5.4	c		
Diphenylamine	122-39-4	10	c	M, A					10	c	73	c
Trichlorofluoromethane	75-69-4	52	c	M					52	c		

Notes:
Sreening values in mg/kg.
All - ESV for protection of all receptors
A - ESV for protection of Avians
M - ESV for protection of Mammals
P - ESV for protection of Plants
SI - ESV for protection of soil invertebrates

LMWPAHs have less than 4 rings
HMWPAHs have 4 or more rings

Table 3 Sources:
a - USEPA (2007): Ecological Soil Screening Levels. http://www.epa.gov/ecotox/ecossl/
b - Oak Ridge National Laboratory:

Efroymson, R.A., M.E. Will, and G.W. Suter. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-126/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf

Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-95/R4. http://www.esd.ornl.gov/programs/ecorisk/documents/tm85r3.pdf

Efroymson, R.A., G.W. Suter, II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals for Ecological Endpoints. Oak Ridge National Laboratory, Oak Ridge, TN. 50 pp. ES/ER/TM-162/R2

c - Los Alamos National Laboratory (LANL). 2012. ECORISK Database Release 3.2. Environmental Programs, Engineering and Technology Division. September 2013. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

d - ECOSAR & Region 4 soil model. See text Section 6.3.

Attachment D-3.

LANL No Effect and Low Effect ESLs
Los Alamos National Laboratory ECORISK Database Table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Levels
(accessed November 4, 2016)

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LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		Sediment	Soil	Sediment	Soil
Acenaphthene	mg/kg	0.076	0.25	0.76	2
Acenaphthylene	mg/kg	0.076	120	0.76	1200
Acetone	mg/kg	0.065	1.2	0.65	6.3
Aldrin	mg/kg		0.037		0.18
Aluminum	mg/kg				
Americium-241	pCi/g	220	190	2200	1900
Amino-2,6-dinitrotoluene[4-]	mg/kg	15	12	150	120
Amino-4,6-dinitrotoluene[2-]	mg/kg	20	14	200	140
Anthracene	mg/kg	0.057	6.8	0.57	9
Antimony	mg/kg	50	2.4	500	24
Aroclor 1016	mg/kg	0.059	1	0.59	3.1
Aroclor 1242	mg/kg	0.054	0.041	0.54	0.41
Aroclor 1248	mg/kg	0.009	0.0072	0.09	0.072
Aroclor 1254	mg/kg	0.054	0.041	0.54	0.41
Aroclor 1260	mg/kg	0.059	0.88	0.59	1.2
Arsenic	mg/kg	9.7	6.8	33	68
Barium	mg/kg	150	110	300	260
Benzene	mg/kg	0.01	24	0.1	240
Benzo[a]anthracene	mg/kg	0.1	0.8	1	8
Benzo[a]pyrene	mg/kg	0.15	53	1.4	170
Benzo[b]fluoranthene	mg/kg	0.19	18	1.9	180
Benzo(g,h,i)perylene	mg/kg	0.17	24	1.7	240
Benzo[k]fluoranthene	mg/kg	0.24	62	2.4	620
Benzoic Acid	mg/kg	1.3	1	13	10
Benzyl Alcohol	mg/kg	330	120	3300	1200
Beryllium	mg/kg	73	2.5	730	25
BHC[alpha-]	mg/kg		58		580
BHC[beta-]	mg/kg	0.005	0.27	0.05	1.3
BHC[gamma-]	mg/kg	0.0023	0.0094	0.0049	0.094
Bis(2-ethylhexyl)phthalate	mg/kg	0.026	0.02	0.26	0.2
Boron	mg/kg	10	2	54	10
Butanone[2-]	mg/kg	3300	360	8700	930
Butyl Benzyl Phthalate	mg/kg	0.1	90	1	900
Cadmium	mg/kg	0.33	0.27	3.3	2.7
Carbazole	mg/kg		80		800
Carbon Disulfide	mg/kg		0.82		8.2

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		Sediment	Soil	Sediment	Soil
Cesium-134	pCi/g	330	550	3300	5500
Cesium-137 + Barium-137	pCi/g	720	1200	7200	12000
Chlordane[alpha-]	mg/kg	0.0032	0.27	0.017	2.7
Chlordane[gamma-]	mg/kg	0.0032	2.2	0.017	22
Chloroaniline[4-]	mg/kg		1		10
Chlorobenzene	mg/kg	0.03	2.4	0.3	24
Chloroform	mg/kg	10	8	28	22
Chlorophenol[2-]	mg/kg	0.055	0.39	0.55	3.9
Chromium (total)	mg/kg	43	28	110	280
Chromium(+6)	mg/kg	680	0.34	6800	3.4
Chrysene	mg/kg	0.16	2.4	1.2	24
Cobalt	mg/kg	230	13	2300	130
Cobalt-60	pCi/g	210	760	2100	7600
Copper	mg/kg	23	15	70	46
Cyanide (total)	mg/kg	0.1	0.1	1	1
DDD[4,4'-]	mg/kg		0.0063		0.033
DDE[4,4'-]	mg/kg	0.0031	0.11	0.031	0.55
DDT[4,4'-]	mg/kg	0.0041	0.044	0.041	0.22
Dibenzo(a,h)anthracene	mg/kg	0.033	12	0.33	120
Dibenzofuran	mg/kg	0.51	6.1	5.1	61
Dichlorobenzene[1,2-]	mg/kg		0.92		9.2
Dichlorobenzene[1,3-]	mg/kg		0.73		7.3
Dichlorobenzene[1,4-]	mg/kg	0.03	0.88	0.3	3.5
Dichloroethane[1,1-]	mg/kg	0.02	210	0.2	2100
Dichloroethane[1,2-]	mg/kg	6.3	0.85	12	1.6
Dichloroethene[1,1-]	mg/kg	0.1	11	1	110
Dichloroethene[cis/trans-1,2-]	mg/kg	0.2	23	2	230
Dieldrin	mg/kg	0.0019	0.0045	0.019	0.009
Diethyl Phthalate	mg/kg		100		1000
Dimethyl Phthalate	mg/kg	100	10	1000	100
Di-n-Butyl Phthalate	mg/kg	0.011	0.011	0.11	0.11
Dinitrobenzene[1,3-]	mg/kg	1.2	0.073	2.9	0.17
Dinitrotoluene[2,4-]	mg/kg	0.29	6	2.9	60
Dinitrotoluene[2,6-]	mg/kg	9.7	4.1	97	41
Di-n-octylphthalate	mg/kg	1.1	0.91	11	9.1
Diphenylamine	mg/kg		10		17

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		Sediment	Soil	Sediment	Soil
Endosulfan	mg/kg	0.00001	0.64	0.0001	6.4
Endrin	mg/kg	0.0019	0.0014	0.019	0.014
Europium-152	pCi/g	17	520	170	5200
Fluoranthene	mg/kg	0.42	10	2.2	23
Fluorene	mg/kg	0.077	3.7	0.53	19
Fluoride	mg/kg	360	150	3600	1500
Heptachlor	mg/kg	0.0024	0.059	0.016	0.59
Hexachlorobenzene	mg/kg		0.079		0.79
Hexanone[2-]	mg/kg		0.36		3.6
HMX	mg/kg	130	16	170	160
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	62	2	620
Iodomethane	mg/kg		0.038		0.077
Iron	mg/kg	20000		40000	
Kepone	mg/kg	0.027	0.021	0.13	0.1
Lead	mg/kg	27	14	54	28
Lead-210	pCi/g	740	1200	7400	12000
Lithium	mg/kg	150	38	730	180
Manganese	mg/kg	460	220	1100	1100
Mercury (inorganic)	mg/kg	0.018	0.013	0.18	0.13
Mercury (methyl)	mg/kg	0.00046	0.00035	0.0046	0.0035
Methoxychlor[4,4'-]	mg/kg	0.03	5	0.3	10
Methyl-2-pentanone[4-]	mg/kg		9.8		98
Methylene Chloride	mg/kg	0.018	2.6	0.18	22
Methylnaphthalene[2-]	mg/kg	0.076	16	0.76	160
Methylphenol[2-]	mg/kg		0.67		7
Methylphenol[3-]	mg/kg		0.69		7
Molybdenum	mg/kg	27	17	270	170
Naphthalene	mg/kg	0.17	1	0.56	10
Neptunium-237	pCi/g	12	50	120	500
Nickel	mg/kg	13	9.7	27	19
Nitroaniline[2-]	mg/kg		5.4		10
Nitrobenzene	mg/kg	27	2.2	270	22
Nitroglycerine	mg/kg	1700	13	18000	130
Nitrotoluene[2-]	mg/kg	28	9.9	280	99
Nitrotoluene[3-]	mg/kg	24	12	240	120
Nitrotoluene[4-]	mg/kg	52	22	520	220

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		Sediment	Soil	Sediment	Soil
Pentachloronitrobenzene	mg/kg	0.92	0.7	9.2	7
Pentachlorophenol	mg/kg	0.01	0.36	0.1	3.6
PETN	mg/kg	1400	100	14000	1000
Phenanthrene	mg/kg	0.2	5.5	1.1	12
Phenol	mg/kg	840	0.79	8400	8
Plutonium-238	pCi/g	110	820	1100	8200
Plutonium-239, 240	pCi/g	110	870	1100	8700
Plutonium-241	pCi/g	280000	17000	2800000	170000
Pyrene	mg/kg	0.19	10	1.5	20
Radium-226	pCi/g	0.21	1.5	2.1	15
Radium-228	pCi/g	0.26	1.2	2.6	12
RDX	mg/kg	3.3	2.3	6.3	4.4
Selenium	mg/kg	0.72	0.52	2.9	3
Silver	mg/kg	0.5	2.6	5	26
Sodium-22	pCi/g	11000	4000	110000	40000
Strontium (stable)	mg/kg	1700	96	17000	960
Strontium-90 + Yittrium-90	pCi/g	150	340	1500	3400
Styrene	mg/kg		1.2		12
Tetrachlorodibenzodioxin[2,3,7,8-]	mg/kg	0.00000036	0.00000029	0.0000024	0.0000019
Tetrachloroethene	mg/kg	0.002	0.18	0.02	0.94
Tetryl	mg/kg	100	1.5	490	7.2
Thallium	mg/kg	0.82	0.05	8.2	0.5
Thorium-228	pCi/g	290	43	2900	430
Thorium-229	pCi/g	110	47	1100	470
Thorium-230	pCi/g	120	52	1200	520
Thorium-232	pCi/g	15	6.2	150	62
Titanium	mg/kg	98	72	980	720
Toluene	mg/kg	0.01	23	0.1	230
Toxaphene (Technical Grade)	mg/kg	0.0001	4.1	0.001	41
Trichlorobenzene[1,2,4-]	mg/kg	0.011	0.27	0.11	2.7
Trichloroethane[1,1,1-]	mg/kg	0.07	260	0.7	2600
Trichloroethene	mg/kg	0.078	42	0.78	420
Trichlorofluoromethane	mg/kg		52		350
Trinitrobenzene[1,3,5-]	mg/kg	1.1	10	1.5	28
Trinitrotoluene[2,4,6-]	mg/kg	25	7.6	32	13
Tritium	pCi/g	660000	36000	6600000	360000

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		Sediment	Soil	Sediment	Soil
Uranium	mg/kg	100	25	1000	250
Uranium-233	pCi/g	620	440	6200	4400
Uranium-234	pCi/g	620	440	6200	4400
Uranium-235	pCi/g	670	440	6700	4400
Uranium-236	pCi/g	660	470	6600	4700
Uranium-238	pCi/g	690	400	6900	4000
Vanadium	mg/kg	30	6.7	61	13
Vinyl Chloride	mg/kg		0.12		1.2
Xylene (Total)	mg/kg	0.13	1.4	1.3	1.7
Zinc	mg/kg	65	48	650	480

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL	Low Effect ESL
		Water	Water
Acenaphthene	µg/L	5.8	58
Acenaphthylene	µg/L	4800	48000
Acetone	µg/L	1500	15000
Aluminum	µg/L	530	1300
Americium-241	pCi/L	5.8	58
Amino-2,6-dinitrotoluene[4-]	µg/L	43000	430000
Amino-4,6-dinitrotoluene[2-]	µg/L	62000	620000
Anthracene	µg/L	0.73	7.3
Antimony	µg/L	30	88
Aroclor 1016	µg/L	0.014	0.14
Aroclor 1242	µg/L	0.014	0.14
Aroclor 1248	µg/L	0.014	0.14
Aroclor 1254	µg/L	0.014	0.14
Aroclor 1260	µg/L	0.014	0.14
Arsenic	µg/L	150	340
Barium	µg/L	3.9	39
Benzene	µg/L	46	460
Benzo[a]anthracene	µg/L	0.027	0.27
Benzo[a]pyrene	µg/L	0.014	0.14
Benzo[b]fluoranthene	µg/L	9	90
Benzo(g,h,i)perylene	µg/L	7.6	76
Benzo[k]fluoranthene	µg/L	0.0041	0.041
Benzoic Acid	µg/L	42	420
Beryllium	µg/L	0.66	6.6
BHC[beta-]	µg/L	2.2	22
BHC[gamma-]	µg/L	0.095	0.95
Bis(2-ethylhexyl)phthalate	µg/L	32	320
Boron	µg/L	1.6	16
Butanone[2-]	µg/L	7200	71000
Butyl Benzyl Phthalate	µg/L	19	190
Cadmium	µg/L	0.28	0.91
Cesium-134	pCi/L	470	4700
Cesium-137 + Barium-137	pCi/L	1100	11000
Chlordane[alpha-]	µg/L	0.0043	0.043
Chlordane[gamma-]	µg/L	0.0043	0.043
Chloride	µg/L	230	860
Chlorobenzene	µg/L	130	1300
Chloroform	µg/L	1.8	18

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL	Low Effect ESL
		Water	Water
Chlorophenol[2-]	µg/L	490	4300
Chromium (total)	µg/L	11	16
Chromium(+6)	µg/L	11	16
Chrysene	µg/L	0.0018	0.018
Cobalt	µg/L	3	30
Cobalt-60	pCi/L	380	3800
Copper	µg/L	5	7
Cyanide (total)	µg/L	5.2	22
DDE[4,4'-]	µg/L	100	1000
DDT[4,4'-]	µg/L	0.001	0.01
Dibenzo(a,h)anthracene	µg/L	0.0034	0.034
Dibenzofuran	µg/L	3.7	37
Dichlorobenzene[1,4-]	µg/L	15	150
Dichloroethane[1,1-]	µg/L	47	470
Dichloroethane[1,2-]	µg/L	100	1000
Dichloroethene[1,1-]	µg/L	25	250
Dichloroethene[cis/trans-1,2-]	µg/L	590	1100
Dieldrin	µg/L	0.056	0.24
Dimethyl Phthalate	µg/L	3	30
Di-n-Butyl Phthalate	µg/L	19	190
Dinitrobenzene[1,3-]	µg/L	16	160
Dinitrotoluene[2,4-]	µg/L	65	330
Dinitrotoluene[2,6-]	µg/L	230	330
Di-n-octylphthalate	µg/L	3	30
Endosulfan	µg/L	0.056	0.22
Endrin	µg/L	0.036	0.086
Europium-152	pCi/L	100	1000
Fluoranthene	µg/L	0.04	0.4
Fluorene	µg/L	3.9	39
Fluoride	µg/L	20	200
Heptachlor	µg/L	0.0038	0.038
HMX	µg/L	330000	890000
Indeno(1,2,3-cd)pyrene	µg/L	4.3	43
Iron	µg/L	1000	10000
Kepone	µg/L	350	1700
Lead	µg/L	1	10
Lead-210	pCi/L	250	2500
Manganese	µg/L	1300	2300

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL	Low Effect ESL
		Water	Water
Mercury (inorganic)	µg/L	0.77	1.4
Mercury (methyl)	µg/L	0.0028	0.028
Methoxychlor[4,4'-]	µg/L	0.03	0.3
Methylene Chloride	µg/L	210	2100
Methylnaphthalene[2-]	µg/L	330	3300
Molybdenum	µg/L	1800	7900
Naphthalene	µg/L	1.1	11
Neptunium-237	pCi/L	7.9	79
Nickel	µg/L	29	260
Nitrobenzene	µg/L	550	2200
Nitroglycerine	µg/L	430000	4500000
Nitrotoluene[2-]	µg/L	39000	390000
Nitrotoluene[3-]	µg/L	47000	470000
Nitrotoluene[4-]	µg/L	87000	870000
Pentachloronitrobenzene	µg/L	10	100
Pentachlorophenol	µg/L	15	19
Perchlorate Ion	µg/L	35000	120000
PETN	µg/L	310000	3100000
Phenanthrene	µg/L	6.3	30
Phenol	µg/L	320	3200
Plutonium-238	pCi/L	19	190
Plutonium-239, 240	pCi/L	20	200
Plutonium-241	pCi/L	420	4200
Pyrene	µg/L	0.025	0.25
Radium-226	pCi/L	0.1	1
Radium-228	pCi/L	0.09	0.9
RDX	µg/L	44000	440000
Selenium	µg/L	5	20
Silver	µg/L	0.1	1
Sodium-22	pCi/L	90000	900000
Strontium (stable)	µg/L	1500	15000
Strontium-90 + Yittrium-90	pCi/L	570	5700
Tetrachlorodibenzodioxin [2,3,7,8-]	µg/L	0.000002	0.00002
Tetrachloroethene	µg/L	98	830
Tetryl	µg/L	5800	27000
Thallium	µg/L	0.03	0.3
Thorium-228	pCi/L	5.9	59

LANL No Effect and Low Effect ESLs

Analyte Name	Units	No Effect ESL	Low Effect ESL
		Water	Water
Thorium-229	pCi/L	6.3	63
Thorium-230	pCi/L	6.8	68
Thorium-232	pCi/L	0.81	8.1
Titanium	µg/L	70000	700000
Toluene	µg/L	9.8	98
Toxaphene (Technical Grade)	µg/L	0.0002	0.002
Trichlorobenzene[1,2,4-]	µg/L	24	240
Trichloroethane[1,1,1-]	µg/L	11	110
Trichloroethene	µg/L	21	210
Trinitrobenzene[1,3,5-]	µg/L	60000	600000
Trinitrotoluene[2,4,6-]	µg/L	40000	73000
Tritium	pCi/L	160000000	1600000000
Uranium	µg/L	5	50
Uranium-233	pCi/L	22	220
Uranium-234	pCi/L	22	220
Uranium-235	pCi/L	24	240
Uranium-236	pCi/L	23	230
Uranium-238	pCi/L	24	240
Vanadium	µg/L	19	190
Xylene (Total)	µg/L	13	130
Zinc	µg/L	65	85

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Attachment D-4.

SCDHEC Standards
South Carolina Department of Health and Environmental Control,
R.61 68 Water Classifications and Standards Table
for Protection of Freshwater Aquatic Life

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SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

APPENDIX: WATER QUALITY NUMERIC CRITERIA FOR THE PROTECTION OF AQUATIC LIFE AND HUMAN HEALTH

This appendix contains three charts (priority pollutants, nonpriority pollutants, and organoleptic effects) of numeric criteria for the protection of human health and aquatic life. The appendix also contains three attachments which address hardness conversions and application of ammonia criteria. Footnotes specific to each chart follow the chart. General footnotes pertaining to all are at the end of the charts prior to the attachments. The numeric criteria developed and published by EPA are hereby incorporated into this regulation. Please refer to the text of the regulation for other general information and specifications in applying these numeric criteria.

PRIORITY TOXIC POLLUTANTS

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
1	Antimony	7440360					5.6 B, ee	640 B, ee	6 ee	65FR66443 SDWA
2	Arsenic	7440382	340 A, D, K	150 A, D, K	69 A, D, Y	36 A, D, Y	10 C	10 C	10 C	65FR31682 57FR60848 SDWA
3	Beryllium	7440417					J, ee	J, ee	4 ee	65FR31682 SDWA
4	Cadmium	7440439	0.53 D, E, K	0.10 D, E, K	43 D, Y	9.3 D, Y	J, ee	J, ee	5 ee	65FR31682 SDWA
5a	Chromium III	16065831	580 D, E, K	28 D, E, K			J, ee	J, ee	100 Total ee	EPA820/B-96-001 65FR31682 SDWA
5b	Chromium VI	18540299	16 D, K	11 D, K	1,100 D, Y	50 D, Y	J, ee	J, ee	100 Total ee	65FR31682 SDWA
6	Copper	7440508	3.8 D, E, K, Z, ll	2.9 D, E, K, Z, ll	5.8 D, Z, Y, cc	3.7 D, Z, Y, cc	1,300 T, ee			65FR31682

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
7	Lead	7439921	14 D, E, Y	0.54 D, E, Y	220 D, Y	8.5 D, Y				65FR31682
8	Mercury	7439976	1.6 D, K, dd	0.91 D, K, dd	2.1 D, bb, dd	1.1 D, bb, dd	0.050 B, ee	0.051 B, ee	2 ee	65FR31682 SDWA
9	Nickel	7440020	150 D, E, K	16 D, E, K	75 D, Y	8.3 D, Y	610 B, ee	4, 600 B, ee		65FR31682
10	Selenium	7782492	L, Q, S	5.0 S	290 D, aa	71 D, aa	170 Z, ee	4,200 ee	50 ee	65FR31682 65FR66443 SDWA
11	Silver	7440224	0.37 D, E, G		2.3 D, G					65FR31682
12	Thallium	7440280					0.24	0.47	2 ee	68FR75510 SDWA
13	Zinc	7440666	37 D, E, K	37 D, E, K	95 D, Y	86 D, Y	7,400 T, ee	26,000 T, ee		65FR31682 65FR66443
14	Cyanide	57125	22 K, P	5.2 K, P	1 P, Y	1 P, Y	140 ee, jj	140 ee, jj	200 ee	EPA820/B-96-001 57FR60848 68FR75510 SDWA
15	Asbestos	1332214							7 million fibers/L L ee	57FR60848
16	2, 3, 7, 8-TCDD (Dioxin)	1746016						0.046 ppq O, C	30ppq O, C	State Standard SDWA
17	Acrolein	107028	3	3			6 ee, nn	9 ee, nn		74FR27535 74FR46587
18	Acrylonitrile	107131					0.051 B, C	0.25 B, C		65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
19	Benzene	71432					2.2 B, C	51 B, C	5 C	IRIS 01/19/00 65FR66443 SDWA
20	Bromate	15541454							10 C	SDWA
21	Bromoform	75252					4.3 B, C	140 B, C	80 Total THMs C	65FR66443 SDWA
22	Bromoacetic acid	79083							60 Total HAA5 C,mm	SDWA
23	Carbon Tetrachloride	56235					0.23 B, C	1.6 B, C	5 C	65FR66443 SDWA
24	Chlorite	67481							100	SDWA
25	Chlorobenzene	108907					130T, ee	1,600 T, ee	100 T, ee	68FR75510 SDWA
26	Chlorodibromomethane	124481					0.40 B, C	13 B, C	80 Total THMs C	65FR66443 SDWA
27	Chloroform	67663					5.7 B, C, hh	470 B, C, hh	80 Total THMs C	62FR42160 SDWA
28	Dibromoacetic acid	631641							60 Total HAA5 C, mm	SDWA
29	Dichloroacetic acid	79436							60 Total HAA5 C,mm	SDWA
30	Dichlorobromomethane	75274					0.55 B, C	17 B, C	80 Total THMs C	65FR66443 SDWA
31	1, 2-Dichloroethane	107062					0.38 B, C	37 B, C	5 C	65FR66443 SDWA

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
32	1, 1-Dichloroethylene	75354					330 ee	7,100 ee	7 C	68FR75510 SDWA
33	1, 2-Dichloropropane	78875					0.50 B, C	15 B, C	5 C	65FR66443 SDWA
34	1, 3-Dichloropropene	542756					0.34 ee	21 ee		68FR75510
35	Ethylbenzene	100414					530 ee	2,100 ee	700 ee	68FR75510 SDWA
36	Methyl Bromide	74839					47 B, ee	1,500 B, ee		65FR66443
37	Methylene Chloride	75092					4.6 B, C	590 B, C	5 C	65FR66443 SDWA
38	Monochloroacetic acid	79118							60 Total HAA5 C,mm	SDWA
39	1, 1, 2, 2-Tetrachloroethane	79345					0.17 B, C	4.0 B, C		65FR66443
40	Tetrachloroethylene	127184					0.69 C	3.3 C	5 C	65FR66443 SDWA
41	Toluene	108883					1,300 ee	15,000 ee	1000 ee	68FR75510 SDWA
42	1,2-Trans-Dichloroethylene	156605					140 ee	10,000 ee	100 ee	68FR75510 SDWA
43	Trichloroacetic acid	79039							60 Total HAA5 C,mm	SDWA

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
44	1, 1, 1-Trichloroethane	71556					J, ee	J, ee	200 ee	65FR31682 SDWA
45	1, 1, 2-Trichloroethane	79005					0.59 B, C	16 B, C	5 C	65FR66443 SDWA
46	Trichloroethylene	79016					2.5 C	30 C	5 C	65FR66443 SDWA
47	Vinyl Chloride	75014					0.025 kk	2.4 kk	2 C	68FR75510 SDWA
48	2-Chlorophenol	95578					81 B, T, ee	150 B, T, ee		65FR66443
49	2, 4-Dichlorophenol	120832					77 B, T, ee	290 B, T, ee		65FR66443
50	2, 4-Dimethylphenol	105679					380 B, T, ee	850 B, T, ee		65FR66443
51	2-Methyl- 4, 6-Dinitrophenol	534521					13 ee	280 ee		65FR66443
52	2, 4-Dinitrophenol	51285					69 B, ee	5,300 B, ee		65FR66443
53	Pentachlorophenol	87865	19 F, K	15 F, K	13 Y	7.9 Y	0.27 B, C	3.0 B, C, H	1 C	65FR31682 65FR66443 SDWA
54	Phenol	108952					10,000 T, ee, nn	860,000 T, ee, nn		74FR27535 74FR46587
55	2, 4, 6-Trichlorophenol	88062					1.4 B, C, T	2.4 B, C		65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
56	Acenaphthene	83329					670 B, T, ee	990 B, T, ee		65FR66443
57	Anthracene	120127					8,300 B, ee	40,000 B, ee		65FR66443
58	Benzidine	92875					0.000086 B, C	0.00020 B, C		65FR66443
59	Benzo (a) Anthracene	56553					0.0038 B, C	0.018 B, C		65FR66443
60	Benzo (a) Pyrene	50328					0.0038 B, C	0.018 B, C	0.2 C	65FR66443 SDWA
61	Benzo (b) Fluoranthene	205992					0.0038 B, C	0.018 B, C		65FR66443
62	Benzo (k) Fluoranthene	207089					0.0038 B, C	0.018 B, C		65FR66443
63	Bis-2-Chloroethyl Ether	111444					0.030 B, C	0.53 B, C		65FR66443
64	Bis-2-Chloroisopropyl Ether	108601					1,400 B, ee	65,000 B, ee		65FR66443
65	Bi-s2-Ethylhexyl Phthalate (DEHP)	117817	v	v	v	v	1.2 B, C	2.2 B, C	6 C	65FR66443 SDWA
66	Butylbenzene Phthalate	85687	ii	ii	ii	ii	1,500 B, ee	1,900 B, ee		65FR66443
67	2-Chloronaphthalene	91587					1,000 B, ee	1,600 B, ee		65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
68	Chrysene	218019					0.0038 B, C	0.018 B, C		65FR66443
69	Dibenzo(a,h)Anthracene	53703					0.0038 B, C	0.018 B, C		65FR66443
70	1, 2-Dichlorobenzene	95501					420 ee	1,300 ee	600 ee	68FR75510 SDWA
71	1, 3-Dichlorobenzene	541731					320 ee	960 ee		65FR66443
72	1, 4-Dichlorobenzene	106467					63 ee	190 ee	75 ee	68FR75510 SDWA
73	3, 3'-Dichlorobenzidine	91941					0.021 B, C	0.028 B, C		65FR66443
74	Diethyl Phthalate	84662	ii	ii	ii	ii	17,000 B, ee	44,000 B, ee		65FR66443
75	Dimethyl Phthalate	13113	ii	ii	ii	ii	270,000 B, ee	1,100,000 B, ee		64FR66443
76	Di-n-butyl Phthalate	84742	ii	ii	ii	ii	2,000 B, ee	4,500 B, ee		65FR66443
77	2, 4-Dinitrotoluene	121142					0.11 C	3.4 C		65FR66443
78	1, 2-Diphenylhydrazine	122667					0.036 B, C	0.20 B, C		65FR66443
79	Fluoranthene	206440					130 B, ee	140 B, ee		65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
80	Fluorene	86737					1,100 B, ee	5,300 B, ee		65FR66443
81	Hexachlorobenzene	118741					0.00028 B, C	0.00029 B, C	1 C	65FR66443 SDWA
82	Hexachlorobutadiene	87683					0.44 B, C	18 B, C		65FR66443
83	Hexachlorocyclo-pentadiene	77474					40 T, ee	1100 T, ee	50 ee	68FR75510 SDWA
84	Hexachloroethane	67721					1.4 B, C	3.3 B, C		65FR66443
85	Indeno 1,2,3(cd) Pyrene	193395					0.0038 B, C	0.018 B, C		65FR66443
86	Isophorone	78591					35 B, C	960 B, C		65FR66443
87	Nitrobenzene	98953					17 B, ee	690 B, H, T, ee		65FR66443
88	N-Nitrosodimethylamine	62759					0.00069 B, C	3.0 B, C		65FR66443
89	N-Nitrosodi-n-Propylamine	621647					0.0050 B, C	0.51 B, C		65FR66443
90	N-Nitrosodiphenylamine	86306					3.3 B, C	6.0 B, C		65FR66443
91	Pyrene	129000					830 B, ee	4,000 B, ee		65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
92	1, 2, 4-Trichlorobenzene	120821					35 ee	70 ee	70 ee	68FR75510 SDWA
93	Aldrin	309002	3.0 G, X		1.3 G, X		0.000049 B, C	0.000050 B, C		65FR31682 65FR66443
94	alpha-BHC	319846					0.0026 B, C	0.0049 B, C		65FR66443
95	beta-BHC	319857					0.0091 B, C	0.017 B, C		65FR66443
96	gamma-BHC (Lindane)	58899	0.95 K		0.16 G		0.98 ee	1.8 ee	0.2 C	65FR31682 68FR75510 SDWA
97	Chlordane	57749	2.4 G	0.0043 G, X	0.09 G	0.004 G, X	0.00080 B, C	0.00081 B, C	2 C	65FR31682 65FR66443 SDWA
98	4, 4'-DDT	50293	1.1 G, gg	0.001 G, X, gg	0.13 G, gg	0.001 G, X, gg	0.00022 B, C	0.00022 B, C		65FR31682 65FR66443
99	4, 4'-DDE	72559					0.00022 B, C	0.00022 B, C		65FR66443
100	4, 4'-DDD	72548					0.00031 B, C	0.00031 B, C		65FR66443
101	Dieldrin	60571	0.24 K	0.056 K, N	0.71 G	0.0019 G, X	0.000052 B, C	0.000054 B, C		65FR31682 65FR66443
102	alpha-Endosulfan	959988	0.22 G, W	0.056 G, W	0.034 G, W	0.0087 G, W	62 B, ee	89 B, ee		65FR31682 65FR66443

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
103	beta-Endosulfan	33213659	0.22 G, W	0.056 G, W	0.034 G, W	0.0087 G, W	62 B, ee	89 B, ee		65FR31682 65FR66443
104	Endosulfan Sulfate	1031078					62 B, ee	89 B, ee		65FR31682 65FR66443
105	Endrin	72208	0.086 K	0.036 K, N	0.037 G	0.0023 G, X	0.059 ee	0.060 ee	2 ee	68FR75510 SDWA
106	Endrin Aldehyde	7421934					0.29 B, ee	0.30 B, H, ee		65FR66443
107	Heptachlor	76448	0.52 G	0.0038 G, X	0.053 G	0.0036 G, X	0.000079 B, C	0.000079 B, C	0.4 C	65FR31682 65FR66443 SDWA
108	Heptachlor Epoxide	1024573	0.52 G, U	0.0038 G, U, X	0.053 G, U	0.0036 G, U, X	0.000039 B, C	0.000039B, C	0.2 C	65FR31682 65FR66443 SDWA
109	Polychlorinated Biphenyls PCBs	--		0.014 M, X		0.03 M, X	0.000064 B, C, M	0.000064 B, C, M	0.5 C	65FR31682 65FR66443 SDWA
110	Toxaphene	8001352	0.73	0.0002 X	0.21	0.0002 X	0.00028 B, C	0.00028 B, C	3 C	65FR31682 65FR66443 SDWA

Footnotes:

A This water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

C This criterion is based on carcinogenicity of 10^{-6} risk. As prescribed in Section E of this regulation, application of this criterion for permit effluent limitations requires the use annual average flow or comparable tidal condition as determined by the Department.

D Freshwater and saltwater criteria for metals are expressed in terms of total recoverable metals. As allowed in Section E of this regulation, these criteria may be expressed as dissolved metal for the purposes of deriving permit effluent limitations. The dissolved metal water quality criteria value may be calculated by using these 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria", October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR§131.36(b)(1). Conversion Factors can be found in Attachment 1 – Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 25 mg/L as expressed as $CaCO_3$. Criteria values for other hardness may be calculated from the following: CMC (dissolved) – $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF), or CCC (dissolved) – $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF) and the parameters specified in Attachment 2 – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent. As noted in footnote D above, the values in this appendix are expressed as total recoverable, the criterion may be calculated from the following: CMC (total) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$, or CCC (total) – $\exp\{m_C [\ln(\text{hardness})] + b_C\}$.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = exp(1.005(pH)-4.869); CCC = exp(1.005(pH)-5.134). Values displayed in table correspond to a pH of 7.8.

G This criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA) and the National Primary Drinking Water Regulation (NPDWR).

J EPA has not calculated a 304(a) human health criterion for this contaminant. The criterion is the Maximum Contaminant Level developed under the Safe Drinking Water Act (SDWA) and the National Primary Drinking Water Regulation (NPDWR).

K This criterion is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*, (EPA-820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg /l and 12.82 µg /l, respectively.

M This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

N The derivation of the CCC for this pollutant did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

O This state criterion is also based on a total fish consumption rate of 0.0175 kg/day.

P This water quality criterion is expressed as µg free cyanide (as CN)/L.

Q This value was announced (61FR58444-58449, November 14, 1996) as a proposed GLI 303 I aquatic life criterion

S This water quality criterion for selenium is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996 – CMC or 0.922 – CCC) that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.

T The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.

U This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

V There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.

SCDHEC R.61 68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

W This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

X This criterion is based on a 304(a) aquatic life criterion issued in 1980 or 1986, and was issued in one of the following documents: Aldrin/Dieldrin (EPA440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Polychlorinated Biphenyls (EPA 440/5- 80-068), Toxaphene (EPA 440/5-86-006). This CCC is based on the Final Residue value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the EPA no longer uses the Final Residue value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

Y This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA 440/5-84-032), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5-84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87- 003).

Z When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.

aa The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 □g/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

bb This water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the EPA no longer uses the Final Residue value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

cc This water quality criterion was derived in *Ambient Water Quality Criteria Saltwater Copper Addendum* (Draft, April 14, 1995) and was promulgated in the Interim Final National Toxics Rule (60FR22228-222237, May 4, 1995).

dd This water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

ee This criterion is a noncarcinogen. As prescribed in Section E of this regulation, application of this criterion for determining permit effluent limitations requires the use of 7Q10 or comparable tidal condition as determined by the Department.

gg This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

hh Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.

ii Although EPA has not published a completed criteria document for phthalate, it is EPA's understanding that sufficient data exist to allow calculation of aquatic life criteria.

jj This recommended water quality criterion is expressed as total cyanide, even though the IRIS RfD the EPA used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g.,$FE_4[FE(CN)_6]_3$), this criterion may be overly conservative.

kk This recommended water quality criterion was derived using the cancer slope factor of 1.4 (Linear multi-stage model (LMS) exposure from birth).

ll Freshwater copper criteria may be calculated utilizing the procedures identified in EPA-822-R-07-001.

mm HAA5 means five haloacetic acids (monochloracitic acid, dichloroacetic acid, trichloroacetic acid, bromoacetic acid and dibromoaccetic acid).

nn This criterion has been revised to reflect the EPA's cancer slope factor (CSF) or reference dose (RfD), as contained in the Integrated Risk Information System (IRIS) as of (Final FR Notice June 10, 2009). The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

Attachment D-5.

Uncertainty Tables

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Uncertainty Tables

Table 1.A. Uncertainty Evaluation for GOSB Interior Subunit (Sediment Media 0-1 ft)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic community organisms - sediment		Montane shrew (Mammalian insectivore)		Occult little brown myotis bat (Mammalian aerial insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Alpha-Chlordane	4.49E+00	c	1.70E-02	2.64E+02	2.70E+00	1.66E+00	3.30E+00	1.36E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American robin (Avian omnivore)		American robin (Avian insectivore)		Violet-green Swallow (Avian aerial insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Alpha-Chlordane	4.49E+00	c	2.70E+00	1.66E+00	1.40E+00	3.21E+00	1.80E+00	2.50E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Montane shrew (Mammalian insectivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ
Cadmium	3.26E+00	d	2.70E+00	1.21E+00	2.90E+00	1.12E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American robin (Avian insectivore)	
			RSV	HQ
Copper	4.81E+01	d	4.60E+01	1.05E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic community organisms - sediment		Deer mouse (Mammalian omnivore)		Montane shrew (Mammalian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Dieldrin	3.40E-01	d	1.90E-02	1.79E+01	1.70E-02	2.00E+01	9.00E-03	3.78E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Occult little brown myotis bat (Mammalian aerial insectivore)	
			RSV	HQ
Dieldrin	3.40E-01	d	1.10E-02	3.09E+01

Table 1.A. Uncertainty Evaluation for GOSB Interior Subunit (Sediment Media 0-1 ft) (cont.)

Uncertainty Tables

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic community organisms - sediment	
			RSV	HQ
Fluorene	1.59E+00	c	5.30E-01	3.00E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic community organisms - sediment	
			RSV	HQ
Gamma-Chlordane	1.09E+01	c	1.70E-02	6.41E+02

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American robin (Avian herbivore)		American robin (Avian omnivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Lead	4.31E+01	d	4.20E+01	1.03E+00	3.30E+01	1.31E+00	2.80E+01	1.54E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Deer mouse (Mammalian omnivore)		Montane shrew (Mammalian insectivore)		Occult little brown myotis bat (Mammalian aerial insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Mercury	5.78E-01	d	3.10E-02	1.86E+01	1.50E-02	3.85E+01	1.90E-02	3.04E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American robin (Avian omnivore)		American robin (Avian insectivore)		Violet-green Swallow (Avian aerial insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Mercury	5.78E-01	d	7.10E-03	8.14E+01	3.50E-03	1.65E+02	4.60E-03	1.26E+02

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American kestrel (Avian intermediate carnivore)		American kestrel (Avian top carnivore)		Red fox (Mammalian top carnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Mercury	5.78E-01	d	1.70E-02	3.40E+01	7.80E-02	7.41E+00	5.60E-01	1.03E+00

Table 1.A. Uncertainty Evaluation for GOSB Interior Subunit (Sediment Media 0-1 ft) (cont.)

Uncertainty Tables

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Generic plant (Terrestrial autotroph - producer)		Montane shrew (Mammalian insectivore)	
			RSV	HQ	RSV	HQ
Thallium	4.64E+00	d	5.00E-01	9.28E+00	2.20E+00	2.11E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
2-Methylnaphthalene	2.58	a	4.47E-01	5.77E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Benthic Organisms**	
			RSV	**HQ**
Barium	92	a	6.00E+01	1.53E+00
DDD	1.8	a	7.81E-03	2.30E+02
DDE	4.5	a	3.74E-03	1.20E+03
Fluoranthene	0.993	a	7.07E-01	1.40E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Benthic Organisms**	
			RSV	**HQ**
Heptachlor Epoxide	0.635	a	1.60E-02	3.97E+01
Phenanthrene	3.91	a	5.96E-01	6.56E+00
Silver	314	a	2.20E+00	1.43E+02

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)
2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1. Table A.1.1 Sediment Media (0-1 ft)
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: c = Los Alamos National Laboratory No Effect ESL for Sediment Media
3: d = Los Alamos National Laboratory No Effect ESL for Soil Media
Hazard Quotient (HQ) = EPC / RSV

Uncertainty Tables

Table 1.B Uncertainty Evaluation for GOSB Interior Subunit (Surface Water)

Analyte[1]	Exposure Point Concentration[2] (µg/L)	RSV Source[3]	Aquatic community organisms	
			RSV	HQ
Alpha-Chlordane	1.15E-01	abc	4.30E-03	2.67E+01
Barium	2.04E+02	c	3.90E+00	5.23E+01
Gamma-Chlordane	1.36E-01	abc	4.30E-03	3.16E+01
Beryllium	1.40E+00	c	6.60E-01	2.12E+00
Chromium	5.64E+01	abc	1.10E+01	5.12E+00
Cobalt	6.62E+00	c	3.00E+00	2.21E+00
Iron	1.63E+04	bc	1.00E+03	1.63E+01
Vanadium	4.87E+01	c	1.90E+01	2.57E+00
DDT	2.28E-02	ac	1.00E-03	2.28E+01
Analyte[1]	**Exposure Point Concentration[2] (µg/L)**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Aluminum	2.41E+04	b	8.70E+01	2.77E+02
DDD	1.98E-02	b	1.10E-02	1.80E+00
Manganese	2.47E+02	b	9.30E+01	2.66E+00
Mercury	2.37E-01	b	1.30E-03	1.82E+02
Silver	1.14E+02	b	6.00E-02	1.91E+03
Analyte[1]	**Exposure Point Concentration[2] (µg/L)**	**RSV Source[3]**	**Freshwater Aquatic Life**	
			RSV	**HQ**
Cadmium	1.03E+01	a	1.00E-01	1.03E+02
Copper	5.92E+02	a	2.90E+00	2.04E+02
Lead	5.87E+01	a	5.40E-01	1.09E+02
Nickel	5.66E+01	a	1.60E+01	3.54E+00
Zinc	3.80E+03	a	3.70E+01	1.03E+02

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)
2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1 Table A.1.2 Surface Water
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014)
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015)
Hazard Quotient (HQ) = EPC / RSV

Uncertainty Tables

Table 2.A Uncertainty Evaluation for GOSB Berm Subunit (Soil 0-1 ft)

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)		American robin (Avian omnivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Lead	4.53E+01	b	4.20E+01	1.08E+00	3.30E+01	1.37E+00	2.80E+01	1.62E+00
Vanadium	5.38E+01	b	1.70E+01	3.16E+00	1.50E+01	3.59E+00	1.30E+01	4.14E+00

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)

2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1. Table A.2.1.1 (Surface Interval 0-1 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory No Effect ESL for Soil Media

Hazard Quotient (HQ) = EPC / RSV

Uncertainty Tables

Table 2.B Uncertainty Evaluation for GOSB Berm Subunit (Soil 1-4 ft)

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)		American robin (Avian omnivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	3.88E+01	b	1.70E+01	2.28E+00	1.50E+01	2.59E+00	1.30E+01	2.99E+00

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)

2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1. Table A.2.1.2 (Subsurface Interval 1-4 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory No Effect ESL for Soil Media

Hazard Quotient (HQ) = EPC / RSV

Uncertainty Tables

Table 3.A Uncertainty Evaluation for Effluent Discharge (Soil 0-1 ft)

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	Deer mouse (Mammalian omnivore)		Montane shrew (Mammalian insectivore)		American robin (Avian omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Mercury	7.22E-02	b	3.10E-02	2.33E+00	1.50E-02	4.81E+00	7.10E-03	1.02E+01

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		American kestrel (Avian intermediate carnivore)	
			RSV	HQ	RSV	HQ
Mercury	7.22E-02	b	3.50E-03	2.06E+01	1.70E-02	4.25E+00

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)		American robin (Avian omnivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	5.38E+01	b	1.70E+01	3.17E+00	1.50E+01	3.59E+00	1.30E+01	4.14E+00

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)
2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1. Table A.4.1 (Surface Interval 0-1ft)
3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Los Alamos National Laboratory No Effect ESL for Soil Media
Hazard Quotient (HQ) = EPC / RSV

Uncertainty Tables

Table 3.B Uncertainty Evaluation for Effluent Discharge (Soil 1-4 ft)

Analyte[1]	Exposure Point Concentration[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)		American robin (Avian omnivore)		American robin (Avian insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	5.32E+01	b	1.70E+01	3.13E+00	1.50E+01	3.54E+00	1.30E+01	4.09E+00

1 – Analytes identified as COPCs from Table D-2 (with RSVs available)
2 – EPC = reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1. Table A.4.2 (Subsurface Interval 1-4 ft)
3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3: b = Los Alamos National Laboratory No Effect ESL for Soil Media
Hazard Quotient (HQ) = EPC / RSV

Attachment D-6.

RESRAD Biota Values
Argonne National Laboratory (ANL) (2006) RESRAD BIOTA (v.1.8) [software]
(www.ead.anl.gov/resrad website accessed January 20, 2017)

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Table 1. Sediment/Soil

Radionuclide	Tier 3 Terrestrial Animal Soil	Tier 3 Aquatic Animal Sediment	Tier 3 Riparian Animal Sediment	Minimum of Tier 3
	BCG (pCi/g)			
Actinium-228	---	---	---	---
Americium-243	---	---	---	---
Barium-133	---	---	---	---
Bismuth-212	---	---	---	---
Bismuth-214	---	---	---	---
Californium-244	---	---	---	---
Carbon-14	4,760	789,000	59,000	4,760
Cobalt-58	1,790	38,600	3,790	1,790
Curium-244	4,060	4,000,000	5,200	4,060
Curium-245 and Curium-246	---	---	---	---
Europium-155	15,800	318,000	31,600	15,800
Lead-212	---	---	---	---
Lead-214	---	---	---	---
Manganese-54	---	---	---	---
Neptunium-239	---	---	---	---
Potassium-40	119	57,900	4,420	119
Promethium-146	---	---	---	---
Radium-224	---	---	---	---
Ruthenium-106	---	---	---	---
Thallium-208	---	---	---	---
Thorium-231	---	---	---	---
Thorium-234	2,160	43,200	4,320	2,160
Tin-113	---	---	---	---
Zinc-65	413	65,800	1,430	413
Zirconium-95	1,170	23,500	2,330	1,170

Table 2. Surface Water

Radionuclide	Tier 3 Aquatic Animal Water	Tier 3 Riparian Animal Water	Minimum of Tier 3
	BCG (pCi/L)		
Bismuth-214	---	---	---
Cesium-137	1,050	42.7	42.7
Curium-244	66.4	1,390	66.4
Iodine-129	1,000,000	38,500	38,500
Lead-212	---	---	---
Lead-214	---	---	---
Potassium-40	2,900	249	249
Technetium-99	2,470,000	667,000	667,000
Thorium-234	266,000	3,800,000	266,000

Attachment D-7.

LANL Receptor-Specific Low Effect ESLs
Los Alamos National Laboratory Receptor-Specific Low Effect ESLs
(website accessed 11-04-2016)

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LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph - producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Acenaphthene	7.60E-01					2.00E+00		4.40E+03	1.60E+03	1.20E+03	1.60E+03							2.50E+05
Acenaphthylene	7.60E-01							4.40E+03	1.60E+03	1.20E+03	1.50E+03							2.50E+05
Acetone	6.50E-01							6.50E+00	6.30E+00	7.70E+01	9.80E+01	7.50E+01	1.40E+02	1.70E+03	2.30E+03	9.70E+03	7.60E+05	3.90E+04
Aldrin								6.00E+01	3.70E-01	1.80E-01	2.30E-01							5.10E+01
Aluminum	5.80E+04																	
Americium-241		6.60E+05	6.60E+05	6.60E+05	6.60E+05	5.00E+03	1.90E+03	2.00E+05	3.30E+05	3.30E+05	2.60E+03	5.00E+04	6.90E+04	1.10E+05	2.20E+03	4.70E+05	5.90E+05	2.60E+05
Amino-2,6-dinitrotoluene[4-]						3.30E+02	1.80E+02	2.90E+03	2.30E+02	1.20E+02	1.50E+02							6.40E+04
Amino-4,6-dinitrotoluene[2-]						1.40E+02	4.30E+02	9.20E+02	2.40E+02	1.50E+02	2.00E+02							9.40E+04
Anthracene	5.70E-01					9.00E+00		1.00E+04	3.10E+03	2.10E+03	2.70E+03							3.40E+05
Antimony						5.80E+01	7.80E+02	2.60E+01	2.40E+01	2.60E+01	5.00E+02							4.60E+02
Aroclor-1016	5.90E-01							1.20E+02	6.00E+00	3.10E+00	3.90E+00							5.80E+02
Aroclor-1242	5.90E-01							1.00E+02	3.00E+00	1.50E+00	1.90E+00	1.00E+01	7.90E-01	4.10E-01	5.40E-01	2.20E+00	5.70E+01	3.30E+02
Aroclor-1248	5.90E-01							5.20E+00	1.40E-01	7.20E-02	9.00E-02	1.00E+01	7.90E-01	4.10E-01	5.40E-01	2.20E+00	5.80E+01	1.50E+01
Aroclor-1254	3.40E-01					6.20E+02		2.50E+02	4.90E+00	2.40E+00	3.00E+00	1.30E+01	8.00E-01	4.10E-01	5.40E-01	2.20E+00	7.10E+01	5.90E+01
Aroclor-1260	5.90E-01							6.40E+03	4.80E+01	2.40E+01	3.00E+01	6.60E+01	2.40E+00	1.20E+00	1.60E+00	6.80E+00	5.70E+02	1.40E+02
Arsenic	3.30E+01					9.10E+01	6.80E+01	2.30E+02	5.10E+01	2.40E+01	4.30E+01	4.20E+02	2.60E+02	1.80E+02	3.50E+02	1.20E+03	8.50E+03	1.30E+03
Barium	3.00E+02					2.60E+02	3.20E+03	2.90E+04	1.80E+04	1.30E+04	3.50E+04	1.40E+03	1.60E+03	1.90E+03	5.30E+03	1.50E+04	5.00E+04	4.10E+05
Benzene	1.00E-01							3.10E+02	2.40E+02	4.70E+02	6.10E+02							1.70E+05
Benzo(a)anthracene	1.00E+00					1.80E+02		5.50E+01	3.40E+01	3.00E+01	5.90E+01	8.00E+00	9.10E+00	1.00E+01	2.20E+01	7.40E+01	3.40E+02	1.10E+03
Benzo(a)pyrene	1.40E+00							7.90E+02	2.70E+02	1.70E+02	2.60E+02							1.10E+04
Benzo(b)fluoranthene	1.90E+00					1.80E+02		1.10E+03	5.20E+02	3.80E+02	5.90E+02							2.40E+04
Benzo(g,h,i)perylene	1.70E+00							4.80E+03	4.70E+02	2.40E+02	3.20E+02							3.30E+04
Benzo(k)fluoranthene	2.40E+00							3.10E+03	1.00E+03	6.20E+02	9.30E+02							4.30E+04
Benzoic Acid								3.70E+01	1.30E+01	1.00E+01	1.30E+01							1.80E+04
Benzyl Alcohol								1.50E+03	1.20E+03	2.60E+03	3.30E+03							1.10E+06
Beryllium						2.50E+01	4.00E+02	1.50E+03	5.60E+02	1.80E+02	7.30E+02							4.20E+03
BHC[alpha-]								6.70E+03	1.00E+03	5.80E+02	7.30E+02							1.40E+05
BHC[beta-]	5.00E-02							1.50E+01	2.30E+00	1.30E+00	1.60E+00	8.00E+02	2.40E+02	1.40E+02	1.90E+02	7.90E+02	2.40E+04	3.40E+02
BHC[gamma-]	4.90E-03					1.00E+00		1.00E+00	1.60E-01	9.40E-02	1.10E-01	4.70E+00	1.40E+00	8.60E-01	1.10E+00	4.60E+00	1.40E+02	2.30E+01
Bis[2-ethylhexyl]phthalate								2.40E+04	1.10E+01	5.90E+00	7.40E+00	2.00E+02	4.00E-01	2.00E-01	2.60E-01	1.00E+00	8.10E+01	3.80E+03
Boron						8.60E+01		6.80E+02	5.60E+02	1.20E+03	1.70E+03	1.00E+01	1.50E+01	3.70E+01	5.40E+01	2.10E+02	5.40E+03	2.10E+05
Butanone[2-]								9.80E+02	9.30E+02	6.80E+03	8.70E+03							3.50E+06
Butyl Benzyl Phthalate	1.00E+00							2.00E+04	1.60E+03	9.00E+02	1.10E+03							1.80E+05
Cadmium	4.90E+00					1.60E+02	7.60E+02	8.80E+01	5.10E+00	2.70E+00	3.30E+00	4.40E+01	5.40E+00	2.90E+00	3.80E+00	1.50E+01	4.70E+03	5.30E+03
Carbazole								1.10E+03	8.00E+02	1.00E+03	1.40E+03							1.30E+05
Carbon Disulfide								1.20E+01	8.20E+00	1.10E+01	1.50E+01							1.90E+03
Cesium-134		2.20E+04	2.20E+04	2.20E+04	2.20E+04	7.00E+03	1.00E+04	5.50E+03	1.10E+04	1.10E+04	1.40E+04	6.90E+03	1.20E+04	2.10E+04	3.30E+03	1.00E+04	1.00E+04	7.30E+03
Cesium-137 + Barium-137		5.00E+04	5.00E+04	5.00E+04	5.00E+04	1.50E+04	2.30E+04	1.20E+04	2.30E+04	2.40E+04	3.20E+04	1.40E+04	2.60E+04	4.60E+04	7.20E+03	4.30E+04	3.90E+04	1.50E+04
Chlordane[alpha-]	1.70E-02					2.20E+01		5.10E+02	5.40E+00	2.70E+00	3.30E+00	9.90E+01	2.70E+00	1.40E+00	1.80E+00	7.40E+00	2.00E+02	6.30E+02
Chlordane[gamma-]	1.70E-02					2.20E+01		6.10E+02	4.40E+01	2.20E+01	2.90E+01	1.10E+02	2.10E+01	1.10E+01	1.50E+01	6.40E+01	1.30E+03	3.70E+03
Chloroaniline[4-]						1.00E+01	1.80E+01											
Chlorobenzene	3.00E-01						2.40E+01	1.30E+03	5.40E+02	4.30E+02	5.40E+02							2.20E+05
Chloroform								4.20E+01	2.20E+01	2.20E+01	2.80E+01							2.20E+04
Chlorophenol[2-]	5.50E-01							6.00E+00	5.40E+00	2.20E+01	3.00E+01	3.90E+00	6.90E+00	2.80E+01	4.00E+01	1.60E+02	3.40E+03	3.30E+03
Chromium (total)	1.10E+02							7.50E+03	1.10E+03	4.50E+02	9.30E+02	6.80E+02	4.00E+02	2.80E+02	6.10E+02	2.00E+03	1.00E+04	1.80E+04
Chromium(+6)						4.00E+00	3.40E+00	2.90E+04	8.60E+03	2.80E+03	9.60E+03	2.80E+03	2.20E+03	1.90E+03	6.80E+03	1.70E+04	4.20E+04	7.30E+04
Chrysene	1.20E+00							5.80E+01	3.10E+01	2.40E+01	4.40E+01							1.10E+03

LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph - producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Cobalt						1.30E+02		1.60E+04	4.00E+03	1.60E+03	3.70E+03	1.70E+03	1.20E+03	9.60E+02	2.30E+03	7.20E+03	2.70E+04	5.50E+04
Cobalt-60		1.40E+04	1.40E+04	1.40E+04	1.40E+04	7.60E+03	7.60E+03	7.60E+03	7.60E+03	7.60E+03	9.60E+03	1.50E+04	1.50E+04	1.50E+04	2.10E+03	1.50E+04	1.50E+04	7.60E+03
Copper	1.40E+02					4.90E+02	5.30E+02	4.10E+02	1.00E+02	6.30E+01	9.10E+01	1.10E+02	6.60E+01	4.60E+01	7.00E+01	2.70E+02	4.00E+03	6.60E+03
Cyanide	1.00E+00							6.60E+03	3.40E+03	3.10E+03	4.20E+03	1.00E+00	1.00E+00	1.00E+00	1.40E+00	4.00E+00	5.90E+00	2.80E+04
DDD								4.70E+02	1.60E+01	8.20E+00	1.00E+01	7.30E-01	6.30E-02	3.30E-02	4.30E-02	1.70E-01	4.20E+00	1.60E+03
DDE	3.10E-02							1.30E+03	1.80E+01	9.30E+00	1.10E+01	2.80E+01	1.00E+00	5.50E-01	7.30E-01	2.90E+00	9.00E+01	2.30E+03
DDT	4.10E-02					6.00E+00		5.70E+01	4.40E-01	2.20E-01	2.70E-01	8.50E+01	2.10E+00	1.00E+00	1.40E+00	5.80E+00	2.20E+02	7.20E+01
Dibenzo(a,h)anthracene	3.30E-01							8.50E+02	2.20E+02	1.20E+02	1.90E+02							8.50E+03
Dibenzofuran	5.10E+00					6.10E+01												
Dichlorobenzene[1,2-]								9.90E+01	1.50E+01	9.20E+00	1.10E+01							3.90E+03
Dichlorobenzene[1,3-]								1.00E+02	1.30E+01	7.30E+00	9.20E+00							3.00E+03
Dichlorobenzene[1,4-]	3.00E-01						1.20E+01	4.00E+01	6.00E+00	3.50E+00	4.40E+00							1.50E+03
Dichloroethane[1,1-]	2.00E-01							3.30E+03	2.10E+03	2.90E+03	3.70E+03							2.40E+06
Dichloroethane[1,2-]								3.20E+02	2.70E+02	8.90E+02	1.10E+03	1.60E+00	2.80E+00	9.20E+00	1.20E+01	5.10E+01	2.90E+03	3.50E+05
Dichloroethene[1,1-]	1.00E+00							3.50E+02	1.40E+02	1.10E+02	1.40E+02							1.30E+05
Dichloroethene[cis/trans-1,2-]	2.00E+00							5.20E+02	2.50E+02	2.30E+02	2.90E+02							2.30E+05
Dieldrin	1.90E-02					1.00E+02		6.00E-01	1.70E-02	9.00E-03	1.10E-02	1.80E+01	1.20E+00	6.40E-01	8.40E-01	3.40E+00	8.30E+01	1.80E+00
Diethyl Phthalate						1.00E+03		7.20E+04	3.60E+04	3.60E+04	4.50E+04							2.20E+07
Dimethyl Phthalate							1.00E+02	6.00E+02	4.60E+02	9.70E+02	1.00E+03							5.80E+05
Di-n-Butyl Phthalate	1.10E-01					6.00E+02		3.40E+04	8.70E+02	4.40E+02	5.50E+02	3.90E+00	2.10E-01	1.10E-01	1.40E-01	5.90E-01	1.70E+01	1.10E+05
Dinitrobenzene[1,3-]								1.70E-01	1.70E-01	1.90E+00	2.90E+00	7.90E-01	1.50E+00	1.70E+01	2.70E+01	1.00E+02	1.30E+03	1.80E+02
Dinitrotoluene[2,4-]	2.90E+00					6.00E+01	1.80E+02	6.60E+02	2.00E+02	1.30E+02	1.80E+02							2.00E+04
Dinitrotoluene[2,6-]							4.40E+01	5.50E+01	4.10E+01	7.10E+01	9.70E+01	5.20E+02	7.60E+02	1.30E+03	1.90E+02	7.80E+03	2.10E+05	1.30E+04
Di-n-octylphthalate								1.10E+05	1.80E+01	9.10E+00	1.10E+01							1.00E+04
Diphenylamine												1.40E+02	3.00E+01	1.70E+01	2.20E+01	9.30E+01	7.20E+03	
Endosulfan	1.00E-04							8.60E+00	6.40E+00	1.00E+01	1.50E+01	1.50E+02	2.20E+02	4.00E+02	6.10E+02	2.30E+03	2.80E+04	9.30E+02
Endrin	2.20E-02					3.40E-02		1.80E+01	4.60E-01	2.30E-01	2.90E-01	4.90E-01	2.80E-02	1.40E-02	1.90E-02	7.70E-02	1.90E+00	4.90E+01
Europium-152		1.00E+04	1.00E+04	1.00E+04	1.00E+04	5.20E+03	5.30E+03	5.20E+03	5.30E+03	5.30E+03	7.40E+02	1.00E+04	1.00E+04	1.00E+04	1.70E+02	1.00E+04	1.00E+04	5.20E+03
Fluoranthene	2.20E+00						2.30E+01	2.30E+03	3.80E+02	2.20E+02	2.80E+02							3.30E+04
Fluorene	5.30E-01						1.90E+01	1.90E+03	6.80E+02	5.00E+02	6.40E+02							8.90E+04
Fluoride								5.70E+03	2.20E+03	1.00E+03	2.40E+03	2.10E+03	1.70E+03	1.50E+03	3.60E+03	1.00E+04	3.10E+04	2.80E+04
Heptachlor	1.60E-02					4.00E+00		4.40E+01	1.10E+00	5.90E-01	7.40E-01	8.60E+01	5.90E+00	3.00E+00	4.00E+00	1.60E+01	4.10E+02	1.20E+02
Hexachlorobenzene						1.00E+02	1.00E+02	1.20E+04	4.00E+00	2.00E+00	2.40E+00	1.00E+03	1.50E+00	7.90E-01	1.00E+00	4.20E+00	1.10E+02	4.40E+02
Hexanone[2-]								5.30E+01	2.30E+01	2.00E+01	2.50E+01	4.70E+00	4.10E+00	3.60E+00	4.80E+00	2.00E+01	3.20E+03	2.20E+04
HMX	1.70E+02					3.50E+03	1.60E+02	9.10E+02	8.00E+02	2.40E+03	3.90E+03							1.50E+05
Indeno(1,2,3-cd)pyrene	2.00E+00							5.30E+03	1.10E+03	6.20E+02	9.30E+02							4.60E+04
Iodomethane												7.70E-02	9.50E-02	1.20E-01	1.60E-01	6.80E-01	9.70E+01	
Iron	4.00E+04																	
Kepone								9.60E+00	2.10E-01	1.00E-01	1.30E-01	9.90E+01	5.10E+00	2.60E+00	3.40E+00	1.40E+01	3.40E+02	2.20E+01
Lead	1.20E+02					5.70E+02	8.40E+03	6.20E+02	2.30E+02	1.30E+02	2.40E+02	4.20E+01	3.30E+01	2.80E+01	5.40E+01	1.90E+02	1.20E+03	7.00E+03
Lead-210		9.00E+04	9.00E+04	9.00E+04	9.00E+04	3.40E+04	1.20E+04	4.30E+04	4.50E+04	4.50E+04	2.50E+04	6.10E+04	5.80E+04	6.30E+04	7.40E+03	8.70E+04	8.90E+04	4.40E+04
Lithium								1.00E+03	4.90E+02	1.80E+02	7.30E+02							4.20E+03
Manganese	1.10E+03					1.10E+03	4.50E+03	1.80E+04	1.40E+04	1.50E+04	5.30E+04	1.40E+04	1.90E+04	3.10E+04	1.10E+05	2.70E+05	6.90E+05	4.10E+05
Mercury (inorganic)	1.00E+00					6.40E+01	5.00E-01	2.00E+02	3.00E+01	1.70E+01	2.20E+01	7.00E-01	2.20E-01	1.30E-01	1.80E-01	6.60E-01	2.90E+00	6.10E+02
Mercury							1.20E+01	9.80E+00	3.10E-02	1.50E-02	1.90E-02	7.50E-01	7.10E-03	3.50E-03	4.60E-03	1.70E-02	7.80E-02	5.60E-01
Methoxychlor[4,4'-]	3.00E-01							1.40E+02	1.80E+01	1.00E+01	1.20E+01	1.10E+03	3.20E+02	1.80E+02	2.50E+02	1.00E+03	2.00E+04	1.70E+03
Methyl-2-pentanone[4-]								1.30E+02	9.80E+01	1.50E+02	1.90E+02							1.70E+05

LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph - producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Methylene Chloride	1.80E-01					1.60E+04		2.60E+01	2.20E+01	7.70E+01	9.80E+01							3.60E+04
Methylnaphthalene[2-]	7.60E-01							9.50E+02	2.40E+02	1.60E+02	2.00E+02							4.20E+04
Methylphenol[2-]						7.00E+00		7.20E+03	5.90E+03	1.30E+04	1.90E+04							1.60E+06
Methylphenol[3-]						7.00E+00												
Molybdenum												1.90E+02	1.80E+02	1.70E+02	2.70E+02	1.00E+03	1.30E+04	
Naphthalene	5.60E-01					1.00E+01		3.20E+01	2.70E+01	7.70E+01	9.90E+01	3.40E+01	5.70E+01	1.60E+02	2.20E+02	8.90E+02	2.10E+04	1.40E+04
Neptunium-237		7.60E+04	7.60E+04	7.60E+04	7.60E+04	2.70E+04	5.00E+02	3.20E+04	3.30E+04	3.20E+04	1.30E+02	7.50E+03	2.20E+03	2.20E+03	1.20E+02	1.30E+04	1.70E+04	5.90E+03
Nickel	4.80E+01					2.70E+02	1.30E+03	8.90E+02	4.10E+01	1.90E+01	2.70E+01	1.60E+03	3.80E+02	2.10E+02	3.20E+02	1.20E+03	2.30E+04	2.50E+03
Nitroaniline[2-]								1.80E+01	1.00E+01	1.20E+01	1.60E+01							4.30E+03
Nitrobenzene							2.20E+01	5.40E+01	4.90E+01	2.00E+02	2.70E+02							4.00E+04
Nitroglycerine						2.10E+02	1.30E+02	7.50E+02	7.50E+02	1.10E+04	1.80E+04							7.10E+05
Nitrotoluene[2-]								1.20E+02	9.90E+01	2.10E+02	2.80E+02							5.80E+04
Nitrotoluene[3-]								1.70E+02	1.20E+02	1.90E+02	2.40E+02							6.70E+04
Nitrotoluene[4-]								2.90E+02	2.20E+02	4.00E+02	5.20E+02							1.20E+05
Pentachloronitrobenzene	3.60E+01							7.80E+03	2.20E+02	1.10E+02	1.40E+02	2.20E+02	1.30E+01	7.00E+00	9.20E+00	3.70E+01	1.00E+03	2.70E+04
Pentachlorophenol	1.00E-01					5.00E+01	1.50E+02	1.50E+03	1.60E+01	8.10E+00	1.00E+01	3.10E+02	7.20E+00	3.60E+00	4.80E+00	1.90E+01	4.90E+02	1.70E+03
PETN								1.00E+03	1.00E+03	8.70E+03	1.40E+04							4.50E+05
Phenanthrene	1.10E+00						1.20E+01	5.20E+02	1.50E+02	1.00E+02	1.40E+02							1.70E+04
Phenols						8.00E+00	1.80E+01	3.80E+02	3.80E+02	5.50E+03	8.40E+03							4.20E+05
Plutonium-238		4.00E+06	4.00E+06	4.00E+06	4.00E+06	1.80E+04	8.20E+03	5.30E+05	1.70E+06	1.60E+06	1.20E+03	5.20E+04	7.70E+04	1.40E+05	1.10E+03	1.20E+06	1.30E+06	4.50E+05
Plutonium-239, 240		7.10E+06	7.10E+06	7.10E+06	7.10E+06	1.90E+04	8.70E+03	6.20E+05	2.80E+06	2.70E+06	1.20E+03	5.40E+04	7.90E+04	1.40E+05	1.10E+03	1.40E+06	1.60E+06	5.10E+05
Plutonium-241		7.60E+06	7.60E+06	7.60E+06	7.60E+06	3.60E+05	1.70E+05	3.60E+06	3.70E+06	3.70E+06	1.20E+07	7.10E+06	7.20E+06	7.20E+06	2.80E+06	7.30E+06	7.30E+06	3.60E+06
Pyrene	1.50E+00						2.00E+01	9.90E+02	3.20E+02	2.20E+02	2.90E+02	7.10E+02	4.60E+02	3.40E+02	4.70E+02	1.90E+03	3.10E+04	2.80E+04
Radium-226		1.40E+04	1.40E+04	1.40E+04	1.40E+04	5.40E+02	1.50E+01	2.10E+03	3.80E+03	3.40E+03	3.00E+00	3.70E+02	8.50E+01	8.30E+01	2.10E+00	7.90E+02	9.50E+03	3.70E+03
Radium-228		2.80E+04	2.80E+04	2.80E+04	2.80E+04	4.80E+02	1.20E+01	2.30E+03	4.90E+03	4.20E+03	7.70E+00	5.00E+02	1.10E+02	1.10E+02	2.60E+00	1.00E+03	1.60E+04	5.60E+03
RDX	3.50E+02						1.50E+01	9.90E+01	5.20E+01	5.20E+01	6.70E+01	4.40E+00	4.50E+00	4.60E+00	6.30E+00	2.60E+01	1.60E+03	2.20E+04
Selerium	2.90E+00					3.00E+00	4.10E+01	2.90E+00	1.20E+00	9.90E-01	1.30E+00	2.00E+00	1.70E+00	1.50E+00	2.10E+00	8.60E+00	1.60E+02	1.30E+02
Silver	5.00E+00					2.80E+03		1.40E+03	2.40E+02	1.40E+02	1.80E+02	1.10E+02	4.30E+01	2.60E+01	3.60E+01	1.40E+02	6.70E+03	4.30E+04
Sodium-22		1.80E+05	1.80E+05	1.80E+05	1.80E+05	8.90E+04	6.50E+04	8.90E+04	9.00E+04	9.00E+04	4.90E+05	1.70E+05	1.60E+05	1.60E+05	1.10E+05	1.40E+05	1.10E+05	4.00E+04
Stronlium (stable)								9.80E+02	9.60E+02	6.60E+03	1.70E+04							1.90E+05
Stronlium-90 + Yittrium-90		3.40E+04	3.40E+04	3.40E+04	3.40E+04	1.10E+04	1.70E+04	1.00E+04	1.60E+04	1.70E+04	2.30E+03	3.40E+03	8.10E+03	3.00E+04	1.50E+03	2.50E+04	2.00E+04	8.00E+03
Styrene						3.20E+01	1.20E+01											
Tetrachlorodibenzodioxin[2,3,7,8-]	8.50E-06						1.00E+01	2.80E-04	3.90E-06	1.90E-06	2.40E-06							5.50E-04
Tetrachloroethene	2.00E-02					1.00E+02		3.90E+01	1.80E+00	9.40E-01	1.10E+00							4.80E+02
Tetryl								7.20E+00	7.30E+00	1.70E+02	4.90E+02							4.50E+03
Thallium						5.00E-01		2.50E+01	7.30E+00	2.20E+00	8.20E+00	9.20E+01	7.50E+01	6.30E+01	2.40E+02	5.60E+02	1.20E+03	5.30E+01
Thorium-228		1.60E+04	1.60E+04	1.60E+04	1.60E+04	1.40E+03	4.30E+02	7.70E+03	8.20E+03	8.30E+03	1.20E+04	1.10E+04	1.20E+04	1.30E+04	2.90E+03	1.60E+04	1.60E+04	8.30E+03
Thorium-229		3.20E+04	3.20E+04	3.20E+04	3.20E+04	1.70E+03	4.70E+02	1.30E+04	1.50E+04	1.50E+04	1.20E+03	8.80E+03	9.90E+03	1.30E+04	1.10E+03	2.70E+04	3.10E+04	1.50E+04
Thorium-230		2.70E+06	2.70E+06	2.70E+06	2.70E+06	2.00E+03	5.20E+02	9.90E+04	7.80E+05	8.10E+05	1.30E+03	1.30E+04	1.50E+04	2.30E+04	1.20E+03	2.30E+05	1.80E+06	6.80E+05
Thorium-232		3.20E+06	3.20E+06	3.20E+06	3.20E+06	2.40E+02	6.20E+01	1.20E+04	1.90E+05	2.00E+05	1.60E+02	1.50E+03	1.80E+03	2.80E+03	1.50E+02	2.90E+04	5.70E+05	1.40E+05
Titanium								5.30E+04	1.50E+03	7.20E+02	9.80E+02							8.20E+04
Toluene	1.00E-01					2.00E+03		5.40E+02	2.50E+02	2.30E+02	2.90E+02							1.10E+05
Toxaphene (Technical Grade)	1.00E-03							2.60E+03	1.10E+02	5.90E+01	7.40E+01	7.50E+02	7.90E+01	4.10E+01	5.50E+01	2.20E+02	5.10E+03	1.10E+04
Trichlorobenzene[1,2,4-]	1.10E-01						1.20E+01	1.00E+02	5.10E+00	2.70E+00	3.30E+00							8.60E+02
Trichloroethane[1,1,1-]	7.00E-01							1.60E+04	4.00E+03	2.60E+03	3.20E+03							2.60E+06
Trichloroethene	7.80E-01							1.50E+03	5.50E+02	4.20E+02	5.20E+02							3.70E+05
Trichlorofluoromethane								1.00E+04	6.60E+02	3.50E+02	4.30E+02							3.50E+05

LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph - producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Trinitroberzene[1,3,5-]	1.50E+00						2.80E+01	1.20E+03	1.20E+03	4.00E+03	1.30E+04							1.00E+05
Trinitrotoluene[2,4,6-]	3.20E+01					1.20E+02	5.80E+01	4.40E+02	4.40E+02	4.90E+03	1.70E+04	1.30E+01	2.60E+01	3.10E+02	1.10E+03	2.70E+03	6.50E+03	1.20E+05
Tritium		6.60E+06	6.60E+06	6.60E+06	6.60E+06	3.60E+05	4.80E+05	2.10E+06	3.30E+06	3.40E+06	1.30E+10	3.00E+06	4.40E+06	6.00E+06	3.00E+09	6.10E+06	5.50E+06	2.20E+06
Uranium	1.00E+03					2.50E+02		4.60E+03	1.80E+03	5.60E+02	2.80E+03	1.90E+04	1.70E+04	1.60E+04	8.80E+04	1.60E+05	3.00E+05	1.20E+04
Uranium-233		1.00E+07	1.00E+07	1.00E+07	1.00E+07	4.40E+03	2.20E+04	2.00E+05	2.90E+06	4.20E+06	2.70E+04	1.50E+05	3.30E+05	1.10E+06	6.20E+03	7.10E+06	7.30E+06	2.30E+06
Uranium-234		3.00E+06	3.00E+06	3.00E+06	3.00E+06	4.40E+03	2.20E+04	1.80E+05	1.20E+06	1.40E+06	2.70E+04	1.50E+05	3.10E+05	9.20E+05	6.20E+03	2.60E+06	2.60E+06	1.10E+06
Uranium-235		1.00E+05	1.00E+05	1.00E+05	1.00E+05	4.40E+03	1.60E+04	4.20E+04	5.20E+04	5.20E+04	3.00E+04	6.50E+04	8.20E+04	9.80E+04	6.70E+03	1.00E+05	1.00E+05	5.20E+04
Uranium-236						4.70E+03	2.40E+04	2.30E+05	7.20E+06	2.30E+07	2.90E+04	1.70E+05	3.70E+05	1.40E+06	6.60E+03	2.40E+07	2.50E+07	4.40E+06
Uranium-238		4.30E+04	4.30E+04	4.30E+04	4.30E+04	4.00E+03	1.10E+04	1.90E+04	2.10E+04	2.10E+04	3.00E+04	3.40E+04	3.80E+04	4.10E+04	6.90E+03	4.20E+04	4.20E+04	2.10E+04
Vanadium						8.00E+01		2.70E+03	9.50E+02	2.80E+02	1.20E+03	1.70E+01	1.50E+01	1.30E+01	6.10E+01	1.20E+02	2.60E+02	6.60E+03
Vinyl Chloride								2.80E+00	1.30E+00	1.20E+00	1.50E+00							1.10E+03
Xylene (Total)	1.30E+00					1.00E+03		7.70E+00	2.40E+00	1.70E+00	2.20E+00	9.00E+02	5.60E+02	4.10E+02	5.50E+02	2.20E+03	1.20E+05	8.00E+02
Zinc	4.50E+02					8.10E+02	9.30E+02	1.60E+04	1.70E+03	9.80E+02	1.20E+03	3.50E+03	8.50E+02	4.80E+02	6.50E+02	2.50E+03	2.40E+04	7.80E+04

LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Surface Water

Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Acenaphthene	5.80E+00	5.80E+01							7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Acenaphthylene	4.80E+03	4.80E+04							7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Acetone	1.50E+03	1.50E+04					1.60E+07	1.40E+07	5.10E+05	2.60E+05	2.20E+05	8.30E+06	3.10E+05	5.80E+05
Aluminum	5.30E+02	1.30E+03					9.10E+06	7.80E+06	1.90E+05	1.00E+05	8.60E+04	4.50E+06	1.20E+05	2.20E+05
Americium-241			5.80E+01	1.70E+03	1.70E+03	1.70E+03	7.60E+08	7.50E+08	9.10E+08	1.30E+10	7.80E+09	1.80E+09	1.70E+09	5.70E+07
Amino-2,6-dinitrotoluene[4-]									9.80E+05	5.00E+05	4.30E+05		6.00E+05	1.10E+06
Amino-4,6-dinitrotoluene[2-]									1.40E+06	7.30E+05	6.20E+05		8.70E+05	1.60E+06
Anthracene	7.30E-01	7.30E+00							1.00E+07	5.20E+06	4.40E+06		6.20E+06	1.10E+07
Antimony	3.00E+01	8.80E+01							5.40E+03	2.70E+03	2.30E+03		3.30E+03	6.10E+03
Aroclor-1016	1.40E-02	1.40E-01							3.60E+03	1.80E+03	1.50E+03		2.20E+03	4.00E+03
Aroclor-1242	1.40E-02	1.40E-01					8.30E+03	7.10E+03	9.60E+03	4.90E+03	4.20E+03	4.10E+03	5.90E+03	1.00E+04
Aroclor-1248	1.40E-02	1.40E-01					8.30E+03	7.10E+03	1.00E+03	5.20E+02	4.40E+02	4.10E+03	6.20E+02	1.10E+03
Aroclor-1254	1.40E-02	1.40E-01					8.30E+03	7.10E+03	3.10E+03	1.60E+03	1.30E+03	4.10E+03	1.90E+03	3.60E+03
Aroclor-1260	1.40E-02	1.40E-01					8.90E+04	7.60E+04	3.10E+03	1.60E+03	1.30E+03	4.40E+04	1.90E+03	3.60E+03
Arsenic	1.50E+02	3.40E+02					1.00E+05	9.10E+04	1.20E+04	6.60E+03	5.60E+03	5.20E+04	7.90E+03	1.40E+04
Barium	3.90E+00	3.90E+01					1.50E+06	1.30E+06	2.00E+04	1.00E+04	8.80E+03	7.60E+05	1.20E+04	2.30E+04
Benzene	4.60E+01	4.60E+02							2.70E+06	1.30E+06	1.10E+06		1.60E+06	3.00E+06
Benzo[a]anthracene	2.70E-02	2.70E-01							1.70E+04	8.90E+03	7.60E+03		1.00E+04	1.90E+04
Benzo[a]pyrene	1.40E-02	1.40E-01							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Benzo[b]fluoranthene	9.00E+00	9.00E+01							4.10E+05	2.10E+05	1.70E+05		2.50E+05	4.60E+05
Benzo[g,h,i]perylene	7.60E+00	7.60E+01							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Benzo[k]fluoranthene	4.10E-03	4.10E-02							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Benzoic Acid	4.20E+01	4.20E+02							4.10E+05	2.10E+05	1.70E+05		2.50E+05	4.60E+05
Beryllium	6.60E-01	6.60E+00							6.80E+04	3.40E+04	2.90E+04		4.10E+04	7.60E+04
BHC[beta-]	2.20E+00	2.20E+01					3.10E+06	2.70E+06	2.00E+04	1.00E+04	8.90E+03	1.50E+06	1.20E+04	2.30E+04
BHC[gamma-]	9.50E-02	9.50E-01					1.80E+04	1.60E+04	1.40E+03	7.30E+02	6.20E+02	9.20E+03	8.80E+02	1.60E+03
Bis[2-ethylhexyl]phthalate	3.20E+01	3.20E+02					9.10E+04	7.80E+04	1.80E+06	9.60E+05	8.20E+05	4.50E+04	1.10E+06	2.10E+06
Boron	1.60E+00	1.60E+01					1.50E+06	1.30E+06	2.80E+06	1.40E+06	1.20E+06	7.70E+05	1.70E+06	3.20E+06
Butanone[2-]	7.20E+03	7.10E+04							4.70E+07	2.40E+07	2.00E+07		2.80E+07	5.30E+07
Butyl Benzyl Phthalate	1.90E+01	1.90E+02							1.60E+07	8.30E+06	7.10E+06		1.00E+07	1.80E+07
Cadmium	2.80E-01	9.10E-01					1.60E+05	1.40E+05	4.00E+04	2.00E+04	1.70E+04	8.20E+04	2.40E+04	4.50E+04
Cesium-134			1.90E+04	9.40E+04	9.40E+04	4.70E+03	1.40E+09	1.40E+09	2.70E+08	3.30E+09	3.00E+09	2.70E+09	9.90E+09	7.50E+07
Cesium-137 + Barium-137			4.60E+04	2.30E+05	2.30E+05	1.10E+04	3.10E+09	3.10E+09	5.90E+08	7.30E+09	6.50E+09	5.80E+09	2.10E+10	1.60E+08
Chlordane[alpha-]	4.30E-03	4.30E-02					8.90E+04	7.60E+04	1.20E+05	6.20E+04	5.20E+04	4.40E+04	7.40E+04	1.30E+05
Chlordane[gamma-]	4.30E-03	4.30E-02					8.90E+04	7.60E+04	1.20E+05	6.20E+04	5.20E+04	4.40E+04	7.40E+04	1.30E+05
Chloride	2.30E+02	8.60E+02												
Chlorobenzene	1.30E+02	1.30E+03							6.10E+06	3.10E+06	2.60E+06		3.70E+06	6.90E+06
Chloroform	1.80E+00	1.80E+01							4.20E+05	2.10E+05	1.80E+05		2.50E+05	4.70E+05
Chlorophenol[2-]	4.90E+02	4.30E+03					9.40E+04	8.00E+04	5.10E+04	2.60E+04	2.20E+04	4.60E+04	3.10E+04	5.80E+04
Chromium [total]	1.10E+01	1.60E+01					1.40E+05	1.20E+05	1.40E+06	7.40E+05	6.30E+05	7.10E+04	8.90E+05	1.60E+06

LANL Receptor-Specific Low Effect ESLs

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Surface Water

Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Chromium[+6]	1.10E+01	1.60E+01					1.40E+05	1.20E+05	1.40E+06	7.40E+05	6.30E+05	7.10E+04	8.90E+05	1.60E+06
Chrysene	1.80E-03	1.80E-02							1.70E+04	8.90E+03	7.60E+03		1.00E+04	1.90E+04
Cobalt	3.00E+00	3.00E+01					4.10E+03	3.50E+03	5.10E+03	2.60E+03	2.20E+03	2.00E+03	3.10E+03	5.80E+03
Cobalt-60			7.60E+03	3.80E+03	3.80E+03	2.30E+04	1.90E+10	1.80E+10	3.30E+09	3.90E+10	3.70E+10	3.40E+10	1.20E+11	9.70E+08
Copper	5.00E+00	7.00E+00					2.60E+05	2.20E+05	7.60E+04	3.90E+04	3.30E+04	1.30E+05	4.60E+04	8.60E+04
Cyanide [total]	5.20E+00	2.20E+01					3.30E+03	2.80E+03	7.00E+06	3.60E+06	3.00E+06	1.60E+03	4.30E+06	7.90E+06
DDE	1.00E+02	1.00E+03					1.00E+04	9.20E+03	1.00E+06	5.20E+05	4.40E+05	5.30E+03	6.20E+05	1.10E+06
DDT	1.00E-03	1.00E-02					2.00E+04	1.70E+04	1.60E+05	8.40E+04	7.10E+04	9.90E+03	1.00E+05	1.80E+05
Dibenz[a,h]anthracene	3.40E-03	3.40E-02							1.30E+05	7.00E+04	5.90E+04		8.30E+04	1.50E+05
Dibenzofuran	3.70E+00	3.70E+01												
Dichlorobenzene[1,4-]	1.50E+01	1.50E+02							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Dichloroethane[1,1-]	4.70E+01	4.70E+02							3.90E+07	2.00E+07	1.70E+07		2.40E+07	4.40E+07
Dichloroethane[1,2-]	1.00E+02	1.00E+03					7.50E+04	6.50E+04	5.10E+06	2.60E+06	2.20E+06	3.70E+04	3.10E+06	5.70E+06
Dichloroethene[1,1-]	2.50E+01	2.50E+02							3.00E+06	1.50E+06	1.30E+06		1.80E+06	3.40E+06
Dichloroethene[cis/trans-1,2-]	5.90E+02	1.10E+03							4.60E+06	2.30E+06	2.00E+06		2.80E+06	5.20E+06
Dieldrin	5.60E-02	2.40E-01					6.40E+03	5.50E+03	2.00E+03	1.00E+03	8.90E+02	3.10E+03	1.20E+03	2.30E+03
DimethylPhthalate	3.00E+00	3.00E+01							7.00E+06	3.50E+06	3.00E+06		4.20E+06	7.90E+06
Di-n-Butyl Phthalate	1.90E+01	1.90E+02					1.10E+04	1.00E+04	2.00E+07	1.00E+07	8.90E+06	5.70E+03	1.20E+07	2.30E+07
Dinitrobenzene[1,3-]	1.60E+01	1.60E+02					3.50E+04	3.00E+04	2.70E+03	1.30E+03	1.10E+03	1.70E+04	1.60E+03	3.00E+03
Dinitrotoluene[2,4-]	6.50E+01	3.30E+02							2.70E+05	1.40E+05	1.20E+05		1.60E+05	3.10E+05
Dinitrotoluene[2,6-]	2.30E+02	3.30E+02							1.80E+05	9.30E+04	7.90E+04		1.10E+05	2.00E+05
Dioctylphthalate	3.00E+00	3.00E+01							6.70E+06	3.40E+06	2.90E+06		4.00E+06	7.50E+06
Endosulfan	5.60E-02	2.20E-01					8.30E+05	7.10E+05	1.50E+04	7.80E+03	6.70E+03	4.10E+05	9.40E+03	1.70E+04
Endrin	3.60E-02	8.60E-02					8.30E+02	7.10E+02	9.40E+03	4.80E+03	4.10E+03	4.10E+02	5.70E+03	1.00E+04
Europium-152			1.00E+03	1.70E+03	1.70E+03	1.70E+04	2.20E+09	2.20E+09	9.00E+08	1.20E+10	8.30E+09	4.20E+09	1.40E+10	1.20E+08
Fluoranthene	4.00E-02	4.00E-01							1.20E+06	6.50E+05	5.60E+05		7.80E+05	1.40E+06
Fluorene	3.90E+00	3.90E+01							2.50E+06	1.30E+06	1.10E+06		1.50E+06	2.90E+06
Fluoride	2.00E+01	2.00E+02					1.00E+06	8.70E+05	5.00E+05	2.50E+05	2.10E+05	5.00E+05	3.00E+05	5.60E+05
Heptachlor	3.80E-03	3.80E-02					7.60E+04	6.50E+04	1.00E+04	5.20E+03	4.40E+03	3.80E+04	6.20E+03	1.10E+04
HMX									2.00E+06	1.00E+06	8.90E+05		1.20E+06	2.30E+06
Indeno[1,2,3-cd]pyrene	4.30E+00	4.30E+01							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Iron	1.00E+03	1.00E+04												
Kepone							1.40E+05	1.20E+05	4.10E+03	2.10E+03	1.70E+03	7.00E+04	2.50E+03	4.60E+03
Lead	1.00E+00	1.00E+01					1.30E+06	1.10E+06	3.80E+04	1.90E+04	1.60E+04	6.40E+05	2.30E+04	4.30E+04
Lead-210			2.50E+03	1.00E+04	1.00E+04	2.50E+03	2.90E+09	2.80E+09	1.90E+09	2.70E+10	1.60E+10	5.90E+09	1.60E+10	1.70E+08
Manganese	1.30E+03	2.30E+03					4.80E+07	4.10E+07	1.60E+06	8.30E+05	7.00E+05	2.40E+07	9.90E+05	1.80E+06
Mercury	7.70E-01	1.40E+00					1.50E+03	1.30E+03	1.40E+05	7.40E+04	6.30E+04	7.80E+02	8.80E+04	1.60E+05
Mercury [methyl]	2.80E-03	2.80E-02					5.30E+02	4.50E+02	1.60E+03	8.40E+02	7.10E+02	2.60E+02	1.00E+03	1.80E+03
Methoxychlor[4,4'-]	3.00E-02	3.00E-01					2.10E+06	1.80E+06	8.20E+04	4.20E+04	3.50E+04	1.00E+06	5.00E+04	9.30E+04
Methylene Chloride	2.10E+02	2.10E+03							5.10E+05	2.60E+05	2.20E+05		3.10E+05	5.80E+05

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Methylnaphthalene[2-]	3.30E+02	3.30E+03							1.60E+06	8.40E+05	7.10E+05		1.00E+06	1.80E+06
Molybdenum	1.80E+03	7.90E+03												
Naphthalene	1.10E+00	1.10E+01					1.10E+03	9.90E+02	5.10E+04	2.60E+04	2.20E+04	5.70E+02	3.10E+04	5.80E+04
Neptunium-237			6.50E+02	6.50E+03	6.50E+03	7.90E+01	4.10E+07	4.00E+07	5.10E+07	7.50E+08	4.30E+08	9.90E+07	8.90E+07	3.10E+06
Nickel	2.90E+01	2.60E+02					3.20E+05	2.70E+05	7.10E+03	3.60E+03	3.00E+03	1.60E+05	4.30E+03	8.00E+03
Nitrobenzene	5.50E+02	2.20E+03							6.00E+05	3.10E+05	2.60E+05		3.70E+05	6.80E+05
Nitroglycerine									1.00E+07	5.30E+06	4.50E+06		6.40E+06	1.10E+07
Nitrotoluene[2-]									9.10E+05	4.60E+05	3.90E+05		5.60E+05	1.00E+06
Nitrotoluene[3-]									1.10E+06	5.60E+05	4.70E+05		6.70E+05	1.20E+06
Nitrotoluene[4-]									2.00E+06	1.00E+06	8.70E+05		1.20E+06	2.20E+06
Pentachloronitrobenzene	1.00E+01	1.00E+02					5.80E+05	5.00E+05	6.70E+06	3.40E+06	2.90E+06	2.90E+05	4.00E+06	7.50E+06
Pentachlorophenol	1.50E+01	1.90E+01					2.70E+05	2.30E+05	2.40E+04	1.20E+04	1.00E+04	1.30E+05	1.50E+04	2.70E+04
Perchlorate Ion							2.10E+07	1.80E+07	2.90E+05	1.40E+05	1.20E+05	1.00E+07	1.70E+05	3.30E+05
PETN									7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Phenanthrene	6.30E+00	3.00E+01							5.20E+05	2.70E+05	2.30E+05		3.20E+05	5.90E+05
Phenol	3.20E+02	3.20E+03							6.10E+06	3.10E+06	2.60E+06		3.70E+06	6.90E+06
Plutonium-238			1.90E+02	1.70E+03	1.70E+03	6.90E+02	3.70E+08	3.70E+08	4.50E+08	6.60E+09	3.80E+09	8.90E+08	8.50E+08	2.80E+07
Plutonium-239, 240			2.00E+02	1.80E+03	1.80E+03	7.40E+02	3.80E+08	3.70E+08	4.80E+08	7.00E+09	4.00E+09	9.20E+08	8.10E+08	2.90E+07
Plutonium-241			4.20E+03	3.70E+04	3.70E+04	1.50E+04	1.20E+12	1.20E+12	2.20E+11	2.50E+12	2.40E+12	2.20E+12	8.40E+12	6.40E+10
Pyrene	2.50E-02	2.50E-01							7.70E+05	3.90E+05	3.30E+05		4.70E+05	8.70E+05
Radium-226			1.00E+00	3.20E+01	3.20E+01	6.40E+02	7.50E+06	7.40E+06	8.50E+06	1.20E+08	7.20E+07	1.70E+07	2.00E+07	5.50E+05
Radium-228			9.00E-01	2.70E+01	2.70E+01	5.40E+02	1.00E+07	9.90E+06	7.60E+06	1.10E+08	6.70E+07	2.10E+07	5.10E+07	6.40E+05
RDX									1.00E+06	5.20E+05	4.40E+05		6.20E+05	1.10E+06
Selenium	5.00E+00	2.00E+01					1.20E+04	1.00E+04	3.40E+03	1.70E+03	1.40E+03	6.10E+03	2.00E+03	3.80E+03
Silver	1.00E-01	1.00E+00					4.50E+05	3.80E+05	1.90E+06	1.00E+06	8.50E+05	2.20E+05	1.10E+06	2.20E+06
Sodium-22			9.00E+05	9.00E+05	9.00E+05	9.00E+05	4.80E+10	4.70E+10	8.50E+09	1.00E+11	9.60E+10	8.80E+10	3.20E+11	2.40E+09
Strontium [stable]	1.50E+03	1.50E+04							2.50E+06	1.30E+06	1.10E+06		1.50E+06	2.90E+06
Strontium-90 + Yittrium-90			5.70E+03	1.70E+05	1.70E+05	3.30E+05	5.20E+08	5.10E+08	5.70E+08	8.30E+09	4.80E+09	1.20E+09	1.50E+09	3.80E+07
Tetrachlorodibenzodioxin[2,3,7,8-]	2.00E-06	2.00E-05							1.00E-01	5.20E-02	4.40E-02		6.20E-02	1.10E-01
Tetrachloroethene	9.80E+01	8.30E+02							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Tetryl									6.30E+04	3.20E+04	2.70E+04		3.80E+04	7.20E+04
Thallium	3.00E-02	3.00E-01					2.90E+04	2.50E+04	7.30E+02	3.70E+02	3.10E+02	1.40E+04	4.40E+02	8.20E+02
Thorium-228			5.90E+01	1.70E+03	1.70E+03	1.70E+03	1.20E+09	1.20E+09	5.70E+08	8.00E+09	5.20E+09	2.30E+09	8.00E+09	6.80E+07
Thorium-229			6.30E+01	1.80E+03	1.80E+03	1.80E+03	3.90E+08	3.90E+08	4.90E+08	7.20E+09	4.10E+09	9.50E+08	8.50E+08	3.00E+07
Thorium-230			6.80E+01	2.00E+03	2.00E+03	2.00E+03	4.20E+08	4.20E+08	5.30E+08	7.80E+09	4.50E+09	1.00E+09	9.00E+08	3.20E+07
Thorium-232			8.10E+00	2.40E+02	2.40E+02	2.40E+02	5.00E+07	5.00E+07	6.30E+07	9.20E+08	5.30E+08	1.20E+08	1.00E+08	3.80E+06
Titanium									1.60E+06	8.30E+05	7.00E+05		9.90E+05	1.80E+06
Toluene	9.80E+00	9.80E+01							2.60E+06	1.30E+06	1.10E+06		1.60E+06	3.00E+06
Toxaphene [Technical Grade]	2.00E-04	2.00E-03					8.30E+05	7.10E+05	8.20E+05	4.20E+05	3.50E+05	4.10E+05	5.00E+05	9.30E+05
Trichlorobenzene[1,2,4-]	2.40E+01	2.40E+02							1.50E+05	7.70E+04	6.60E+04		9.30E+04	1.70E+05

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Trichloroethane[1,1,1-]	1.10E+01	1.10E+02							1.00E+08	5.20E+07	4.40E+07		6.20E+07	1.10E+08
Trichloroethene	2.10E+01	2.10E+02							1.00E+07	5.20E+06	4.40E+06		6.20E+06	1.10E+07
Trinitrobenzene[1,3,5-]									1.30E+06	7.00E+05	6.00E+05		8.40E+05	1.50E+06
Trinitrotoluene[2,4,6-]							1.40E+05	1.20E+05	1.60E+06	8.40E+05	7.10E+05	7.30E+04	1.00E+06	1.80E+06
Tritium			1.60E+09	1.60E+09	1.60E+09	1.60E+09	1.30E+13	1.30E+13	2.30E+12	2.70E+13	2.60E+13	2.40E+13	9.00E+13	6.80E+11
Uranium	5.00E+00	5.00E+01					6.50E+06	5.50E+06	1.50E+05	7.80E+04	6.70E+04	3.20E+06	9.40E+04	1.70E+05
Uranium-233			2.20E+02	1.90E+03	1.90E+03	3.90E+02	2.70E+09	2.60E+09	5.00E+08	6.10E+09	5.50E+09	5.00E+09	1.80E+10	1.40E+08
Uranium-234			2.20E+02	1.90E+03	1.90E+03	3.90E+02	2.70E+09	2.60E+09	5.00E+08	6.10E+09	5.50E+09	5.00E+09	1.80E+10	1.40E+08
Uranium-235			2.40E+02	2.10E+03	2.10E+03	4.30E+02	2.90E+09	2.90E+09	5.40E+08	6.60E+09	6.00E+09	5.40E+09	2.00E+10	1.50E+08
Uranium-236			2.30E+02	2.10E+03	2.10E+03	4.20E+02	2.90E+09	2.80E+09	5.30E+08	6.50E+09	5.90E+09	5.30E+09	1.90E+10	1.50E+08
Uranium-238			2.40E+02	2.20E+03	2.20E+03	4.40E+02	3.00E+09	2.90E+09	5.50E+08	6.80E+09	6.10E+09	5.50E+09	2.00E+10	1.50E+08
Vanadium	1.90E+01	1.90E+02					9.10E+04	7.80E+04	4.30E+04	2.20E+04	1.80E+04	4.50E+04	2.60E+04	4.80E+04
Xylene [Total]	1.30E+01	1.30E+02					8.90E+06	7.60E+06	2.60E+06	1.30E+06	1.10E+06	4.40E+06	1.60E+06	3.00E+06
Zinc	6.50E+01	8.50E+01					1.00E+07	8.50E+06	1.20E+07	6.60E+06	5.60E+06	4.90E+06	7.90E+06	1.40E+07

Attachment D-8.

GOSB Area Use Factors

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GOSB Area Use Factors

LANL Receptors	AUF (ha)[1]	AUF (acre)	PAUF (ha)[2]	PAUF (acre)	Basin Interior (acres)	Basin Berm (acres)	Discharge Area (acres)	Basin specific AUF[3]	Berm specific AUF[3]	Discharge specific AUF[3]	Basin specific PAUF[4]	Berm specific PAUF[4]	Discharge specific PAUF[4]
American kestrel	106	262	4240	10477	0.25	0.17	0.25	9.54E-04	6.62E-04	9.54E-04	2.39E-05	1.66E-05	2.39E-05
American robin	0.42	1.04	16.8	42	0.25	0.17	0.25	2.41E-01	1.67E-01	2.41E-01	6.02E-03	4.18E-03	6.02E-03
Deer mouse	0.077	0.19	3	7	0.25	0.17	0.25	1.31E+00	9.12E-01	1.31E+00	3.37E-02	2.34E-02	3.37E-02
Desert cottontail	3.1	7.7	124	306	0.25	0.17	0.25	3.26E-02	2.26E-02	3.26E-02	8.16E-04	5.66E-04	8.16E-04
Montane shrew	0.39	0.96	15.6	39	0.25	0.17	0.25	2.59E-01	1.80E-01	2.59E-01	6.49E-03	4.50E-03	6.49E-03
Red fox	1038	2565	41520	102596	0.25	0.17	0.25	9.75E-05	6.76E-05	9.75E-05	2.44E-06	1.69E-06	2.44E-06
Violet-green swallow	0.68	1.68	27.2	67	0.25	0.17	0.25	1.49E-01	1.03E-01	1.49E-01	3.72E-03	2.58E-03	3.72E-03
Occult little brown myotis bat	100	247	4000	9884	0.25	0.17	0.25	1.01E-03	7.02E-04	1.01E-03	2.53E-05	1.76E-05	2.53E-05

1 - Home range taken from Table 3.3-1 of LANL 2015 Screening Level Ecological Risk Assessment Methods, Revision 4

2 - Population area taken from Table 3.3-1 of LANL 2015 Screening Level Ecological Risk Assessment Methods, Revision 4

3 - Unit-specific Area Use Factor (AUF) = Site size (acres) / AUF (acres)

4 - Unit-specific Population Area Use Factor (PAUF) = Site size (acres) / PAUF (acres)

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Attachment D-9.

AUF-Adjusted HQs

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Table 1.A. AUF-Adjusted HQs for GOSB Interior Subunit (Sediment Media 0-1 ft)

Analyte[1]	Mean[2]	RSV Source[3]	Montane shrew (Mammalian insectivore)			Occult little brown myotis bat (Mammalian aerial insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Alpha-Chlordane	1.69E+00	c	6.49E-03	4.16E+02	4.06E-03	2.53E-05	1.30E+05	1.30E-05

Analyte[1]	Mean[2]	RSV Source[3]	American robin (Avian omnivore)			American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Alpha-Chlordane	1.69E+00	c	6.02E-03	4.48E+02	3.77E-03	6.02E-03	2.32E+02	7.27E-03

Analyte[1]	Mean[2]	RSV Source[3]	Violet-green Swallow (Avian aerial insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Alpha-Chlordane	1.69E+00	c	3.72E-03	4.84E+02	3.49E-03

Analyte[1]	Mean[2]	RSV Source[3]	Montane shrew (Mammalian insectivore)			American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Cadmium	1.82E+00	d	6.49E-03	4.16E+02	4.37E-03	6.02E-03	4.82E+02	3.78E-03

Analyte[1]	Mean[2]	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Copper	3.20E+01	d	6.02E-03	7.64E+03	4.19E-03

Analyte[1]	Mean[2]	RSV Source[3]	Deer mouse (Mammalian omnivore)			Montane shrew (Mammalian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]

Dieldrin	1.12E-01	d	3.37E-02	5.04E-01	2.23E-01	6.49E-03	1.39E+00	8.10E-02

Table 1.A. AUF-Adjusted HQs for GOSB Interior Subunit (Sediment Media 0-1 ft) (cont.)

Analyte[1]	Mean[2]	RSV Source[3]	Occult little brown myotis bat (Mammalian aerial insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Dieldrin	1.12E-01	d	2.53E-05	4.35E+02	2.59E-04

Analyte[1]	Mean[2]	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Lead	2.67E+01	d	6.02E-03	6.97E+03	3.83E-03	6.02E-03	5.48E+03	4.88E-03

Analyte[1]	Mean[2]	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Lead	2.67E+01	d	6.02E-03	4.65E+03	5.75E-03

Analyte[1]	Mean[2]	RSV Source[3]	Deer mouse (Mammalian omnivore)			Montane shrew (Mammalian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	2.59E-01	d	3.37E-02	9.19E-01	2.82E-01	6.49E-03	2.31E+00	1.12E-01

Analyte[1]	Mean[2]	RSV Source[3]	Occult little brown myotis bat (Mammalian aerial insectivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	2.59E-01	d	2.53E-05	7.51E+02	3.45E-04	6.02E-03	1.18E+00	2.20E-01

Analyte[1]	Mean[2]	RSV Source[3]	American robin (Avian insectivore)			Violet-green Swallow (Avian aerial insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	2.59E-01	d	6.02E-03	5.81E-01	4.46E-01	3.72E-03	1.24E+00	2.10E-01

Table 1.A. AUF-Adjusted HQs for GOSB Interior Subunit (Sediment Media 0-1 ft) (cont.)

Analyte[1]	Mean[2]	RSV Source[3]	American kestrel (Avian intermediate carnivore)			American kestrel (Avian top carnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	2.59E-01	d	2.39E-05	7.12E+02	3.64E-04	2.39E-05	3.27E+03	7.93E-05

Analyte[1]	Mean[2]	RSV Source[3]	Red fox (Mammalian top carnivore)		
			AUF[4]	RSV[5]	HQ[5]
Mercury	2.59E-01	d	2.44E-06	2.30E+05	1.13E-06

Analyte[1]	Mean[2]	RSV Source[3]	Montane shrew (Mammalian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Thallium	1.18E+00	d	6.49E-03	3.39E+02	3.49E-03

1 – COPCs identified in Table D-2 with receptor-specific RSVs available

2 – Mean concentration from Appendix A Table A.1.1 Sediment Media (0-1 ft)

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: c = Los Alamos National Laboratory Low Effect ESL for Sediment Media

3: d = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

Table 2.A AUF-Adjusted HQs for GOSB Berm Subunit (Soil Media 0-1 ft)

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Lead	1.89E+01	b	4.18E-03	1.01E+04	1.88E-03	4.18E-03	7.90E+03	2.39E-03
Vanadium	4.62E+01	b	4.18E-03	4.07E+03	1.14E-02	4.18E-03	3.59E+03	1.29E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Lead	1.89E+01	b	4.18E-03	6.70E+03	2.81E-03
Vanadium	4.62E+01	b	4.18E-03	3.11E+03	1.49E-02

1 – COPCs identified in Table D-6 with receptor-specific RSVs available

2 – Mean concentration from Appendix A Table A.2.1.1 Soil Media (0-1 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

Table 2.B AUF-Adjusted HQs for GOSB Berm Subunit (Soil Media 1-4 ft)

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Vanadium	2.85E+01	b	4.18E-03	4.07E+03	7.02E-03	4.18E-03	3.59E+03	7.95E-03

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Vanadium	2.85E+01	b	4.18E-03	3.11E+03	9.18E-03

1 – COPCs identified in Table D-8 with receptor-specific RSVs available

2 – Mean concentration from Appendix A A.2.1.2 Soil Media (1-4 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

Table 3.A AUF-Adjusted HQs for Effluent Discharge (Soil Media 0-1 ft)

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	Deer mouse (Mammalian omnivore)			Montane shrew (Mammalian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	5.24E-02	b	3.37E-02	9.19E-01	5.70E-02	6.49E-03	2.31E+00	2.26E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian omnivore)			American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Mercury	5.24E-02	b	6.02E-03	1.18E+00	4.44E-02	6.02E-03	5.81E-01	9.01E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American kestrel (Avian intermediate carnivore)		
			AUF[4]	RSV[5]	HQ[5]
Mercury	5.24E-02	b	6.02E-03	2.82E+00	1.85E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Vanadium	3.52E+01	b	6.02E-03	2.82E+03	1.25E-02	6.02E-03	2.49E+03	1.41E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Vanadium	3.52E+01	b	6.02E-03	2.16E+03	1.63E-02

1 – COPCs identified in Table D-10 with receptor-specific RSVs available.

2 – Mean concentration from Appendix A Table A.4.1 Soil Media (0-1 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

Table 3.B AUF-Adjusted HQs for Effluent Discharge (Soil Media 1-4 ft)

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Vanadium	3.95E+01	b	6.02E-03	2.82E+03	1.40E-02	6.02E-03	2.49E+03	1.59E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Vanadium	3.95E+01	b	6.02E-03	2.16E+03	1.83E-02

1 – COPCs identified in Table D-12 with receptor-specific RSVs available

2 – Mean concentration from Appendix A Table A.4.2 Soil Media (1-4 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

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Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian herbivore)			American robin (Avian omnivore)		
			AUF[4]	RSV[5]	HQ[5]	AUF[4]	RSV[5]	HQ[5]
Vanadium	3.95E+01	b	6.02E-03	2.82E+03	1.40E-02	6.02E-03	2.49E+03	1.59E-02

Analyte[1]	Mean[2] (mg/kg)	RSV Source[3]	American robin (Avian insectivore)		
			AUF[4]	RSV[5]	HQ[5]
Vanadium	3.95E+01	b	6.02E-03	2.16E+03	1.83E-02

1 – COPCs identified in Table D-12 with receptor-specific RSVs available

2 – Mean concentration from Appendix A Table A.4.2 Soil Media (1-4 ft)

3: a = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)

3: b = Los Alamos National Laboratory Low Effect ESL for Soil Media

4 – Site-specific Area Use Factor (AUF) for receptor from Attachment D-8

5 – AUF-adjusted value

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APPENDIX E

PRINCIPAL THREAT SOURCE MATERIAL EVALUATION

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Attachment E-2. USEPA Radionuclide Preliminary Remediation Goals for Superfund Website: Default PRGs for Composite Worker (i.e., Industrial Worker) Scenario

LIST OF ABBREVIATIONS AND ACRONYMS

COC	constituent of concern
EPC	exposure point concentration
ft	feet
GOSB	G-Area Oil Seepage Basin
HI	hazard index
HQ	hazard quotient
m	meter
OU	Operable Unit
PRG	preliminary remediation goal
PTSM	principal threat source material
RSL	regional screening level
SRS	Savannah River Site
USEPA	U.S. Environmental Protection Agency

E-1. INTRODUCTION

The concept of principal threat waste and low level threat waste as developed by the U.S. Environmental Protection Agency (USEPA) in the National Contingency Plan (40 *Code of Federal Regulations* 300.430(a)(1)(iii)) is to be applied on a site-specific basis when characterizing source material. Source materials are those materials that include or contain hazardous substances, pollutants, or contaminants that act as a reservoir for migration to surface water, or air, or that act as a source for direct exposure (USEPA 1991).

The determination of whether the source materials present at a waste unit would be classified as principal threat source material (PTSM) is based mainly on the USEPA guidance document (USEPA 1991). In this guidance, the USEPA defines principal threat wastes as "those source materials considered to be highly toxic or mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur." These include liquids and other highly mobile materials (e.g., materials that released from surface soil due to volatilization, leaching, or surface runoff) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, the guidance does state that treatment alternatives for source materials should generally be evaluated where the combined toxicity and mobility pose a potential risk of 1E-03 or greater. According to USEPA, the PTSM concept expectation was to "help streamline and focus the remedy selection process, not as a mandatory waste classification requirement."

The USEPA, South Carolina Department of Health and Environmental Control, and U.S. Department of Energy evaluated the USEPA guidance with respect to toxicity and contaminant migration analysis performed at Savannah River Site (SRS). In practice, SRS risk assessment and contaminant migration evaluations identify constituents of concern (COCs) associated with source material or impacted media and determine the associated risk (i.e., adverse health impacts as measured by the hazard index [HI] and numerical estimate of risk) or potential impact to environmental media. If threshold risk levels are exceeded, problems are identified and an evaluation of remedial alternatives is conducted in the Feasibility Study. Since the risk assessment does not evaluate human receptor exposure to subsurface soils, further

reevaluation is needed to account for potentially highly toxic source material or contaminated soils at depth that would results in unacceptable risk should exposure occur. Therefore, a quantitative determination of whether contamination exists above PTSM levels at the G-Area Oil Seepage Basin (GOSB) Operable Unit (OU) in all soil depths was performed.

E-1.1 Background

The GOSB OU consists of a manmade, earthen basin located southeast of N Area (Central Shops) that is within an area currently designated for industrial use. It was initially used for liquid waste disposal during SRS plant construction in the early 1950s. It may have received unknown liquid waste from the time of plant construction until the 1960s, although no records exist of such disposals. Up until 1983, the GOSB received effluent from a small sanitary wastewater treatment facility and between 1983 until 1992 received effluent from the Central shops sanitary wastewater treatment plant via a National Pollutant Discharge Elimination System permitted outfall (CS-11). The designation of the basin as an oil seepage basin may be a misnomer because there is no information regarding its use for management and disposal of waste oils. The GOSB is currently inactive; however, rainwater is typically retained in the basin. The GOSB basin is approximately 3 meter (m) (10 feet [ft]) deep around the edges of the basin with the northern and southern sides (0.9 m [3 ft] and 0.6 m [2 ft] high, respectively, being the highest. The GOSB OU is segregated into subunits for investigation, evaluation, and potential remediation purposes based on the primary source of contamination, that is, historical water discharges to the basin. The GOSB OU subunits include the 1) GOSB Interior Subunit, 2) GOSB Berm Subunit, 3) Pipeline Subunit, and 4) Effluent Discharge Subunit. For the PTSM evaluation, data for the GOSB OU includes sediment and soil media combined from all depth intervals from all subunits; the subunits are not individually evaluated.

The plan view of the GOSB OU is shown in Figure E-1.

E-1.2 Data

In 2009, a sampling campaign was conducted to determine the nature and extent of any hazardous substances in the GOSB Interior Basin and surrounding environment, and to collect

sufficient data to support the human health and ecological risk assessment, contaminant migration evaluation, and PTSM analysis. Ninety-five soil, sediment, and surface water samples from fifty-three locations were collected from within the basin and the surrounding area for characterization of the GOSB OU. In addition, from November 2016 through January 2017, a total of twenty soil, groundwater, and surface water samples were collected from seventeen locations within the GOSB Basin Interior Subunit and the surrounding area for additional characterization. All data used in the GOSB OU PTSM evaluation are presented in Appendix A (Table A.5.1).

E-1.3 Receptor

The USEPA default industrial worker receptor scenario (termed composite worker) is the receptor scenario evaluated under this PTSM evaluation for GOSB OU. The principal exposure assumptions for the industrial worker are 25 years, 250 days/year, and 8 hours per day. Given the current and expected future land use of the area in which the GOSB OU is located, the industrial worker is the most likely receptor exposure.

E-1.4 Sources of Risk-Based Threshold Values

The USEPA Regional Screening Levels (RSLs) website (USEPA 2016) is the source of chemical constituent, risk-based threshold values used in this evaluation. The website was accessed on May 7, 2017. The threshold limits for the industrial worker scenario were obtained from the generic composite worker soil table. The RSLs for this scenario are provided in Attachment E-1.

The USEPA Superfund Radionuclide Preliminary Remediation Goals (PRGs) for Superfund website (USEPA 2017) is the source of the radionuclide threshold values for the industrial worker used in this evaluation. Threshold limits for the composite worker were obtained by using the website calculator function with the default exposure parameters to derive PRGs. The website was accessed on May 10, 2017. The PRGs for this scenario are provided in Attachment E-2.

E-2. PTSM EVALUATION PROCESS

To determine whether contaminated source material/soils/sediments should be preliminarily considered PTSM, a simple quantitative assessment evaluating the toxicity of the source is used where the results are compared to a threshold for determining PTSM.

In determining whether the source should be considered PTSM, the evaluation considers the cumulative effects of both the potential risk from carcinogenic constituents and the adverse effects from noncarcinogens to an industrial worker receptor. The source material (i.e., sediment and/or soil) is preliminarily considered to be PTSM if the cumulative risk exceeds at least one of the following threshold screening criteria:

- Carcinogens – greater than 1E-03 industrial worker risk
- Noncarcinogens – industrial worker hazard index (HI) greater than 10

In the preliminary screen, the unit maximum concentration for every detected constituent for the sediment and/or soil media from the all depth interval from all subunits in the GOSB OU is determined and used as the exposure point concentration (EPC). Appendix A presents the maximum detected constituent concentrations and activity concentrations for the GOSB OU used in the PTSM evaluation (Table A.5.1).

For carcinogens, the individual risk associated with each constituent is calculated by multiplying the ratio of the EPC to the RSL or PRG by 1E-06. Each of these risks is summed to calculate the cumulative carcinogenic risk associated with the source. For noncarcinogens, a hazard quotient (HQ) associated with each constituent is calculated by dividing the EPC by the RSL. These HQs are summed to derive the cumulative HI. If neither threshold criteria for PTSM are exceeded based on the maximum detected concentrations and activity concentrations, then PTSM is not present and it is not necessary to evaluate further.

E-2.1 GOSB Sediment and Soil Media Combined

A summary of the screening evaluation performed for PTSM is summarized below.

E-2.1.1 Screening Evaluation

For the screening evaluation for PTSM, maximum concentrations for nonradiological constituents and activity concentrations for radionuclides in sediment and soil (all depths) from all subunits were used to calculate HQs for noncarcinogens and numerical risk for carcinogens. The following equations are used to calculate HQs and risks for the PTSM evaluation:

$$noncarcinogen\ hazard\ quotient = \frac{[Maximum\ Concentration]}{[RSL]}$$

$$carcinogen\ risk\ estimate = \left(\frac{[Maximum\ Concentration]}{[RSL\ or\ PRG]}\right) \times 1E\text{-}06$$

E-2.1.2 Results

Results of the PTSM evaluation for the GOSB OU indicate that the HI is 1 and the cumulative risk is 3.9E-04. Table E-1 presents the results of the PTSM screening evaluation for the GOSB OU.

E-3. SUMMARY/CONCLUSIONS OF THE PTSM EVALUATION

Based on the results of the PTSM evaluation, no PTSM refined COCs are identified for the GOSB OU. The revised CSM is presented in Chapter 3.

E-4. REFERENCES

USEPA, 1991. U.S. Environmental Protection Agency, *A Guide to Principal Threat and Low Level Threat Wastes*, Superfund Publication 9380.3-06FS, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 2016. USEPA Regional Screening Levels, U.S. Environmental Protection Agency, National Center for Environmental Assessment, Arlington, VA, accessed May 2017, https://www.epa.gov/risk/regional-screening-levels-rsls

USEPA, 2017. *Preliminary Remediation Goals for Radionuclides,* U.S. Environmental Protection Agency, Office of Land and Emergency Management, Washington, DC, accessed May 2017, https://epa-prgs.ornl.gov/radionuclides

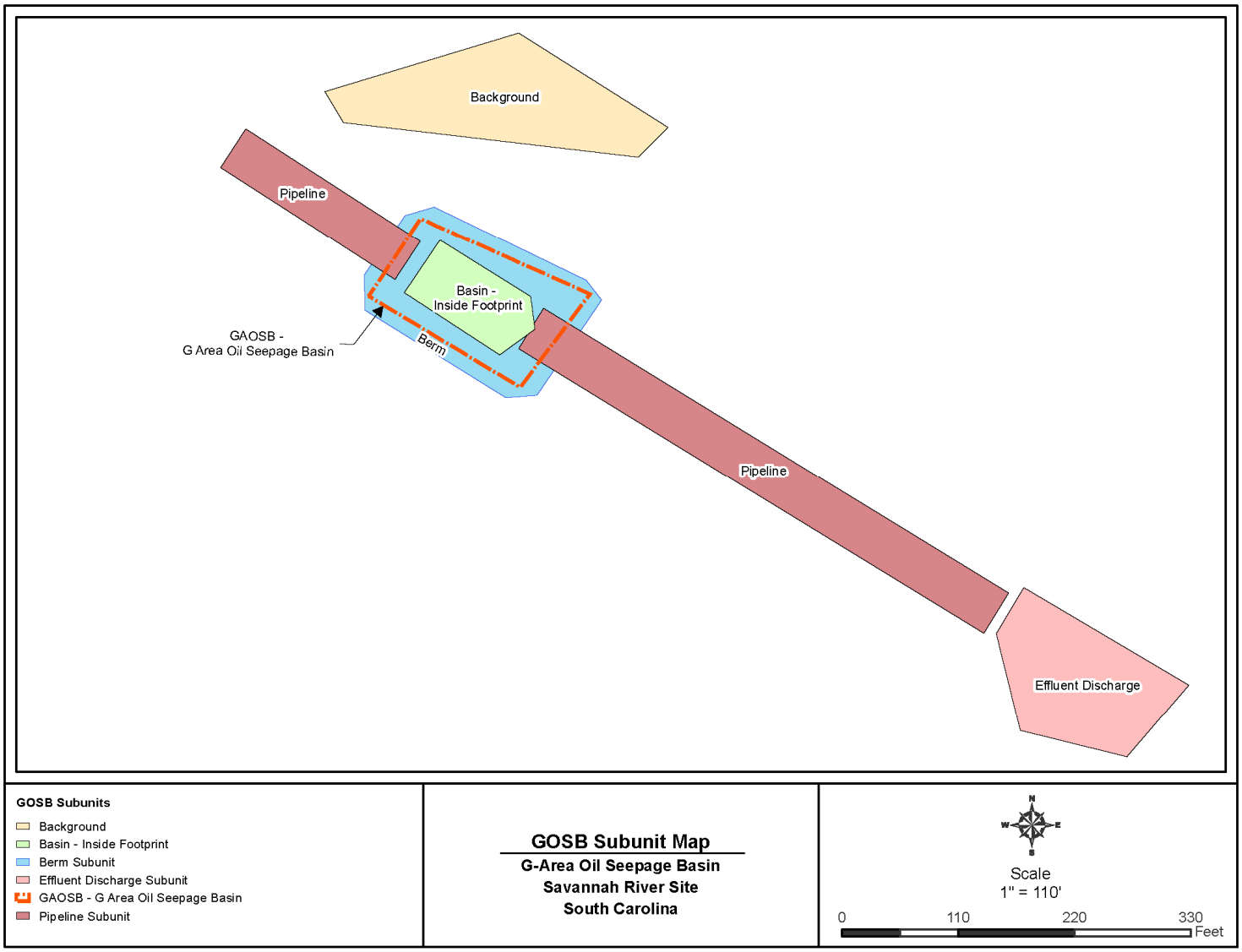

Figure E-1. GOSB OU

Table E-1. PTSM Screening Evaluation for G-Area Oil Seepage Basin Operable Unit (sediment and soil, all depth intervals)

Constituent	EPC[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial RSL[2]	Industrial HQ Estimate[3]	Industrial RSL/PRG[2]	Industrial Risk Estimate[4]
Inorganics *(mg/kg)*					
Aluminum	1.89E+04	1.1E+06	1.72E-02	---	---
Antimony	2.93E+00	4.7E+02	6.23E-03	---	---
Arsenic	4.81E+01	4.8E+02	1.00E-01	3.0E+00	1.60E-05
Barium	9.20E+01	2.2E+05	4.18E-04	---	---
Beryllium	8.11E-01	2.3E+03	3.53E-04	6.9E+03	1.18E-10
Cadmium	4.19E+00	9.8E+02	4.28E-03	9.3E+03	4.51E-10
Calcium	1.57E+04	EN[5]	---	---	---
Chromium[6]	8.67E+01	3.5E+03	2.48E-02	6.3E+00	1.38E-05
Cobalt	3.96E+00	3.5E+02	1.13E-02	1.9E+03	2.08E-09
Copper	4.81E+01	4.7E+04	1.02E-03	---	---
Cyanide	8.10E-01	1.5E+02	5.40E-03	---	---
Iron	8.52E+04	8.2E+05	1.04E-01	---	---
Lead	7.29E+01	8.0E+02	9.11E-02	---	---
Magnesium	3.68E+02	EN[5]	---	---	---
Manganese	5.37E+02	2.6E+04	2.07E-02	---	---
Mercury[7]	5.78E-01	4.6E+01	1.26E-02	---	---
Nickel	2.49E+01	2.2E+04	1.13E-03	6.4E+04	3.89E-10
Potassium	3.80E+02	EN[5]	---	---	---
Selenium	3.72E+00	5.8E+03	6.41E-04	---	---
Silver	3.14E+02	5.8E+03	5.41E-02	---	---
Sodium	3.11E+02	EN[5]	---	---	---
Thallium	4.64E+00	1.2E+01	3.87E-01	---	---
Vanadium	1.98E+02	5.8E+03	3.41E-02	---	---
Zinc	4.60E+02	3.5E+05	1.31E-03	---	---
Organics *(mg/kg)*					
1,2-Dichlorobenzene	5.92E-04	9.3E+03	6.37E-08	---	---
1,3-Dichlorobenzene	8.42E-03	NA[8]	---	NA[8]	---
1,4-Dichlorobenzene	3.44E-02	2.5E+04	1.38E-06	1.1E+01	3.13E-09
2-Methylnaphthalene	2.58E+00	3.0E+03	8.60E-04	---	---
Acenaphthene	1.78E-02	4.5E+04	3.96E-07	---	---
Acetone	1.73E-01	6.7E+05	2.58E-07	---	---
Anthracene	2.80E-02	2.3E+05	1.22E-07	---	---
Benzene	4.78E-04	4.2E+02	1.14E-06	5.1E+00	9.37E-11
Benzo(g,h,i)perylene	6.70E-02	NA[8]	---	NA[8]	---
Benzo[a]anthracene	1.95E-01	---	---	2.9E+00	6.72E-08
Benzo[a]pyrene	1.38E-01	---	---	2.9E-01	4.76E-07
Benzo[b]fluoranthene	2.47E-01	---	---	2.9E+00	8.52E-08

Table E-1. PTSM Screening Evaluation for G-Area Oil Seepage Basin Operable Unit (sediment and soil, all depth intervals) (cont.)

Constituent	EPC[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial RSL[2]	Industrial HQ Estimate[3]	Industrial RSL/PRG[2]	Industrial Risk Estimate[4]
Benzo[k]fluoranthene	1.92E-02	---	---	2.9E+01	6.62E-10
Bis(2-ethylhexyl)phthalate	1.14E-01	1.6E+04	7.13E-06	1.6E+02	7.13E-10
Caprolactam	1.42E+01	4.0E+05	3.55E-05	---	---
Carbazole	2.64E-02	NA[8]	---	NA[8]	---
Carbon Disulfide	3.34E-03	3.5E+03	9.54E-07	---	---
Chlorobenzene	2.18E-02	1.3E+03	1.68E-05	---	---
Chloroform	1.09E-03	1.0E+03	1.09E-06	1.4E+00	7.79E-10
Chloromethane	5.30E-04	4.6E+02	1.15E-06	---	---
Chrysene	1.67E-01	---	---	2.9E+02	5.76E-10
Ethylbenzene	5.10E-04	2.0E+04	2.55E-08	2.5E+01	2.04E-11
Fluoranthene	9.93E-01	3.0E+04	3.31E-05	---	---
Fluorene	1.59E+00	3.0E+04	5.30E-05	---	---
Indeno[1,2,3-cd]pyrene	6.47E-02	---	---	2.9E+00	2.23E-08
Cumene	4.25E-03	9.9E+03	4.29E-07	---	---
Methyl acetate	5.03E-02	1.2E+06	4.19E-08	---	---
Methylcyclohexane	4.40E-04	NA[8]	---	NA[8]	---
Methyl ethyl ketone	6.13E-02	1.9E+05	3.23E-07	---	---
Phenanthrene	3.91E+00	NA[8]	---	NA[8]	---
Pyrene	6.83E-01	2.3E+04	2.97E-05	---	---
Styrene	6.22E-03	3.5E+04	1.78E-07	---	
Toluene	1.32E-03	4.7E+04	2.81E-08	---	---
m,p-Xylene	7.08E-04	2.4E+03	2.95E-07	---	---
Pesticides/PCBs *(mg/kg)*					
Aldrin	1.49E-02	3.5E+01	4.26E-04	1.8E-01	8.28E-08
Alpha-Benzene Hexachloride	1.12E-03	6.6E+03	1.70E-07	3.6E-01	3.11E-09
Alpha-Chlordane	7.32E+00	4.5E+02	1.63E-02	7.7E+00	9.51E-07
Beta-Benzene Hexachloride	4.38E-03	---	---	1.3E+00	3.37E-09
DDD	1.80E+00	---	---	9.6E+00	1.88E-07
DDE	4.50E+00	---	---	9.3E+00	4.84E-07
DDT	3.83E-02	5.2E+02	7.37E-05	8.5E+00	4.51E-09
Dieldrin	5.00E-01	4.1E+01	1.22E-02	1.4E-01	3.57E-06
Endosulfan Sulfate	7.13E-04	NA[8]	---	NA[8]	---
Endrin	1.45E-03	2.5E+02	5.80E-06	---	---
Endrin Ketone	1.61E-03	NA[8]	---	NA[8]	---
Gamma-Chlordane	1.09E+01	4.5E+02	2.42E-02	7.7E+00	1.42E-06
Heptachlor	8.97E-03	5.8E+02	1.55E-05	6.3E-01	1.42E-08
Heptachlor Epoxide	9.45E-01	1.5E+01	6.30E-02	3.3E-01	2.86E-06
Aroclor 1242	3.02E-02	---	---	9.5E-01	3.18E-08
Aroclor 1254	3.66E-02	1.5E+01	2.49E-03	9.7E-01	3.77E-08

Table E-1. TSM Screening Evaluation for G-Area Oil Seepage Basin Operable Unit (sediment and soil, all depth intervals) (cont.)

Constituent	EPC[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial RSL[2]	Industrial HQ Estimate[3]	Industrial RSL/PRG[2]	Industrial Risk Estimate[4]
Aroclor 1260	3.57E-02	---	---	9.9E-01	3.61E-08
Radionuclides *(pCi/g)*					
Barium-133	2.47E-02	---	---	1.2E-01	2.02E-07
Cesium-137	2.84E-01	---	---	6.9E-02	4.12E-06
Potassium-40	4.21E+00	---	---	2.2E-01	1.92E-05
Thorium-232[9]	2.75E+00	---	---	1.5E-02	1.80E-04
Radium-228	2.47E+00	---	---	na[11]	na[11]
Actinium-228	2.11E+00	---	---	na[11]	na[11]
Thorium-228	2.75E+00	---	---	na[11]	na[11]
Lead-212	2.17E+00	---	---	na[11]	na[11]
Thallium-208	6.44E-01	---	---	na[11]	na[11]
Tritium	1.11E+01	---	---	1.6E-01	6.94E-05
Uranium-235	1.69E-01	---	---	7.3E-02	2.31E-06
Uranium-238[10]	1.47E+00	---	---	2.0E-02	7.35E-05
Uranium-233/234[12]	1.19E+00	---	---	na[11]	na[11]
Thorium-230	1.47E+00	---	---	na[11]	na[11]
Radium-226	1.37E+00	---	---	na[11]	na[11]
Lead-214	1.39E+00	---	---	na[11]	na[11]
Bismuth-214	1.23E+00	---	---	na[11]	na[11]
		Hazard Index	**1.00**	Cumulative Risk	**3.89E-04**
		PTSM?[13]	**NO**	PTSM?[14]	**NO**

1 - EPC - maximum detected concentration from all depths, sediment and soil media combined from Table A.5.1 in Appendix A.
2 - Nonradiological RSLs are default industrial worker soil values from the "USEPA Regional Screening Levels (RSLs)" website (May 2016). Radiological PRGs are default industrial worker soil values from the "USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund" calculator (May 2017).
3 - Hazard Estimate - exposure point concentration/RSL concentration.
4 - Risk Estimate - (exposure point concentration/PRG or RSL concentration) × 1E-06.
5 - EN - essential nutrient, RSL is not available.
6 - RSL for hexavalent chromium used (most conservative).
7 - RSL for elemental mercury used (most conservative).
8 - Not available, RSL for this constituent is not available.
9 - Radium-228, actinium-228, thorium-228, lead-212 and thallium-208 are daughter products of thorium-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity for these daughters was used in this assessment. The daughter products are not screened separately since they are considered in the thorium-232 secular equilibrium PRG.
10 - Uranium-234, thorium-230, radium-226, lead-214, and bismuth-214 are daughter products of uranium-238 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity for daughters was used in this assessment. The daughter products are not screened separately since they are considered in the uranium-238 secular equilibrium PRG.
11 - Not applicable per footnotes 9 and 10 above
12 - Uranium-233/-234 assumed to be uranium-234 for evaluation purposes (i.e., included in the uranium-238 decay chain).
13 - Waste unit potentially has PTSM if HI ≥ 10 for noncarcinogenic constituents.
14 - Waste unit potentially has PTSM if cumulative risk ≥ 1E-03 for carcinogenic constituents.

EPC = exposure point concentration
HI = hazard index
HQ = hazard quotient
NA = not available
PRG = preliminary remediation goal
PTSM = principal threat source material
RSL = regional screening level

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Attachment E-1

USEPA Regional Screening Levels Website:
Default RSLs for Composite Worker (i.e., Industrial Worker) Scenario
(May 2016)
(Website accessed May 7, 2017)

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Default RSLs for Composite Worker (i.e., Industrial Worker)

Contaminant	Carcinogenic TR = 1E-06				Noncancer HI = 1			
Analyte	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL THQ=1 (mg/kg)	Dermal SL THQ=1 (mg/kg)	Inhalation SL THQ=1 (mg/kg)	Noncarcinogenic SL THI=1 (mg/kg)
Acenaphthene	-	-	-	-	7.0E+04	1.3E+05	-	4.5E+04
Anthracene	-	-	-	-	3.5E+05	6.4E+05	-	2.3E+05
Acetone	-	-	-	-	1.1E+06	-	1.8E+06	6.7E+05
Aldrin	1.9E-01		4.3E+00	1.8E-01	3.5E+01	-	-	3.5E+01
Alpha-Benzene Hexachloride	5.2E-01	1.2E+00	9.3E+03	3.6E-01	9.3E+03	2.2E+04	-	6.6E+03
Alpha-Chlordane	9.3E+00	5.5E+01	1.9E+02	7.7E+00	5.8E+02	3.4E+03	4.7E+03	4.5E+02
Aluminum	-	-	-	-	1.2E+06	-	3.0E+07	1.1E+06
Antimony	-	-	-	-	4.7E+02	-	-	4.7E+02
Arsenic	3.6E+00	1.7E+01	3.9E+03	3.0E+00	5.8E+02	2.8E+03	8.9E+04	4.8E+02
Aroclor 1242	1.6E+00	2.8E+00	1.3E+01	9.5E-01	-	-	-	-
Aroclor 1254	1.6E+00	2.8E+00	1.8E+01	9.7E-01	2.3E+01	3.9E+01	-	1.5E+01
Aroclor 1260	1.6E+00	2.8E+00	2.8E+01	9.9E-01	-	-	-	-
Barium	-	-	-	-	2.3E+05	-	3.0E+06	2.2E+05
Benzene	5.9E+01	-	5.6E+00	5.1E+00	4.7E+03	-	4.6E+02	4.2E+02
Benzo[a]anthracene	4.5E+00	8.1E+00	4.9E+02	2.9E+00	-	-	-	-
Benzo[a]pyrene	4.5E-01	8.1E-01	1.5E+04	2.9E-01	-	-	-	-
Benzo(g,h,i)perylene				NA	-	-	-	NA
Benzo[b]fluoranthene	4.5E+00	8.1E+00	1.5E+05	2.9E+00	-	-	-	-
Benzo[k]fluoranthene	4.5E+01	8.1E+01	1.5E+05	2.9E+01	-	-	-	-
Beryllium			6.9E+03	6.9E+03	2.3E+03		1.2E+05	2.3E+03
Beta-Benzene hexachloride	1.8E+00	4.3E+00	3.1E+04	1.3E+00			-	
Bis(2-ethylhexyl)phthalate	2.3E+02	5.5E+02	6.9E+06	1.6E+02	2.3E+04	5.5E+04	-	1.6E+04
Cadmium	-	-	9.3E+03	9.3E+03	1.2E+03	6.9E+03	6.0E+04	9.8E+02
Caprolactam	-	-	-		5.8E+05	1.4E+06	1.3E+07	4.0E+05
Carbazole	-	-	-	NA		-	-	NA
Carbon Disulfide	-	-	-	-	1.2E+05	-	3.6E+03	3.5E+03
Chlorobenzene	-	-	-	-	2.3E+04	-	1.4E+03	1.3E+03
Chloroform	1.1E+02	-	1.4E+00	1.4E+00	1.2E+04	-	1.1E+03	1.0E+03
Chloromethane	-	-	-	-	-	-	4.6E+02	4.6E+02
Chromium(III), Insoluble Salts	-	-	-	-	1.8E+06	-	-	1.8E+06
Chromium(VI)	6.5E+00	-	2.0E+02	6.3E+00	3.5E+03	-	6.0E+05	3.5E+03
Chrysene	4.5E+02	8.1E+02	1.5E+06	2.9E+02		-	-	-
Cobalt	-	-	1.9E+03	1.9E+03	3.5E+02	-	3.6E+04	3.5E+02
Copper	-	-	-	-	4.7E+04	-	-	4.7E+04
Cumene (Isopropylbenzene)	-	-	-	-	1.2E+05	-	1.1E+04	9.9E+03
Cyanide	-	-	-	-	7.0E+02	-	1.9E+02	1.5E+02
DDD	1.4E+01	3.2E+01	2.4E+05	9.6E+00	-	-	-	-
DDE	9.6E+00		2.7E+02	9.3E+00	-	-	-	-
DDT	9.6E+00	7.6E+01	1.7E+05	8.5E+00	5.8E+02	4.6E+03	-	5.2E+02

Default RSLs for Composite Worker (i.e., Industrial Worker) (cont.)

Contaminant	Carcinogenic TR = 1E-06				Noncancer HI = 1			
Analyte	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL THQ=1 (mg/kg)	Dermal SL THQ=1 (mg/kg)	Inhalation SL THQ=1 (mg/kg)	Noncarcinogenic SL THI=1 (mg/kg)
1,2-Dichlorobenzene	-	-	-	-	1.1E+05	-	1.0E+04	9.3E+03
1,3-Dichlorobenzene	-	-	-	NA	-	-	-	NA
1,4-Dichlorobenzene	6.1E+02		1.2E+01	1.1E+01	8.2E+04		3.7E+04	2.5E+04
Dieldrin	2.0E-01	4.8E-01	3.6E+03	1.4E-01	5.8E+01	1.4E+02	-	4.1E+01
Endosulfan	-	-	-	-	7.0E+03		-	7.0E+03
Endosulfan sulfate	-	-	-	NA	-		-	NA
Endrin	-	-	-	-	3.5E+02	8.3E+02	-	2.5E+02
Endrin Ketone	-	-	-	NA	-	-	-	NA
Ethylbenzene	3.0E+02		2.8E+01	2.5E+01	1.2E+05		2.5E+04	2.0E+04
Fluoranthene	-	-	-	-	4.7E+04	8.5E+04	-	3.0E+04
Fluorene	-	-	-	-	4.7E+04	8.5E+04	-	3.0E+04
Gamma-Chlordane	9.3E+00	5.5E+01	1.9E+02	7.7E+00	5.8E+02	3.4E+03	4.7E+03	4.5E+02
Heptachlor	7.3E-01		4.5E+00	6.3E-01	5.8E+02	-	-	5.8E+02
Heptachlor Epoxide	3.6E-01		4.0E+00	3.3E-01	1.5E+01	-	-	1.5E+01
Indeno[1,2,3-cd]pyrene	4.5E+00	8.1E+00	1.5E+05	2.9E+00	-	-	-	-
Iron	-	-	-	-	8.2E+05	-	-	8.2E+05
Lead	-	-	-	-	-	-	-	8.0E+02
Manganese	-	-	-	-	2.8E+04	-	3.0E+05	2.6E+04
Mercury	-	-	-	-	-	-	4.6E+01	4.6E+01
Methyl Mercury	-	-	-	-	1.2E+02	-	-	1.2E+02
Methyl Acetate	-	-	-	-	1.2E+06	-	-	1.2E+06
Methyl Acrylate	-	-	-	-	-	-	6.1E+02	6.1E+02
2-Methylnaphthalene	-	-	-	-	4.7E+03	8.5E+03	-	3.0E+03
Methyl Ethyl Ketone	-	-	-	-	7.0E+05	-	2.7E+05	1.9E+05
Nickel	-	-	6.4E+04	6.4E+04	2.3E+04	-	5.4E+05	2.2E+04
Pyrene	-	-	-	-	3.5E+04	6.4E+04	-	2.3E+04
Selenium	-	-	-	-	5.8E+03	-	1.2E+08	5.8E+03
Silver	-	-	-	-	5.8E+03	-	-	5.8E+03
Styrene	-	-	-	-	2.3E+05	-	4.1E+04	3.5E+04
Thallium	-	-	-	-	1.2E+01	-	-	1.2E+01
Toluene	-	-	-	-	9.3E+04	-	9.4E+04	4.7E+04
Vanadium	-	-	-	-	5.9E+03	-	6.0E+05	5.8E+03
m,p-Xylene	-	-	-	-	2.3E+05	-	2.4E+03	2.4E+03
Zinc	-	-	-	-	3.5E+05	-	-	3.5E+05

HI = hazard index
SL = screening level
THI = target hazard index
THQ = target hazard quotient
TR = target result

Attachment E-2

USEPA Radionuclide Preliminary Remediation Goal for Superfund Website: Default PRGs for Composite Worker (i.e., Industrial Worker) Scenario (Website accessed May 10, 2017)

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Default Composite Worker (i.e., Industrial Worker) PRGs for Soil

Isotope	Ingestion PRG TR=1.0E-6 (pCi/g)	Inhalation PRG TR=1.0E-6 (pCi/g)	External Exposure PRG TR=1.0E-6 (pCi/g)	Total PRG TR=1.0E-6 (pCi/g)
Secular Equilibrium PRG for Barium-133	3.63E+02	3.31E+05	1.22E-01	1.22E-01
Secular Equilibrium PRG for Cesium-137	5.03E+01	9.67E+04	6.91E-02	6.90E-02
Secular Equilibrium PRG for Potassium-40	1.06E+02	4.90E+04	2.19E-01	2.19E-01
Secular Equilibrium PRG for Thorium-232	1.74E+00	4.70E+01	1.54E-02	1.53E-02
Secular Equilibrium PRG for Tritium	-	1.6E-01	-	1.60E-01
Secular Equilibrium PRG for Uranium-235	2.91E+00	3.46E+01	7.51E-02	7.31E-02
Secular Equilibrium PRG for Uranium-238	6.35E-01	7.51E+01	2.06E-02	2.00E-02

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APPENDIX F

REMEDIAL GOAL OPTION CALCULATIONS

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LIST OF ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CM	contaminant migration
DDE	dichlorodiphenyldichloroethylene
ECO	ecological
ERA	ecological risk assessment
GOSB	G-Area Oil Seepage Basin
HH	human health
HQ	hazard quotient
OU	operable unit
PTSM	principal threat source material
RCOC	refined constituent of concern
RSL	regional screening level
RSV	refinement screening level
RGO	remedial goal option

F.1 INTRODUCTION

The remedial goal options (RGOs) calculations for the G-Area Oil Seepage Basin (GOSB) Operable Unit (OU) are provided in this appendix.

F.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS RGOS

As presented in the Remedial Investigation (Chapter 3), there are no applicable or relevant and appropriate requirements (ARAR) refined constituents of concern (RCOCs) identified for any media (i.e., soil, sediment or surface water) within the GOSB OU. Therefore, no ARAR RGOs are presented.

F.3 CONTAMINANT MIGRATION BASED RGOS

The contaminant migration (CM) analysis is presented in Appendix B of this document. No CM RCOCs were identified for any subunits within the GOSB OU. Therefore, CM RGOs are not developed in this appendix.

F.4 HUMAN HEALTH RISK-BASED RGOS

The human health (HH) risk assessment is presented in Appendix C of this document. HH RCOCs alpha-chlordane, gamma-chlordane, dichlorodiphenyldichloroethylene (DDE), dieldrin, and heptachlor epoxide were identified in sediment media in the GOSB Interior Subunit for the resident. HH RCOCs gamma-chlordane, dieldrin, and heptachlor epoxide were identified in sediment in the GOSB Interior Subunit for the industrial worker. No RCOCs were identified for the other GOSB subunits.

Risk-based RGOs are based on the regional screening levels presented in Appendix C and are calculated for these two exposure scenarios at a hazard quotient (HQ) of 0.1, 1, and 3 for noncarcinogenic health effects and at various target risk levels (1E-06, 1E-05, and 1E-04) for carcinogenic effects. The HH RGOs for sediment media are provided in Table F-1.

No HH RCOCs were identified for surface water or soil media.

F.5 ECOLOGICAL RISK-BASED RGOS

The ecological risk assessment (ERA) is presented in Appendix D of this document. Ecological (ECO) RCOCs are identified in two media that were evaluated in the ERA (sediment and surface water). Risk-based RGOs are the refinement screening values (RSVs) for sediment and surface water. All sediment and surface water RCOCs are associated with the GOSB Interior Subunit. There were no RCOCs identified for the soil media in either the Berm Subunit or the Effluent Discharge Subunit. Therefore, there are no RGOs for the soil media. The ECO RGOs for sediment media and surface water are provided in Table F-2.

F.6 PRINCIPAL THREAT SOURCE MATERIAL RGOS

The principal threat source material (PTSM) evaluation is presented in Appendix E of this document. No PTSM RCOCs were identified for the GOSB OU. Therefore, RGOs are not developed in this appendix.

Table F-1. Human Health Risk-Based RGOs for Sediment Media

	Resident (mg/kg)						Industrial Worker (mg/kg)					
HH RCOC	**Risk = 1E-06**	**Risk = 1E-05**	**Risk = 1E-04**	**HQ = 0.1**	**HQ = 1**	**HQ = 3**	**Risk = 1E-06**	**Risk = 1E-05**	**Risk = 1E-04**	**HQ = 0.1**	**HQ = 1**	**HQ = 3**
Alpha-chlordane	1.7	17	170	3.5	35	105	-	-	-	-	-	-
Gamma-chlordane	1.7	17	170	3.5	35	105	7.7	77	770	45	450	1,350
DDE	2	20	200	-	-	-	-	-	-	-	-	-
Dieldrin	0.034	0.34	3.4	0.32	3.2	9.6	0.14	1.4	14	4.1	41	123
Heptachlor epoxide	0.07	0.7	7	0.1	1	3	0.33	3.3	33	1.5	15	45

- = not applicable

Risk based RGOs are Regional Screening levels (RSLs) (1E-06 and HQ = 1) from the USEPA RSLs website that are provided in Appendix C.

Table F-2. Ecological Risk-Based RGOs for Sediment and Surface Water Media

Media	Receptor	Constituent	RGO	HQ Basis
Sediment	Benthic organism	Alpha-chlordane (mg/kg)	0.017	HQ = 1
Sediment	Benthic organism	DDD (mg/kg)	0.00781	HQ = 1
Sediment	Benthic organism	DDE (mg/kg)	0.00374	HQ = 1
Sediment	Benthic organism	Dieldrin (mg/kg)	0.009	HQ = 1
Sediment	Benthic organism	Gamma-chlordane (mg/kg)	0.017	HQ = 1
Sediment	Benthic organism	Heptachlor epoxide	0.016	HQ = 1
Sediment	Benthic organism	Silver (mg/kg)	2.2	HQ = 1
Surface water	Aquatic organism	Alpha-chlordane (µg/L)	0.0043	HQ = 1
Surface water	Aquatic organism	Gamma-chlordane (µg/L)	0.0043	HQ = 1
Surface water	Aquatic organism	Silver (µg/L)	0.06	HQ = 1

HQ = hazard quotient

RGO = remedial goal option: risk based RGOs are the RSVs that are provided in Appendix D.

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APPENDIX G

NATURAL RESOURCE INJURY EVALUATION CHECKLIST

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NATURAL RESOURCE INJURY EVALUATION CHECKLIST

This checklist is provided to assist project teams in determining the potential for natural resource injuries in the conduct and planning of remedial activities. For the most part, the questions only require a simple 'yes/no' or 'to be determined' response. Some require a short answer or explanation. However, it is in the best interest of the project team to be as complete as possible and add any relevant information.

Five main areas are being evaluated, as follows:

- Are there potential natural resource injuries and what do they consist of?
- What are the potential impacts from implementing the remedial alternatives?
- Are there potential residual injuries that will not be addressed by the alternative?
- Would implementation of the alternative cause additional injuries?
- What potential irreversible and irretrievable resources may be identified?

The checklist should be re-visited and revised as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities continue and additional information from the G-Area Oil Seepage Basin (GOSB) Operable Unit (OU) becomes available.

1. Has a release of a hazardous substance occurred?

Yes. OU-related constituents were identified in sediment and surface water media associated with the GOSB Interior Subunit. Exposure to such constituents under a residential or industrial worker scenario may result in risk exceeding the upper bound of the CERCLA risk range. Also, constituents in sediment and surface water exceed ecological screening levels for benthic organisms and aquatic organisms, respectively.

2a. Have natural resources for which Federal or State agencies (or Indian Tribes) may assert trusteeship under CERCLA been or are likely to have been adversely affected by the release?

No. Natural resources are defined by Section 101(16) of CERCLA, as "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources." The National Contingency Plan (NCP) Section 300.600(b) indicates that natural resources may include not only the environmental organisms and abiotic resources, but the "supporting ecosystems associated with the biotic resources" as well. Resources are categorized into five groups: 1) Surface water resources, 2) groundwater resources, 3) air resources, 4) geologic resources, and 5) biological resources. Resources can also be classified as direct use (i.e., drinking water, hunting, etc.) or nonuse (i.e., aesthetic value or existence). Nonuse services do not require physical or visual contact between people and the resource. Nonuse resources include resources that provide well-being for people (or other flora/fauna) because they exist (e.g., nesting sites, threatened and endangered species, natural areas, etc.).

While releases are associated with GOSB Interior Subunit sediment and remaining surface water, neither of these media are classified as natural resources as defined above. Further, there is no indication that constituents present in these media have migrated to surrounding soil or to underlying groundwater.

2b. List the potentially affected resources (e.g. ground water, waterfowl, etc.).

Not applicable.

3. Is the amount of hazardous substance released sufficient to potentially cause a natural resource injury?

Not applicable.

4. Will the remedial alternatives being considered, or action already taken, sufficiently address the injuries to natural resources (including residual injuries)?

As discussed in 2A above, there are no injuries to natural resources. However, remedial alternatives are identified and evaluated in the Corrective Measures Study/Feasibility Study (CMS/FS) to address sediment and surface water media associated with the

GOSB Interior Subunit only. Each alternative for the GOSB Interior Subunit is evaluated as to whether it would be protective of human health and the environment.

5. Will the remedial alternatives being considered produce additional impacts to natural resources during remediation?

As discussed in 2A above, there are no injuries to natural resources. However, each alternative for the GOSB Interior Subunit is evaluated as to whether it would impact surrounding natural resources during and after implementation.

The potential costs for addressing resource injuries during remedial action implementation will be taken into consideration when selecting a remedial alternative. The liability (damage) associated with resource injuries could drive the cost of the intended best or lowest cost alternative.

6. Identify any irreversible and/or irretrievable resource losses in the appropriate documentation.

No irreversible and/or irretrievable resource losses are known to exist associated with the remedial actions developed for the GOSB Interior Subunit.

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APPENDIX H

DETAILED COST ESTIMATES

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Appendix H
GOSB Interior Alternate A-3 Place 0.6 m (2-Ft) Clean Fill Layer and Manage Surface Water[1]
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	Comments
Direct Capital Costs					
Subcontractor Mobilization/demobiliaztion	1	ea	$ 29,010.00	$ 29,010.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Site surveys	1	ea	$ 4,325.00	$ 4,325.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Clearing ~~and Grubbing~~	0.67	acres	$ 4,197.00	$ 2,811.99	Clear LOD (push trees to side and leave near site)
Access Roads Improvements	3200	lf	$ 33.96	$ 108,672.00	SRNS Estimate on 7/25/2017
Dewatering rainwater	415,000	gals	$ 0.60	$ 249,000.00	Based on costs for D-Area Basin. Includes construction & dismantlement of spray field (approx. 4 acres)
Install BMPs	1000	ft	$ 5.00	$ 5,000.00	Includes installing and removing silt fence on access roads and near outfalls
Excavation of Berms and stockpilling	334	BCY	$ 9.53	$3,183.02	Excavation for Minor Structures 2cy bucket sand and gravel, $9.53
Clean fill soil sampling & analyses	1	ea	$ 1,500.00	$ 1,500.00	Includes analyses for TAL/TCL/RAD screen 1 composit sample per 1000 cy
Hauling of backfill from SRS borrow	466	BCY	$ 10.72	$ 4,995.52	Includes travel time from on-site borrow area.
Placement of backfill	466	BCY	$ 10.00	$ 4,660.00	Includes contouring.
Land Use Controls					
Posting of Warning Signs	2	ea	$ 100.00	$ 200.00	
Land Use Control Implementation Plan	1	ea	$ 7,500.00	$ 7,500.00	
Subtotal - Direct Capital Cost				$420,858 *	
Mobilization/Demobilization	25%	of subtotal direct capital		$105,214 *	
Site Preparation/Site Restoration	25%	of subtotal direct capital		$105,214 *	
Total Direct Capital Cost		(sum of * items)		**$631,286**	
Indirect Capital Costs					
Engineering & Design	14%	of direct capital		$88,380	
Project/Construction Management	25%	of direct capital		$157,822	
Health & Safety	6%	of direct capital		$37,877	
Overhead	30%	of direct capital + indirect capital		$274,610	
Contingency	20%	of direct capital + indirect capital		$237,995	
Total Indirect Capital Cost				**$796,683**	
Total Estimated Capital Cost				**$1,427,970**	
Direct O&M Costs	-0.3%	real interest rate from OMB Cirular No. A-94[2]			
Confirmation Sampling of Accumulated rain water	5	years O&M			
Sampling and Analysisof rainwater	1	ea	$3,000	$3,000	Analyses for pesticides and metals
Access contorls (Existing System during Post-Rod and Sampling)	1	ea	$1,000	$1,000	
Subtotal - Annual Costs		1		$4,000	
Present Worth Annual Sampling (-0.3% Discount Rate)				$20,181	
Annual Costs (Institutional Controls)	30	years O&M			
Access Controls	1	ea	$1,000	$1,000	
Annual Inspections/Maintenance (additional soil)	1	ea	$7,500	$7,500	
Subtotal - Annual Costs				$8,500	
Present Worth Annual Costs (-0.3% Discount Rate)				$267,247	
Five Year Costs	6				
Remedy Review	1	ea	$20,000	$20,000	
Subtotal -Five Year O&M Costs				$20,000	
Present Worth Five Year Costs (-0.3% Discount Rate)				$121,270	
Total Present Worth Direct O&M Cost				**$408,698**	
Indirect O&M Costs					
Project/Admin Management	151%	of direct O&M		$617,134	
Health & Safety	18%	of direct O&M		$73,566	
Overhead	30%	of direct O&M + indirect O&M		$329,819	
Contingency	15%	of direct O&M + indirect O&M		$214,383	
Total Present Worth Indirect O&M Cost				**$1,234,901**	
Total Estimated Present Worth O&M Cost				**$1,643,599**	
TOTAL ESTIMATED COST				**$3,071,569**	

1. Managing the surface water includes dewatering the basin prior to excavation and constructing a spray field
2. Interest rate from OMB Circular No. A-94 (December 12,2016)

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Appendix H
GOSB Interior Alternate A-4 Backfill Basin and Manage Surface Water[1]
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	Comments
Direct Capital Costs					
Subcontractor Mobilization/demobiliaztion	1	ea	$ 29,010.00	$29,010.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Site surveys	1	ea	$ 4,325.00	$4,325.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Clearing	0.67	acres	$ 4,197.00	$2,811.99	Clear LOD (push trees to side and leave near site)
Access road improvements	3200	lf	$ 33.96	$108,672.00	SRNS Estimate on 7/25/2017
Dewatering of 415,000 gals of rainwater	415,000	gals	$ 0.60	$249,000.00	Based on costs for D-Area Basin. Includes construction and dismantlement of spray field (aprox. 4 acres)
Install BMPs	1000	ft	$ 5.00	$5,000.00	Includes installing and removing silt fence on access roads and near outfalls
Excavation of Berms and stockpilling	334	BCY	$ 9.53	$3,183.02	Excavation for Minor Structures 2cy bucket sand and gravel, $9.53
Clean fill/top soil sampling & analyses	2	ea	$ 1,500.00	$3,000.00	Includes analyses for TAL/TCL/RAD screen 1 composit sample per 1000 cy of common fill and top soil
Hauling/placement/compaction of backfill from SRS borrow	5200	BCY	$ 20.72	$107,744.00	Includes hauling, placing and compacting
Compaction testing/reporting	15	hrs	$150.00	$2,250.00	Assume 2 half days for testing and half day for reporting.
Hauling/Placement of top soil from off SRS	300	CY	$ 35.00	$10,500.00	Includes purchasing sod offsite, hauling and placement
Sod installation	1700	yd2	$ 5.00	$8,500.00	Includes purchasing sod offsite, hauling and placement
Subtotal - Direct Capital Cost				$533,996 *	
Mobilization/Demobilization	25%	of subtotal direct capital		$133,499 *	
Site Preparation/Site Restoration	25%	of subtotal direct capital		$133,499 *	
Total Direct Capital Cost	(sum of * items)			**$800,994**	
Indirect Capital Costs					
Engineering & Design	14%	of direct capital		$112,139	
Project/Construction Management	25%	of direct capital		$200,249	
Health & Safety	6%	of direct capital		$48,060	
Overhead	30%	of direct capital + indirect capital		$348,432	
Contingency	20%	of direct capital + indirect capital		$301,975	
Total Indirect Capital Cost				**$1,010,854**	
Total Estimated Capital Cost				**$1,811,848**	
Direct O&M Costs	-0.3%	real interest rate	from OMB Cirular No. A-94[2]		
Annual Costs (Existing System during Post-ROD Design & Const)	5	years O&M			
Access Controls	1	ea	$750	$750	
Subtotal - Annual Costs				$750	
Present Worth Annual Costs (-0.3% Discount Rate)				$3,784	
Total Present Worth Direct O&M Cost				**$3,784**	
Indirect O&M Costs					
Project/Admin Management	151%	of direct O&M		$5,714	
Health & Safety	18%	of direct O&M		$681	
Overhead	30%	of direct O&M + indirect O&M		$3,054	
Contingency	15%	of direct O&M + indirect O&M		$1,985	
Total Present Worth Indirect O&M Cost				**$11,434**	
Total Estimated Present Worth O&M Cost				**$15,217**	
TOTAL ESTIMATED COST				**$1,827,066**	

1. Managing the surface water includes dewatering the basin prior to excavation and constructing a spray field
2. Interest rate from OMB Circular No. A-94 (December 12,2016)

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Appendix H
GOSB Interior Alternate A-5 Excavation and Manage Surface Water[1]
Savannah River Site

Item	Quantity	Units	Unit Cost	Total Cost	Comments
Direct Capital Costs					
Subcontractor Mobilization/demobiliaztion	1	ea	$ 29,010.00	$29,010.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Site surveys	1	ea	$ 4,325.00	$4,325.00	Price is scaled from D-Ash Basin Estimate (SRNS-RP-2015-00490)
Clearing	0.67	acres	$ 4,197.00	$2,811.99	Clear-LOD (push trees to side and leave near site)
Access road improvements	3200	lf	$ 33.96	$108,672.00	SRNS Estimate on 7/25/2017
Dewatering of 415,000 gals of rainwater via spray field	415,000	gals	$ 0.60	$249,000.00	Based on costs for D-Area Basin. Includes construction and dismantlement of spray field (approx. 4 acres)
Install BMPs	1000	ft	$ 5.00	$5,000.00	Includes installing and removing silt fence on access roads and near outfalls
Excavation and loading onto rolloffs for drying	740	BCY	$ 9.53	$7,052.20	Excavation for Minor Structures 2cy bucket sand and gravel, $9.53
Post Excavation confirmation sampling	10	samples	$ 600.00	$6,000.00	Pesticides and Metals
Waste characterization sampling	10	samples	$ 1,500.00	$15,000.00	TCLP
Transportation of waste sediments	740	BCY	$ 15.00	$11,100.00	Cycle 8 miles, 15 mph average, 15 min wait
Disposal of waste sediments	1110	tn	$ 57.00	$63,270.00	Quote from 7/17/2017
Subtotal - Direct Capital Cost				$501,241 *	
Mobilization/Demobilization	25%	of subtotal direct capital		$125,310 *	
Site Preparation/Site Restoration	25%	of subtotal direct capital		$125,310 *	
Total Direct Capital Cost	(sum of * items)			**$751,862**	
Indirect Capital Costs					
Engineering & Design	14%	of direct capital		$105,261	
Project/Construction Management	25%	of direct capital		$187,965	
Health & Safety	6%	of direct capital		$45,112	
Overhead	30%	of direct capital + indirect capital		$327,060	
Contingency	20%	of direct capital + indirect capital		$283,452	
Total Indirect Capital Cost				**$948,850**	
Total Estimated Capital Cost				**$1,700,711**	
Direct O&M Costs	-0.3%	real interest rate	from OMB Cirular No. A-94[2]		
Annual Costs (Existing System during Post-ROD Design & Const)	5	years O&M			
Access Controls	1	ea	$750	$750	
Subtotal - Annual Costs				$750	
Present Worth Annual Costs (-0.3% Discount Rate)				$3,784	
Total Present Worth Direct O&M Cost				**$3,784**	
Indirect O&M Costs					
Project/Admin Management	151%	of direct O&M		$5,714	
Health & Safety	18%	of direct O&M		$681	
Overhead	30%	of direct O&M + indirect O&M		$3,054	
Contingency	15%	of direct O&M + indirect O&M		$1,985	
Total Present Worth Indirect O&M Cost				**$11,434**	
Total Estimated Present Worth O&M Cost				**$15,217**	
TOTAL ESTIMATED COST				**$1,715,929**	

1. Managing the surface water includes dewatering the basin prior to excavation and constructing a spray field
2. Interest rate from OMB Circular No. A-94 (December 12,2016)

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