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Record of Decision
Remedial Alternative Selection for the G-Area Oil Seepage Basin (761-13G) Operable Unit (U)

SEMS Number: 93

SRNS-RP-2018-01050

Revision ~~0~~1 Redline

~~January~~ April 2019

DISCLAIMER

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Prepared for
U.S. Department of Energy
by
Savannah River Nuclear Solutions, LLC
Aiken, South Carolina

RECORD OF DECISION
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Savannah River Site
Aiken, South Carolina

Prepared By:
Savannah River Nuclear Solutions, LLC
for the
U.S. Department of Energy under Contract DE-AC09-08SR22470
Savannah River Operations Office
Aiken, South Carolina

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DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

G-Area Oil Seepage Basin (761-13G) Operable Unit
Superfund Enterprise Management System Identification Number: OU-SEMS 93
Savannah River Site
Comprehensive Environmental Response, Compensation and Liability Act
Identification Number: SC1 890 008 989
Aiken, South Carolina
United States Department of Energy

The G-Area Operable Unit (GOSB) (761-13G) Operable Unit (OU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS).

The FFA is a legally binding agreement between regulatory agencies (United States Environmental Protection Agency [USEPA) and South Carolina Department of Health and Environmental Control [SCDHEC]) and regulated entities (United States Department of Energy [USDOE]) that establishes the responsibilities and schedules for the comprehensive remediation of SRS. The media associated with this OU are soil, sediment and surface water. Groundwater is not a subunit of the GOSB OU and will be addressed as part of the Central Shops Groundwater OU.

Statement of Basis and Purpose

This decision document presents the selected remedial action for the GOSB OU, located at the SRS near Aiken, South Carolina. The remedy was chosen in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the information contained in the Administrative Record File for this site.

The USEPA, SCDHEC and USDOE concur with the selected remedy.

Assessment of the Site

There has been a release of pesticides/fungicides into the GOSB OU that poses a threat to the environment. The response action selected in this Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The selected remedy for the GOSB OU is *Backfill Basin and Manage Surface Water (Alternative A-4)* because it is effective in preventing exposure of contaminated media to human and ecological receptors. Following backfill of the basin, the future land use for the GOSB OU will be unrestricted and will not require a five-year remedy review.

The selected remedy consists of the removal and management of the surface water present in the basin and the controlled-compaction backfilling of 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 3.1 meter (m [10 feet {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. Specific activities associated with this remedial alternative include dewatering of the basin, clearing approximately (~) 0.27 hectare (0.67 acre), excavation of the berms, backfilling the basin with ~4,460 cubic meters (5,834 cubic yards) 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.

The RCRA permit will be revised to reflect selection of the final remedy using the procedures under 40 Code of Federal Regulation Part 270, and South Carolina Hazardous Waste Management Regulations R.61-79.264.101; 270.

Statutory Determinations

Based on the unit RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment (BRA) report, a portion of the GOSB OU poses a threat to human health and the environment. Therefore, *Alternative 4, Backfill Basin and Manage Surface Water* has been selected as the remedy for the GOSB OU. As part of the selected remedy, the future land use of the GOSB OU will be unrestricted.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required for this remedial action.

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action (unless justified by a waiver), and is cost-effective. The remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy because it does not employ treatment to reduce the toxicity, mobility, or volume of the contaminated media.

Data Certification Checklist

This ROD provides the following information:

- Constituents of concern (COCs) and their respective concentrations (Section V).
- Baseline risk represented by the COCs (Section VII).
- Cleanup levels established for the COCs and the basis for the levels (Section VIII).
- Current and reasonably anticipated future land and groundwater use assumptions used in the BRA and ROD (Section VI).
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section VI).

- Estimated capital, operation and maintenance, and total present-worth cost; discount rate; and the number of years over which the remedy cost estimates are projected (Section IX).

- Key decision factor(s) that led to selecting the remedy (i.e., describe how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria) (Section X).

Date	Angelia A. Holmes Acting Assistant Manager for Infrastructure and Environmental Stewardship U.S. Department of Energy Savannah River Operations Office
Date	Franklin E. Hill Director Superfund Division U.S. Environmental Protection Agency - Region 4
Date	Henry J. Porter Chief Bureau of Land and Waste Management South Carolina Department of Health and Environmental Control

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DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)

G-Area Oil Seepage Basin (761-13G) Operable Unit (U)

SEMS Number: 93

SRNS-RP-2018-01050
Rev. ~~0~~1 Redline

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LIST OF ABBREVIATIONS AND ACRONYMS

~	approximate, approximately
<, ≤	less than, less than or equal to
>, ≥	greater than, greater than or equal to
ac	acre
ARAR	applicable or relevant and appropriate requirement
ARF	Administrative Record File
AWQC	ambient water quality criteria
bgs	below ground surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulation
cm	centimeter
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
ERA	ecological risk assessment
EPC	exposure point concentration
ESV	ecological screening value
FFA	Federal Facility Agreement
ft	feet
FS	Feasibility Study
gal	gallon
GOSB	G-Area Oil Seepage Basin
ha	hectare
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HSWA	Hazardous and Solid Waste Amendments
in.	inch
IOU	Integrator Operable Unit
km	kilometer
km^2	square kilometer
L	liter
LANL	Los Alamos National Laboratory
LLC	Limited Liability Company
LOAEL	Lowest Observed Adverse Effect Level
LUC	Land Use Control

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

µg/L	microgram per liter
m	meter
m^3	cubic meter
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mi	mile
mi^2	square mile
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OU	operable unit
PCB	polychlorinated biphenyl
PRG	preliminary remedial goal
PTSM	principal threat source material
PW	present-worth
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 objective
RI	Remedial Investigation
ROD	Record of Decision
RSL	regional screening level
RSV	refinement screening value
SARA	Superfund Amendments Reauthorization Act
SB/PP	Statement of Basis/Proposed Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SEMS	Superfund Enterprise Management System
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SVOC	semi-volatile organic compound
TCR	total cumulative risk
UCL	upper confidence limit
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WSRC	Washington Savannah River Company, LLC
yd^3	cubic yard

I. SAVANNAH RIVER SITE AND OPERABLE UNIT NAME, LOCATION, AND DESCRIPTION

Unit Name, Location, and Brief Description

G-Area Oil Seepage Basin (761-13G) Operable Unit
Superfund Enterprise Management System Identification Number: OU-SEMS 93
Savannah River Site
Comprehensive Environmental Response, Compensation and Liability Act Identification Number: SC1 890 008 989
Aiken, South Carolina
United States Department of Energy

Savannah River Site (SRS) occupies approximately (~) 802.9 square kilometers (km^2 [310 square miles {mi^2}]) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is located ~40.2-kilometers (km [25-miles {mi}]) southeast of Augusta, Georgia, and 32.1-km (20-mi) south of Aiken, South Carolina.

The United States Department of Energy (USDOE) owns SRS, which historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. Chemical and radioactive wastes have resulted from the nuclear material production processes. Hazardous substances, as defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), are present in the environment at SRS.

The Federal Facility Agreement (FFA) (FFA 1993) for SRS lists the *G-Area Oil Seepage Basin (761-13G) Operable Unit (OU)* (GOSB OU) as a Resource Conservation and Recovery Act (RCRA)/CERCLA Solid Waste Management Unit requiring further evaluation.

The GOSB OU was evaluated through an investigation process that integrates and combines the RCRA corrective action process with the CERCLA remedial process to

determine the actual or potential impact to human health and the environment of releases of hazardous substances to the environment.

II. SITE AND OPERABLE UNIT COMPLIANCE HISTORY

SRS Operational and Compliance History

The primary mission of SRS has been to produce tritium, plutonium, and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense program was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes have resulted from the nuclear material production processes. These wastes have been treated, stored, and in some cases, disposed of at SRS. Past disposal practices have resulted in soil and groundwater contamination.

Hazardous waste materials handled at SRS are managed under RCRA, a comprehensive law requiring responsible management of hazardous waste. Certain SRS activities require South Carolina Department of Health and Environmental Control (SCDHEC) operating or post-closure permits under RCRA. SRS received a RCRA hazardous waste permit from the SCDHEC, which was most recently renewed on February 11, 2014. Module VIII of the Hazardous and Solid Waste Amendments (HSWA) portion of the RCRA permit mandates corrective action requirements for non-regulated solid waste management units subject to RCRA 3004(u).

On December 21, 1989, SRS was included on the National Priorities List. The inclusion created a need to integrate the established RCRA facility investigation (RFI) program with CERCLA requirements to provide a focused environmental program. In accordance with Section 120 of CERCLA (42 United States Code Section 9620), USDOE has negotiated a FFA (FFA 1993) with United States Environmental Protection Agency (USEPA) and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy that

fulfills these dual regulatory requirements. USDOE functions as the lead agency for remedial activities at SRS, with concurrence by the USEPA - Region 4 and the SCDHEC.

Operable Unit Operational and Compliance History

The GOSB OU is located southeast of N-Area (Central Shops) in relatively flat terrain, ~54-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 and contains no stressed vegetation or other visual indications of contamination. The layout of the GOSB OU is shown in Figure 2.

A schematic diagram of the GOSB is shown in Figure 3. 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). 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-centimeter (cm [12-inch {in.}]) vitrified clay pipe (previously plugged and 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 the disposal of radioactive or hazardous materials at the GOSB. 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 was

also known as the N-Area Oil Seepage Basin (761-13N) on early SRS engineering drawings.

The basin 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 semi-VOCs (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/pesticides. Bromoform, 1,3-dichlorobenzene, and 1,2-dichlorobenzene were detected in the surface water samples (WSRC 1991).

The basin has received no discharges since it was isolated from the active system in the early 1990s. The basin was drained and the influent sewer line was plugged as part of the isolation. Since the isolation, rainwater continues to accumulate and be retained in the basin due to normal rainfall, with the quantity fluctuating throughout the year. 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 liters (414,000 gallons [gal]). Sandy clay underlies the decayed organic material. Figure 4 is a photograph of the GOSB that was taken in February 2017.

Characterization of the GOSB OU was conducted in 2009 and 2016-2017. Results of the characterization efforts are documented in the *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) (SRNS 2018a). The RFI/Remedial Investigation (RI)/Baseline Risk Assessment (BRA) portion of the document summarizes the data associated with the unit, describes the nature and extent of the contaminants in affected media, and evaluates potential risk to human and ecological receptors. The Corrective Measures Study/Feasibility Study (CMS/FS) portion outlines potential remedial alternatives and screens remedial technologies. The CMS/FS also includes a detailed alternative analysis that was used to support the selection of a final remedy.

The USEPA, SCDHEC and USDOE have agreed on the preferred response action identified in the *Statement of Basis/Proposed Plan for the G-Area Oil Seepage Basin (GOSB) (761-13G) Operable Unit (OU) (U)* (SRNS 2018b). The remedy selected in this Record of Decision (ROD) does not contain any significant changes from the preferred alternative presented in the Statement of Basis/Proposed Plan (SB/PP).

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require the public to be given an opportunity to review and comment on the draft permit modification and proposed remedial alternative. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA (42 United States Code Sections 9613 and 9617). These requirements include establishment of an Administrative Record File (ARF) that documents the investigation and selection of the remedial alternative for addressing soil, sediment and surface water media associated with the GOSB OU. The ARF must be established at or near the facility at issue.

The SRS FFA Community Involvement Plan (WSRC 2011) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act, 1969. SCHWMR R.61-79.124 and Section 117(a) of CERCLA, as amended, require the advertisement of the draft permit modification and notice of any proposed remedial action and provide the public an opportunity to participate

in the selection of the remedial action. The *Statement of Basis/Proposed Plan for the G-Area Oil Seepage Basin (GOSB) (761-13G) Operable Unit (OU) (U)* (SRNS 2018b), a part of the ARF, highlights key aspects of the investigation and identifies the preferred action for addressing the GOSB OU.

The FFA ARF, which contains the information pertaining to the selection of the response action, is available at the following locations:

US Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina – Aiken
471 University Parkway
Aiken, South Carolina 29803
(803) 641-3504

Thomas Cooper Library
Government Information and Maps Department
University of South Carolina
1322 Green Street
Columbia, South Carolina 29208
(803) 777-4841

The RCRA ARF for SCDHEC is available for review by the public at the following locations:

The South Carolina Department of Health and Environmental Control
Aiken Environmental Affairs Office
206 Beaufort Street, Northeast
Aiken, South Carolina 29801
(803) 642-1637

The South Carolina Department of Health and Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, South Carolina 29201
(803) 898-2000

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to interested citizens in South Carolina and Georgia, and through notices in the *Aiken Standard*, *The Augusta Chronicle*, *The People-Sentinel*, and *The State* newspapers. The public comment period was also announced on local radio stations.

The SB/PP 45-day public comment period began on November 28, 2018, and ended on January 11, 2019. A Responsiveness Summary, prepared to address any comments received during the public comment period, is provided in Appendix A of this ROD. No comments were received from the public. A Responsiveness Summary will also be available with the final RCRA permit.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT

Due to the complexity and size of multiple waste units in different areas, the SRS is divided into watersheds for the purpose of managing a comprehensive cleanup strategy. The SRS is segregated into six watersheds: Upper Three Runs, Lower Three Runs, Fourmile Branch, Steel Creek, Pen Branch, and the Savannah River. In addition, the SRS also identifies six Integrator Operable Units (IOUs) which are the surface water bodies and associated wetlands that correspond to the six respective watersheds. Waste units within a watershed may be evaluated and remediated individually or grouped with other waste units and evaluated as part of a larger Area OU. Upon disposition of all the waste units within a watershed, a final comprehensive ROD for the corresponding IOU (i.e., surface water and associated wetlands) will be pursued with additional public involvement. The GOSB OU is located within the Pen Branch watershed (Figure 1).

A remedial action is needed at the inner basin portion of the GOSB OU because pesticides/fungicides are present in sediment and surface water that may potentially pose a threat to human health and the environment. The remedial action to backfill the basin and manage the surface water is effective in preventing exposure of contaminated media to human and ecological receptors.

V. OPERABLE UNIT CHARACTERISTICS

Conceptual Site Model for the GOSB OU

The Conceptual Site Model (CSM) is an objective framework for assessing data pertinent to the investigation. The CSM identifies and evaluates 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 can take from the source to the exposed receptor. The following five (5) components constitute an exposure pathway:

1. Source (facility operations, spill, etc.)
2. Exposure medium (soil, sediment, surface water, etc.)
3. Exposure point (soil surface, sediment surface, etc.)
4. Exposure route (ingestion, dermal contact, inhalation, external radiation, etc.)
5. Receptor (resident, worker, wildlife, etc.)

If any of these elements is 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 conceptually 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.

The GOSB OU comprises four subunits. These subunits represent geographically distinct locations within the GOSB OU, each of which contains 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 (and environmental samples associated with each subunit) include the following:

- GOSB Interior Subunit (sediment 0 to 0.3 m [0 to1 ft], 0.3 to 1.2 m [1 to 4 ft], and surface water)
- GOSB Berm Subunit (soil 0 to 0.3 m [0 to 1 ft], 0.3 to 1.2 m [1 to 4 ft], 2.4 to 3.0 m [8 to 10 ft])

- Pipeline Subunit (soil 2.4 to 3.0 m [8 to 10 ft])
- Effluent Discharge Subunit (soil 0 to 0.3 m [0 to 1 ft], 0.3 to 1.2 m [1 to 4 ft])

Media Assessment

The overall approach that was implemented during various facets of the GOSB OU investigation is described in the *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)* (SRNS 2018a). The RI was 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 sampled and evaluated to support the contaminant fate and transport analysis.

Subunit Investigation (Soil, Sediment and Surface Water Media)

Characterization of the GOSB OU was conducted in 2009 and 2016-2017. Figure 5 shows the sampling locations for each subunit investigation. A brief description of the characterization efforts for each subunit is provided below.

GOSB Interior Subunit

In 2009, ten composite basin floor/wall sediment 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) depth intervals and analyzed for inorganics (metals), pesticides, polychlorinated biphenyls (PCBs), VOCs, SVOCs and radiological indicators (gross alpha/ nonvolatile beta). Constituents detected in these sediment samples include inorganics (metals), pesticides, VOCs, SVOCs (i.e., polycyclic aromatic hydrocarbons), and radionuclides.

In 2009, five surface water samples (unfiltered) were collected from within the basin and analyzed for inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological

indicators. Constituents detected in these surface water samples included inorganics (metals), pesticides, VOCs, and radiological indicators.

In 2016, six surface water samples (filtered and unfiltered) were collected from within the basin and analyzed for inorganics (metals), VOCs, SVOCs, and radiological indicators. These additional samples were collected to address an uncertainty identified with the samples collected in 2009 with high turbidity (and therefore potentially-biased surface water sample results). Constituents detected in these surface water samples included inorganics (metals), VOCs, and radiological indicators.

GOSB Berm Subunit

In 2009, 39 soil samples were collected from 13 locations along the basin perimeter ~~at 15-m (50-ft) depth intervals~~ which were spaced 15-m (50-ft) apart. 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 3.0-m (8- to 10-ft) depth intervals and analyzed for inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators. Constituents detected in the berm soil samples were inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators. No data gaps were identified for the Basin Berm Subunit and no new data was collected for this subunit during the 2016-2017 sampling event.

Pipeline Subunit

In 2009, soil sampling occurred at 29 locations, which were spaced ~7.6-m (25-ft) apart along both sections of the pipeline. The data objective was to characterize the impact of any leaks from the pipeline. All pipeline samples were collected from the 2.4- to 3.0-m (8- to 10-ft) depth interval along the buried clay pipe and analyzed for VOCs, SVOCs, and PCBs, inorganics, and radiological indicators. Detected soil constituents included inorganics (metals), VOCs, and SVOCs. No data gaps were identified for the Pipeline Subunit and no new pipeline data was collected during the 2016-2017 sampling event.

Effluent Discharge Subunit

In 2009, effluent discharge sampling occurred at 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). The data objective was to characterize the impact of GOSB pipeline effluent on the shallow soil. Samples were analyzed for VOCs, SVOCs, and pesticides/PCBs, inorganics (metals), tritium, and radiological indicators/ gamma spectroscopy. Detected soil constituents included inorganics (metals), pesticides, VOCs, and SVOCs. In 2016, six additional soil samples were collected from 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) near the end of the pipeline to better characterize the nature and extent of contaminants. Detected soil constituents included VOCs, pesticides, PCBs, inorganics (metals), and radiological indicators.

Groundwater Investigation

Groundwater is not a part of the GOSB OU, but groundwater samples were collected in the vicinity of the basin to determine whether a past release to the shallow aquifer had occurred. In 2017, filtered and unfiltered groundwater samples were collected from eight piezometers and were analyzed for inorganics (metals), pesticides, PCBs, VOCs, SVOCs, and radiological indicators. Constituents detected in these groundwater samples included inorganics (metals), pesticides, SVOCs/VOCs, and radiological indicators.

Media Assessment Results

The characterization data was used to perform a human health risk assessment (HHRA) and ecological risk assessment (ERA), a principal threat source material (PTSM) evaluation, and contaminant migration to groundwater analysis (SRNS 2018a). Table 1 summarizes the results of these evaluations and identifies refined constituents of concern (RCOCs) for the subunit that requires remedial action. RCOCs are those constituents that were retained following a weight-of-evidence evaluation and require remedial action.

In summary, the GOSB Interior Subunit is the only subunit at the GOSB OU that presents a problem warranting remedial action. Pesticides/fungicides 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. A brief description of the media assessment results for each subunit is provided below; refer to Figure 5 to identify sample locations described in the text.

GOSB Interior Subunit

Pesticides/fungicides are present in the sediment and surface water in the basin interior that may potentially pose a threat to human health and the environment. The pesticides/ fungicides entered the basin through normal storm water and wastewater flow and included chlordane, dieldrin, heptachlor epoxide, dichlorodiphenyltrichloroethane (DDT) (and breakdown products), and silver. Chlordane (banned in 1988) to control termites and ants, and DDT (banned in 1972) as an insecticide, were commonly used in agricultural applications and at SRS until the time they were banned from use. Note that dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE) are breakdown products of DDT. In addition, silver has been a registered pesticide since 1954 and continues to be a common element in the chemical formulations of disinfectants, sanitizers and fungicides. There were no contaminant migration problems warranting action identified for the GOSB Interior subunit.

Chlordane occurs as a mixture of pure chlordane and other related chemicals, including the congeners alpha-chlordane and gamma-chlordane. Both alpha-chlordane and gamma-chlordane were detected in five of five sediment samples, with none being J-qualified (i.e., estimated). Maximum detected concentrations of both congeners of chlordane were from sample location GOSB-51. Alpha-chlordane ranges from 0.14 to 7.32 milligram per kilogram (mg/kg), while gamma-chlordane ranges from 0.175-10.9 mg/kg. Alpha-chlordane was identified as a problem warranting action in sediment for the future resident scenario and benthic dwelling organisms; gamma-chlordane was identified as a problem

warranting action in sediment for the future resident and future industrial worker scenarios and benthic dwelling organisms.

Alpha-chlordane was detected in six of eleven surface water samples. One of the six samples was J-qualified (i.e., estimated). In 2016, the maximum detected concentration was 0.22 microgram per liter (µg/L) at the GOSB-64 sample location. The maximum detected concentration was from the 2016 data set. Alpha-chlordane was identified as a problem warranting action in surface water for aquatic organisms.

Gamma-chlordane was detected in seven of eleven surface water 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 sample location. The maximum detected concentration for 2016 unfiltered samples was 0.21 µg/L at the GOSB-64 sample location (detected in four of six samples with two J-qualified). Gamma-chlordane was identified as a problem warranting action in surface water for aquatic organisms.

DDD was detected in four of five sediment 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 sample location. DDD was identified as a problem warranting action in sediment for benthic organisms.

DDE was detected in five of five sediment samples, with none being J-qualified (i.e., estimated). Concentrations range from 0.05 to 4.5 mg/kg. The maximum detected concentration of 4.5 mg/kg from sample location GOSB-51. DDE was identified as a problem warranting action in sediment for the future resident scenario and benthic organisms.

Dieldrin was detected in three of five sediment samples, with the three detections being J- qualified (i.e., estimated). Concentrations range from nondetect to 0.5 mg/kg, with a mean of 0.112 mg/kg. Sample location GOSB-51 had the highest concentration. Dieldrin was identified as a problem warranting action in sediment for the future resident and future industrial worker scenarios and benthic organisms.

Heptachlor epoxide was detected in three of five sediment samples, with one being J-qualified (i.e., estimated). Concentrations range from nondetect to 0.845 mg/kg. Sample location GOSB-51 had the highest concentration. Heptachlor epoxide was identified as a problem warranting action in sediment for the future resident and future industrial worker scenario and benthic organisms.

Silver was detected in five of five sediment 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 sample location. Silver was identified as a problem warranting action in sediment for benthic organisms.

Silver was detected in nine of eleven surface water 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 sample location. 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 biasing the analytical 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 sample location (detected in four of six samples with four J-qualified). Silver was identified as a problem warranting action in surface water for aquatic organisms.

GOSB Berm Subunit

There was no human health, ecological, or contaminant migration problem warranting action identified at this subunit (SRNS 2018a).

Pipeline Subunit

There was no human health, ecological, or contaminant migration problem warranting action identified at this subunit (SRNS 2018a).

Effluent Discharge Subunit

There was no human health, ecological, or contaminant migration problem warranting action identified at this subunit (SRNS 2018a).

Groundwater

Groundwater samples were taken upgradient, sidegradient and downgradient from 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. Based on this evaluation of the groundwater sampling results, it was concluded that the GOSB OU is not a source of groundwater contamination in the area (SRNS 2018a).

Site Specific Factors

No site-specific factors requiring special consideration that might affect the remedial action for the GOSB OU are present at the site.

Contaminant Transport Analysis

Given the location and concentrations of contamination at the GOSB OU, there are no known or potential routes of off-site migration that could impact human health or the environment.

VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

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 used in the risk evaluation. According to the SRS Future Use Project Report (USDOE 1996), residential

uses of SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the GOSB OU as being within an industrial area. The future land use is reasonably anticipated to remain industrial with USDOE maintaining control of the land.

Groundwater Uses/Surface Water Uses

Groundwater is not part of the GOSB OU and will be addressed separately as part of the Central Shops Groundwater OU.

VII. SUMMARY OF OPERABLE UNIT RISKS

Baseline Risk Assessment

As a component of the RFI/RI process, a BRA was performed to evaluate risks associated with the GOSB OU (SRNS 2018a). The BRA estimates what risks the site poses if no action were taken. It provides a basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The BRA includes human health and ecological risk assessments. This section of the ROD summarizes the results of the BRA for the GOSB OU (SRNS 2018a).

Summary of Human Health Risk Assessment

The GOSB OU is in an area currently designated for industrial use. No current or projected future development of the OU 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 were evaluated. The hypothetical 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 (i.e., 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 for soil are 26 years, 350 days per year, and 24 hours per day. Exposure routes associated with soil or sediment include incidental ingestion, inhalation of particulates and vapors, dermal absorption, and external exposure to radiation. The 0 to 0.3-m (0 to 1-ft) surface interval from the GOSB Interior Subunit (sediment), GOSB Berm Subunit (soil) and the Effluent Discharge Subunit (soil) were evaluated in the HHRA.

The *future resident* receptor scenario is also evaluated for surface water. This includes a comparison of constituents to surface water threshold levels based on regulatory-based limits (i.e., maximum contaminant levels [MCLs]) or risk-based threshold values, as appropriate. Surface water in the GOSB Interior Subunit was evaluated in the HHRA.

The *future industrial worker* receptor scenario is a standard USEPA exposure scenario, which addresses long-term risks to workers who are exposed to subunit contaminants within an industrial setting. The standard exposure assumptions for soil are 25 years, 250 days per year, and 8 hours per day. The future industrial worker scenario considers an adult who hypothetically works on-unit in an outdoor setting for the majority of time. Exposure routes associated with soil or sediment include incidental ingestion, inhalation of particulates and vapors, dermal absorption, and external exposure to radiation. The 0 to 0.3-m (0- to 1-ft) surface interval from the GOSB Interior Subunit (sediment), GOSB Berm Subunit (soil) and the Effluent Discharge Subunit (soil) were evaluated in the HHRA.

The USEPA publishes regional screening levels (RSLs) for nonradiological constituents and preliminary remediation goals (PRGs) for radiological constituents, which are risk-based concentrations (or activities) that can be used to evaluate potentially contaminated waste sites. RSLs and PRGs combine current USEPA toxicity values with standard exposure factors that represent reasonable maximum exposure conditions to estimate contaminant concentrations in soil 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 *USEPA Regional Screening Levels* website (USEPA 2016) was the source of RSLs used in this assessment. The generic table located on the USEPA website was published in May 2016 and used all default parameters for both the residential and industrial worker scenarios. The website was accessed on May 7, 2017.

The *USEPA Superfund Radionuclide Preliminary Remediation Goals for Superfund* website (USEPA 2017) was the source of the PRGs used in this assessment. The website was accessed on May 8, 2017. The PRGs for a residential scenario were obtained by using the website calculator function to derive site-specific PRGs. These site-specific PRG values were calculated by using all default parameters as standard input assumptions with the exception of the fruit and vegetable consumption pathways (SRNS 2012). The PRGs for an industrial worker scenario were obtained from the generic table which assumed all default parameters.

The first step of the formal HHRA for soil (and sediment) was data screening to identify human health constituents of potential concern (COPCs). The maximum detected soil (or sediment) concentration from the 0- to 0.3-m (0- to 1-ft) sample depth interval for each constituent was compared to a residential RSL or PRG screening value and SRS background concentration, if appropriate (i.e., for naturally-occurring constituents only). Constituents that exceeded the soil screening criteria were identified as COPCs and were carried forward to the quantitative risk evaluation.

The quantitative risk assessment was implemented by a streamlined approach which used the RSLs/PRGs to calculate the human health risk estimates for each GOSB OU subunit. For carcinogens, the risk estimate was calculated using the following equation:

Cancer Risk = (exposure point concentration / RSL or PRG) x 1E-06

The exposure point concentration (EPC) is identified as the lesser of the maximum detected value or the 95% upper confidence limit (UCL) of the mean concentration. Carcinogenic

constituents with an individual cancer risk greater than (>) 1E-06 were identified as human health constituents of concern (COCs).

For noncarcinogens, the hazard estimate was calculated using the following equation:

Noncancer Hazard Quotient = EPC / RSL

If the total hazard index (HI) was less than (<) 1, then no COCs were identified. If the total HI was greater than or equal to (≥) 1, then the constituents were segregated based on relevant target organs. Hazard Quotients (HQs) were summed according to target organs. Constituents were identified as human health COCs if the total organ HQ was ≥0.1 and the total organ HI was ≥1.

A recommendation of whether a human health COC should be carried forward for further remedial evaluation was based on a thorough analysis of each constituent in an uncertainty discussion. COCs that were not eliminated in the refinement process based on a weight-of-evidence evaluation were classified as human health RCOCs.

For surface water, maximum detected concentrations of each constituent were conservatively compared to drinking water MCLs. In the absence of a MCL, the lowest value for the tap water RSL/PRG or promulgated ambient water quality criteria (AWQC) (Federal/State) was used as a screening threshold. Constituents that exceed the MCL (PRG/RSL or AWQC) thresholds were further evaluated in the refinement of COCs step. No RCOCs were identified for surface water.

There were no human health RCOCs for the GOSB Berm Subunit, Pipeline Subunit, or the Effluent Discharge Subunit. Human health RCOCs were identified for the GOSB Interior Subunit only (sediment). The Risk Assessment Guidance for Superfund Part D tables are presented for the RCOCs identified in the BRA to support the human health risk discussion. Table 2 lists the RCOCs and their EPC, Table 3 provides a summary of the cancer toxicity data, and Table 4 and Table 5 provide the calculated risk levels for the future resident and future industrial worker scenarios, respectively.

More specifically, 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) were identified as human health RCOCs in sediment for the future resident scenario; the total cumulative risk (TCR) was 3.0E-05 (Table 4).

For the future industrial worker scenario, gamma-chlordane (risk = 1.4E-06), dieldrin (risk = 2.4E-06), and heptachlor epoxide (risk = 1.9E-06) were identified as human health RCOCs in sediment; the TCR was 5.7E-06 (Table 5).

Summary of Ecological Risk Assessment

Ecological risk is associated with the potential for harmful effects to ecosystems resulting from exposure to an environmental stressor. A stressor is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact.

The habitats within the GOSB OU support both terrestrial and aquatic/semi-aquatic receptors on a relatively small scale. The media of concern are primarily sediment (basin sediment), soil (basin berm and effluent discharge area), and surface water. Surface water and the 0- to 0.3-m (0- to 1-ft) surface interval from the GOSB Interior Subunit (sediment, aquatic/semi-aquatic receptors) and the 0- to 0.3-m (0- to 1-ft) surface and 0.3- to 1.2-m (1- to 4-ft) subsurface intervals from the GOSB Berm Subunit and Effluent Discharge Subunit were evaluated (soil, terrestrial receptors) in the ERA.

Ecological threshold levels are medium- 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 Lowest Observed Adverse Effect Level (LOAEL) for wildlife receptors. The GOSB ecological screening values (ESVs) in the initial screening-level effects evaluation 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 constituents.

The threshold values used for the ESV and RSV assessments were derived from three sources: 1) the *USEPA Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft* (USEPA 2015); 2) the Los Alamos National Laboratory (LANL) ECORISK Database Tool (LANL 2015); and 3) the SCDHEC, R.61-68, Water Classifications and Standards (SCDHEC 2014).

The GOSB OU ERA consisted 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 included a screening-level ecological effects evaluation in which constituent concentrations in sediment, soil, or surface water were compared to relevant ecological screening levels; constituents that exceeded ESVs or that had no ESV were considered constituents of potential ecological concern (COPECs). COPECs that result from the screening-level evaluation are carried forward to a refinement-level risk (hazard) calculation in which refinement-level HQs are calculated for each COPEC. The refinement-level screening is based on LOAEL thresholds (or chronic levels for surface water) and the 95% UCL on the mean. Analytes that failed the refinement-level screening were considered COPCs. Uncertainties associated with the screening thresholds, background concentrations, nature and extent of contamination, age of data, or contaminants that result from the screening and refinement processes were discussed in an uncertainty evaluation. The uncertainty discussion concluded with a determination of whether the constituent should or should not be considered a RCOC. The screening level ecological effects evaluation for the GOSB OU indicated that more information was not needed to make remedial decision recommendations for the protection of ecological receptors. Site-specific biological sampling or additional studies were not warranted. Problems warranting action for the GOSB Interior Subunit, both for sediment and surface water, were identified. There were no ecological RCOCs for the GOSB Berm Subunit, Pipeline Subunit, or the Effluent Discharge Subunit.

The ecological RCOCs for the GOSB Interior Subunit include the following: for sediment, 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) depth interval that may pose a risk to benthic organisms. For surface water, alpha-chlordane (HQ = 9), gamma-chlordane (HQ = 9) and silver (HQ = 30) are present at levels that may pose a risk to aquatic organisms.

Table 6 presents the ecological exposure pathways of concern related to the ecological RCOCs in sediment (benthic organisms) and surface water (aquatic organisms). The exposure routes, assessment endpoints and measurement endpoints associated with the RCOCs/media of concern are also identified.

The summary of ecological risks associated with the relevant medium (i.e. HQ calculation), the basis of these risks, how risks were determined, and RCOC concentrations expected to be protective of ecological receptors are presented in Table 7.

Summary of the Fate and Transport Analysis

A fate and transport analysis was performed to identify contaminant migration COCs. A constituent was identified as a contaminant migration COC if leachability modeling predicted the constituent will leach to groundwater and exceed MCLs (or RSLs/PRGs in the absence of a MCL) within 1,000 years. No contaminant migration RCOCs were identified at the GOSB OU as a result of this evaluation. In addition, groundwater samples collected as part of the 2017 sampling effort confirmed there were no contaminant releases from the basin and corroborate the conclusions of the contaminant migration analysis.

Discussion of Principal Threat Source Material

Source materials are those materials that include or contain hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air that acts as a source for direct exposure (USEPA 1991). PTSM are defined as those source materials that have a high toxicity or mobility and cannot

be reliable~~y~~ contained or present a significant risk to human health or the environment. No threshold level of toxicity/risk has been established to define "principal threat." However, treatment or removal alternatives should be considered for source materials when the cumulative risk for the future industrial worker exceeds 1E-03 for carcinogens or a HI of 10 for noncarcinogens. The identification of PTSM based on mobility is evaluated under the contaminant migration analysis. In order to determine whether contaminants in soil or sediment at the GOSB OU may be considered PTSM, a quantitative assessment evaluating the toxicity of the source material was performed.

Data used for the GOSB OU PTSM evaluation included sediment and soil results combined from all depth intervals from all four subunits. The USEPA default industrial worker was the receptor scenario evaluated under the PTSM evaluation for the GOSB OU. 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 exposure scenario.

In the preliminary screen, the maximum detected concentration for every constituent from all four subunits in the GOSB OU was determined and used as the EPC. HQs for noncarcinogens and risk estimates for carcinogens were calculated using industrial worker RSLs/PRGs as risk-based threshold levels.

Results of the PTSM evaluation for the GOSB OU indicate that the HI was one (1) and the cumulative risk was 3.9E-04. Therefore, no PTSM RCOCs were identified for the GOSB OU.

Conclusion

As determined in the RFI/RI/BRA (SRNS 2018a), the GOSB Interior Subunit identified unacceptable risks for sediment under the future resident and future industrial worker scenarios. The GOSB Interior Subunit also poses a potential threat to ecological receptors for benthic organisms (sediment) and aquatic organisms (surface water). No problems warranting action were identified for the GOSB Berm, Pipeline, or Effluent Discharge Subunits.

VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS

This section discusses the remedial action objectives (RAOs) and remedial goals (RGs) for the GOSB OU. The goals of the remedial action are to protect human health and the environment and mitigate the effects of contamination.

Remedial Action Objectives

RAOs are medium- or OU-specific objectives for protecting human health and the environment. RAOs usually specify potential receptors and exposure pathways, and are identified during project scoping once the CSM is understood. RAOs describe what the remediation must accomplish and are used as a framework for developing remedial alternatives. The RAOs are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. The following RAOs have been identified for the GOSB Interior Subunit sediment:

- Protect the future 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) depth interval that exceeds 1E-06 risk-based threshold level. Also, protect the future 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) depth 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.

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

- 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.

Remedial Goals

Remedial goal options (RGOs) serve to provide a range of cleanup goals for each RCOC and are typically identified along with the RAOs. Following public comment and approval of the SB/PP, the final cleanup goals or RGs for the selected remedy are chosen from the RGOs and documented in the ROD.

RGs can be qualitative statements or numerical values often expressed as concentrations in soil and groundwater, or actions (installation of engineered barriers, placement of caps and covers, etc.) that achieve the RAO. These cleanup goals are either concentration levels that correspond to a specific risk or hazard or are based on Applicable, or Relevant and Appropriate Requirements (ARARs). Contaminant concentrations will be monitored during the remedial action to determine when the action is complete.

RGOs were calculated for the future resident and future industrial worker scenarios as well as ecological receptors (aquatic and benthic dwelling organisms) and are presented in Table 8. The RGOs correspond to a target cancer risk of 1E-06 for the human receptors and HQ =1 for ecological receptors. The final RG is the lesser of the human health or ecological RGO for each RCOC in each medium (Table 8).

Figure 6 is a map of the human health RCOC locations that exceed the RGOs for a future resident scenario; Figure 7 is a map of the human health RCOC locations that exceed the RGOs for a future industrial worker scenario. For ecological receptors, Figure 8 is a map of the ecological RCOC locations that exceed the RGOs for benthic organisms (sediment), and Figure 9 is a map of the ecological RCOC locations that exceed the RGOs for aquatic organisms (surface water).

Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, as amended by the Superfund Amendments Reauthorization Act (SARA), requires that remedial actions for cleanup of hazardous substances must comply with requirements and standards set forth under federal and state environmental laws and regulations that are ARARs. ARARs include only federal or state environmental or facility laws and regulations and do not include occupational safety or worker protection requirements. SARA requires that the remedial action for a site meet all ARARs unless a waiver is invoked.

ARARs consist of two sets of requirements: those that are applicable, and those that are relevant and appropriate. Applicable requirements are those substantive standards that specifically address the situation at a CERCLA site and are promulgated under Federal or State environmental laws. If a requirement is not applicable, it may still be relevant and appropriate. "Applicability" is a legal and jurisdictional determination, while the determination of "relevant and appropriate" relies on professional judgment, considering environmental and technical factors at the site. A requirement may be "relevant", in that it covers situations similar to that at the site, but may not be "appropriate" to apply for various reasons and, therefore, not well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; if a requirement is applicable, however, all substantive parts must be followed. In addition to ARARs, many federal and state environmental and public health programs include criteria, guidance, and proposed standards that are not legally binding but provide useful approaches or recommendations. Such information is required to be considered when RGs are developed.

Key ARARs associated with each alternative are discussed in more detail in the Description of Alternatives section. The complete list of ARARs for the selected remedy are presented in Table 9.

IX. DESCRIPTION OF ALTERNATIVES

This section presents and summarizes the remedial alternatives for the final remedy for the GOSB OU. The GOSB OU CMS/FS included the identification and screening of technologies, development and screening of alternatives, and a detailed analysis of remedial alternatives (SRNS 2018a).

Remedy Components, Common Elements, and Distinguishing Features of Each Alternative

The range of alternatives includes an option that involves little or no treatment yet provides protection to human health and the environment by preventing or controlling exposure through land use controls (LUCs). Remedial alternatives were developed for the GOSB Interior Subunit to address pesticide contamination in the sediment and surface water. No action is needed for the GOSB Berm, Pipeline, or Effluent Discharge Subunits.

Alternative A-1. No Action

The No Action alternative is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to serve as a baseline for comparison with other remedial alternatives. 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. The No Action alternative would not address the risk to future residents or industrial workers via exposure to the contaminated sediments, or the risks to benthic and aquatic organisms via exposure to the contaminated sediments and surface water. This alternative does not include a five-year remedy review.

Summary of Costs

Capital Cost:	$0
Operations and Maintenance (O&M):	$0
Total Present-Worth (PW) Cost:	$0

Alternative A-2. Land Use Controls

LUCs that include institutional controls (i.e., administrative measures) and engineering controls (i.e., signs, fences, etc.) are not appropriate as a stand-alone remedy for the GOSB Interior Subunit as it does not address the RAO for protection of ecological receptors. Therefore, LUCs as a stand-alone remedy were not retained for a detailed analysis.

Alternative A-3. Place 0.6-m (2-ft) 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 dewatering 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 cubic meters (m^3 [610 cubic yards {yd^3}]) of clean fill to cover the basin bottom sediments. For the purpose of developing a cost estimate, initial dewatering of the basin is assumed to be by pumping and spray irrigating. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B. Sampling of rainwater collected in the basin after remedial action completion would be necessary to confirm the effectiveness and continued protectiveness of the remedy.

Alternative A-3 would require LUCs and five-year remedy reviews.

Summary of Costs

Capital Cost:	$1,427,970
O&M:	$1,643,599
Total PW Cost:	$3,071,569

Alternative A-4. Backfill Basin and Manage Surface Water

Alternative A-4 was also carried forward for a detailed analysis. This alternative entails backfilling of the basin to natural grade by a controlled compaction method with clean fill, and construction of a vegetative cover. The thickness of the required fill material, a minimum of 3.1 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. Specific activities associated with this remedial alternative include dewatering of the basin, clearing ~0.27 hectare (ha [0.67 acre {ac}]), 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. This alternative will require site clearing for equipment staging and road improvements to accommodate the high volume of truck traffic for the hauling of soil backfill. For the purpose of developing a cost estimate, dewatering of the basin is assumed to be by pumping and spray irrigating. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B.

Alternative A-4 would not require LUCs or five-year remedy reviews.

Summary of Costs

Capital Cost:	$1,811,848
O&M:	$15,217
Total PW Cost:	$1,827,066

Alternative A-5. Excavate and Manage Surface Water

Alternative A-5 was carried forward for a detailed analysis. This alternative consists of excavation of the contaminated sediments in the basin with off-site disposal. Specifically,

this remedial alternative includes dewatering of the basin, clearing ~0.27 ha (0.67 ac), installation of erosion control measures such as silt fencing along portions of the haul roads and where needed 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. For the purpose of developing a cost estimate, dewatering of the basin is assumed to be by pumping and spray irrigating. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B.

No debris is anticipated based on observations of the basin when it was drained in the early 1990s. 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 RGs have been achieved. For estimating purposes, 10 post-excavation confirmation samples (pesticides and metals) and 10 waste characterization samples (Toxicity Characteristic Leaching Procedure) were assumed to be necessary.

Alternative A-5 would not require LUCs or five-year remedy reviews.

Summary of Costs

Capital Cost:	$1,700,711
O&M:	$15,217
Total PW Cost:	$1,715,928

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP (40 Code of Federal Regulations [CFR] 300.430(e)(9)) requires that potential remedial alternatives undergo detailed analysis using relevant evaluation criteria that will

be used to select a final remedy. USEPA has established nine evaluation criteria to address the statutory requirements under CERCLA. The criteria fall into categories of: threshold criteria, primary balancing criteria, and modifying criteria. The nine evaluation criteria are detailed in Table 10.

The potential remedial alternatives have been evaluated against the threshold and primary balancing criteria. Provided below is a summary of the comparison of the alternatives against the CERCLA evaluation criteria. Key advantages and disadvantages for each alternative relative to one another and in relation to the two threshold criteria and five primary balancing criteria are discussed below and summarized in Table 11.

Overall Protection of Human Health and the Environment

Alternative A-1 — No Action does not address the risk to the future industrial worker or resident from exposure to contaminated sediments, or risk to aquatic and benthic organisms via exposure to contaminated sediments and surface water. Therefore, Alternative A-1 is not protective of human health and the environment.

Alternative A-3 — Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water provides protection of human health and the environment and would achieve RAOs in a short period (several months) of time. This alternative consists of placing 0.6 m (2 ft) of clean fill over the impacted basin-bottom sediments to break the direct exposure pathway to human and ecological receptors. Prior to placing the fill, the surface water within the basin will be spray irrigated to the land surface. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B.

Alternative A-4 — Backfill Basin and Manage Surface Water provides protection of human health and the environment and would achieve RAOs in a short period (several months) of time. This alternative entails backfilling of the basin to natural grade by a controlled compaction method with clean fill and construction of a vegetative cover to break the direct

exposure pathway to human and ecological receptors. Prior to backfilling the basin, the surface water within the basin will be spray irrigated to the land surface. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B.

Alternative A-5 — Excavate and Manage Surface Water physically removes the source of contamination and provides protection of human health and the environment and would achieve RAOs in a short period (several months) of time. This alternative consists of excavation of the contaminated sediments in the basin to break the direct exposure pathway to human and ecological receptors. Prior to excavation, the surface water within the basin will be spray irrigated to the land surface. The land application of the GOSB surface water does not pose a threat to human or terrestrial ecological receptors (SRNS 2018b). The evaluation that examines the risk posed by any short-term or cross-media impacts due to spray irrigation of water to the land surface is provided in Appendix B.

Compliance with ARARs

There are no ARARs associated with Alternative A-1; however, there are action-specific ARARs for Alternatives A-3, A-4, and A-5 associated with basin water management, particulate air emissions, storm water control, and disposal of solid waste to an off-unit permitted landfill.

Short-Term Effectiveness

Alternative A-1 — No Action does not meet the RAOs and will allow the unit-related contaminants to continue to adversely affect human health and the environment.

Alternative A-3 — Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water can be completed in a short timeframe while posing no risk to the community. Remedial workers have the greatest risk of exposure during construction activities. Initial protection against

the threats associated with exposure to contaminated sediments would be achieved in <6 months from the commencement of construction activities.

Alternative A-4 — Backfill Basin and Manage Surface Water can be completed in a short timeframe while posing no risk to the community. Initial protection against the threats associated with exposure to contaminated sediments and achievement of the RAOs would be achieved in <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.

Alternative A-5 — Excavate and Manage Surface Water can be completed in a short timeframe while posing no risk to the community. Initial protection against the threats associated with exposure to contaminated sediments and achievement of the RAOs would be achieved in <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.

Long-Term Effectiveness and Permanence

Alternative A-1 — No Action does not provide for long-term effectiveness or permanence because an unacceptable residual risk to human health and the environment under future conditions at the GOSB OU would remain unchanged.

Alternative A-3 — Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water will break the exposure pathway; however, the long-term effectiveness of Alternative A-3 is uncertain because of the contaminants remaining beneath the 0.6-m (2-ft) soil layer that could affect future rainwater collected in the basin. Sampling of accumulated water and

engineering controls to monitor and maintain an adequate cover over contaminants would be necessary to ensure continued long-term effectiveness. LUCs and five-year remedy reviews would be required.

Alternative A-4 — Backfill Basin and Manage Surface Water will provide long-term effectiveness with no associated long-term O&M requirements. Residual risks will be reduced by the placement of a clean soil layer ranging in thickness from ~3.1 m to 4.9 m (10 ft to 16 ft). The thickness of the clean fill layer will ensure that exposure to contaminated sediments will be prevented with no requirement to monitor and maintain post-remediation conditions. 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.

Alternative A-5 — Excavate and Manage Surface Water permanently removes and safely disposes of the contaminated surface water and sediments and offers long-term protection. No contaminants would be left in place; therefore, there would be no remaining risk, and LUCs and five-year remedy reviews would not be required.

Reduction of Toxicity, Mobility, or Volume through Treatment

None of the alternatives employs any treatment to reduce the toxicity, mobility, or volume of the contaminated media.

Implementability

Implementability is not a consideration for *Alternative A-1 — No Action* since this alternative requires no action.

Alternative A-3 — Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water requires initial dewatering of the basin and placement of clean fill over the impacted basin-bottom sediments. The alternative is technically feasible in that 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 initial dewatering effort. SRS has extensive experience in dewatering and earth moving activities.

Alternative A-4 — Backfill Basin and Manage Surface Water requires initial dewatering of the basin and backfilling the basin. Alternative A-4 is considered to be technically feasible in that dewatering can be achieved with standard equipment and controlled-compaction 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 has 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.

Alternative A-5 — Excavate and Manage Surface Water requires initial dewatering of the basin and backfilling the basin. Alternative A-5 is considered to be technically feasible in that dewatering can be achieved with standard equipment and excavation 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 has 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.

Cost

The total PW cost (rounded to the nearest $100) for each of the alternatives is provided in the following table.

Alternative	Description	*Cost*
Alternative A-1	No Action	*$0*
Alternative A-3	Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water	*$3,071,600*
Alternative A-4	Backfill Basin and Manage Surface Water	*$1,827,100*
Alternative A-5	Excavate and Manage Surface Water	*$1,715,900*

XI. THE SELECTED REMEDY

Detailed Description of the Selected Remedy

Alternative A-4, Backfill Basin and Manage Surface Water, is the selected alternative because the remedy is effective in preventing exposure of contaminated media to human and ecological receptors, and does not require LUCs or a five-year remedy review. A comparative alternative ranking of all alternatives is provided in Table 12.

Alternative A-4 entails the controlled-compaction backfilling of 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 3.1 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, prevents exposure to pesticides buried at depth. Specific activities associated with this remedial alternative include dewatering of the basin, clearing ~0.27 ha (0.67 ac), 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. There is ample forested area adjacent to the basin to receive irrigation from the dewatering effort. The local topography and conceptual basin cross-section for Alternative 4 is presented in Figure 10.

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 1990s. 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 not occur as long as administrative site use procedures that prohibit unauthorized excavations at SRS are in place.

Alternative A-4 does not require LUCs or five-year remedy reviews and a Land Use Control Implementation Plan is not required.

Cost Estimate for the Selected Remedy

The estimated PW to implement *Alternative 4- Backfill Basin and Manage Surface Water* is $1,827,100 (Table 13). The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the ARF, an Explanation of Significant Difference to this ROD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to –30 percent of the actual project cost.

Estimated Outcomes of Selected Remedy

Based on information currently available, the USDOE, USEPA, and SCDHEC believe that backfilling the basin to the natural grade and surface water management provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The selected remedy has the highest short-term effectiveness of all the alternatives. It ranks similarly to the other alternatives with respect to long-term effectiveness and cost (Table 12). Baseline risks identified in the BRA will be reduced through control of pathway to exposure. Figure 11 is a generic CSM for the GOSB OU subunits that illustrates how the primary exposure routes of concern will be broken/rendered incomplete

upon implementation of the selected remedy. The GOSB Interior Subunit will not require LUCs and will be available for unrestricted land use. The USDOE expects the Selected Remedy to satisfy the statutory requirements in CERCLA Section 121(b) to: 1) be protective of human health and the environment, 2) comply with ARARs, and 3) be cost-effective.

The following GOSB OU Subunits have no final COCs; thus, No Action is the appropriate response and the subunits are available for unrestricted land use:

- GOSB Berm Subunit
- Pipeline Subunit
- Effluent Discharge Subunit

XII. WASTE DISPOSAL AND TRANSPORT

No debris is anticipated based on observations of the basin when it was drained in the early 1990s. However, any debris encountered will be managed as CERCLA waste and disposed of at an approved waste disposal facility.

XIII. STATUTORY DETERMINATIONS

Based on the unit RFI/RI/BRA report, a portion of the GOSB OU poses a threat to human health and the environment. Therefore, *Alternative 4, Backfill Basin and Manage Surface Water* has been selected as the remedy for the GOSB OU. As a result of the selected remedy, the future land use of the GOSB OU will be unrestricted.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required for this remedial action.

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action (unless justified by a waiver), and is cost-effective. The remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy

because it does not employ treatment to reduce the toxicity, mobility, or volume of the contaminated media.

XIV. EXPLANATION OF SIGNIFICANT CHANGES

The remedy selected in this ROD does not contain any significant changes from the preferred alternative presented in the SB/PP (SRNS 2018b). No comments were received during the public comment period.

XV. RESPONSIVENESS SUMMARY

The Responsiveness Summary is included as Appendix A of this document.

XVI. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION

A summary of the key deliverables and submittal dates for the GOSB OU is shown in Figure 12 and is summarized below:

- 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
- Remedial Action Start — September 30, 2020
- Submit Rev.0, Post Construction Report/Corrective Measures Implementation Report/Remedial Action Completion Report — June 22, 2021

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XVII. REFERENCES

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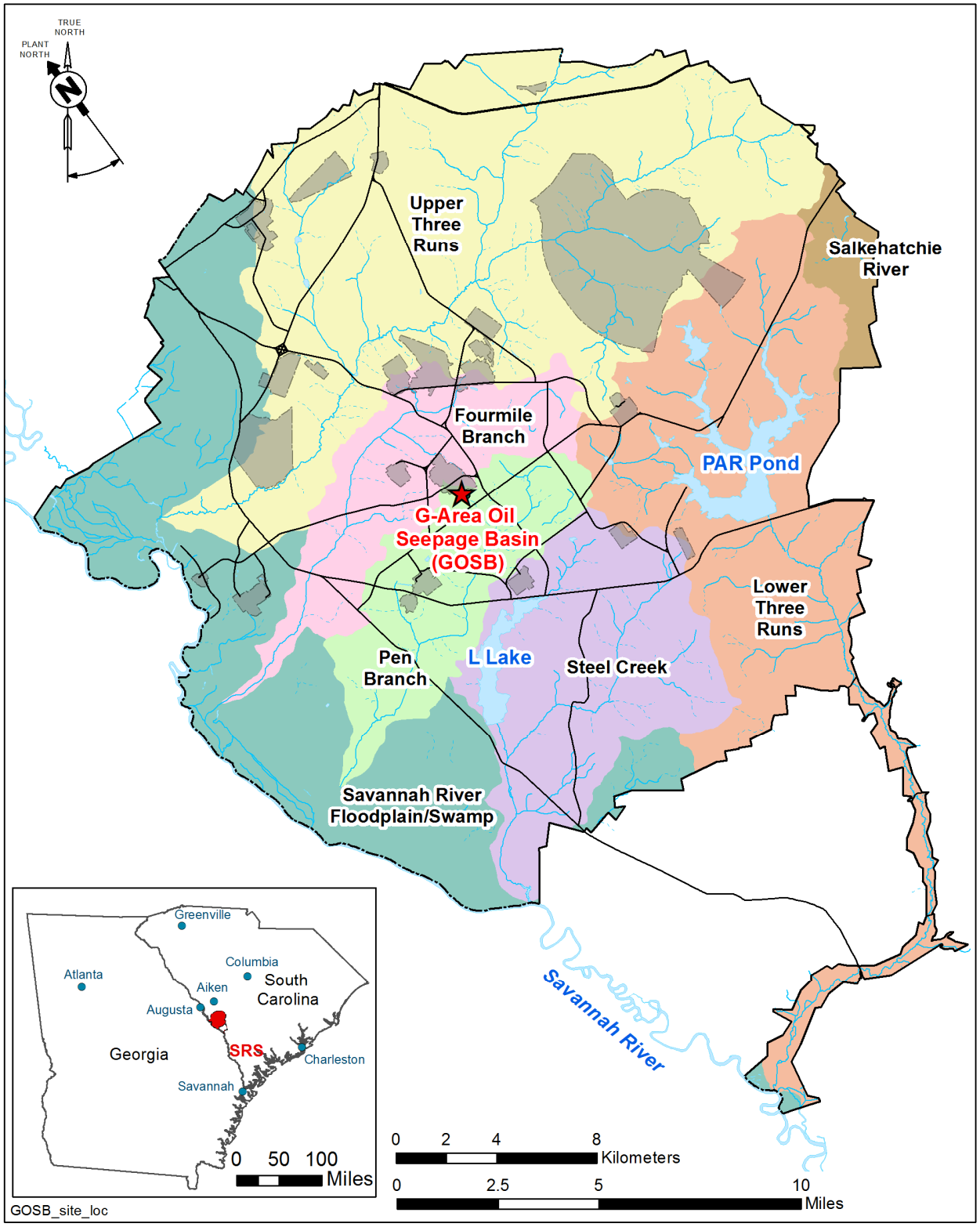


Figure 1. Location of the GOSB OU within the Savannah River Site

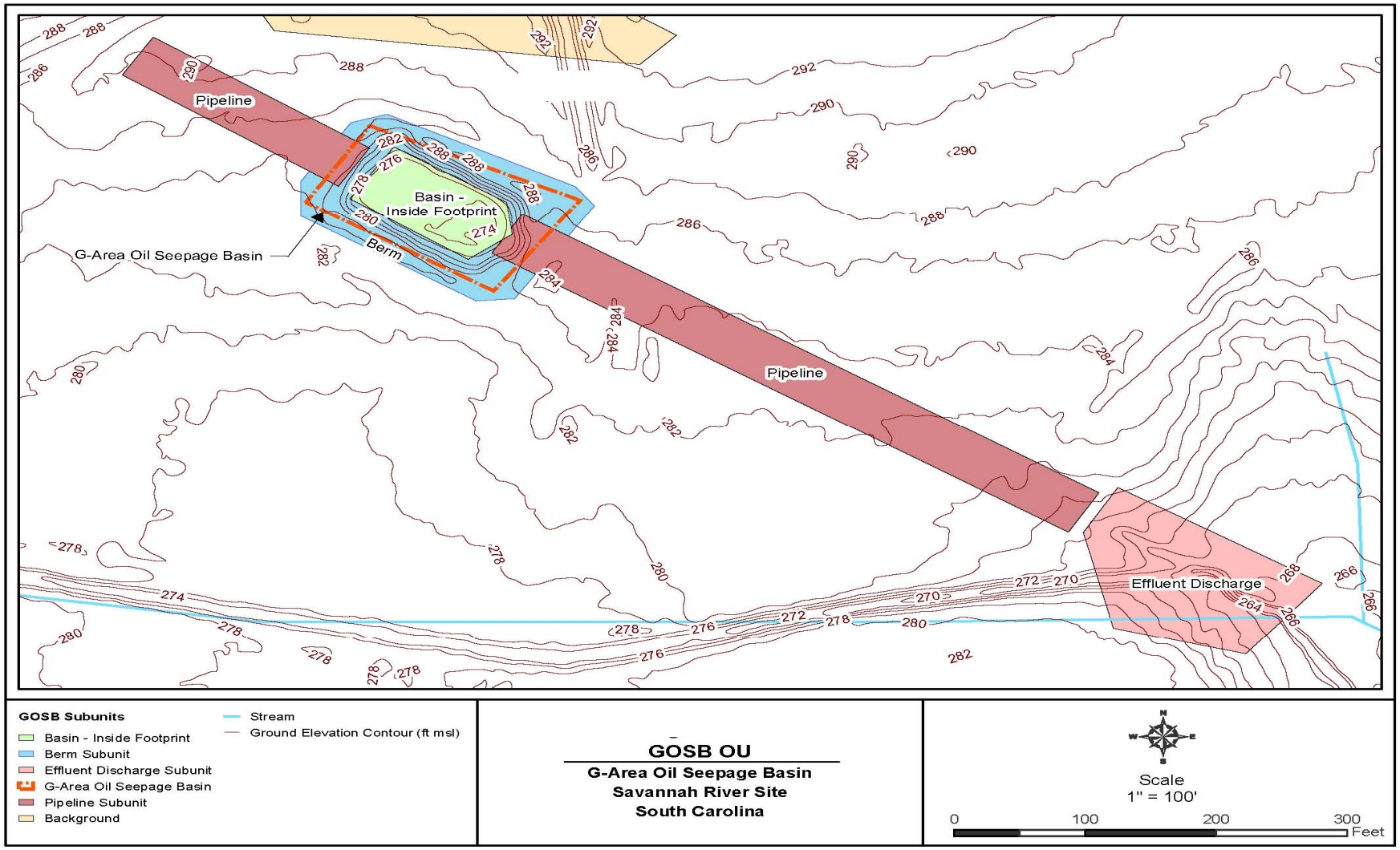


Figure 2. Layout of the GOSB OU

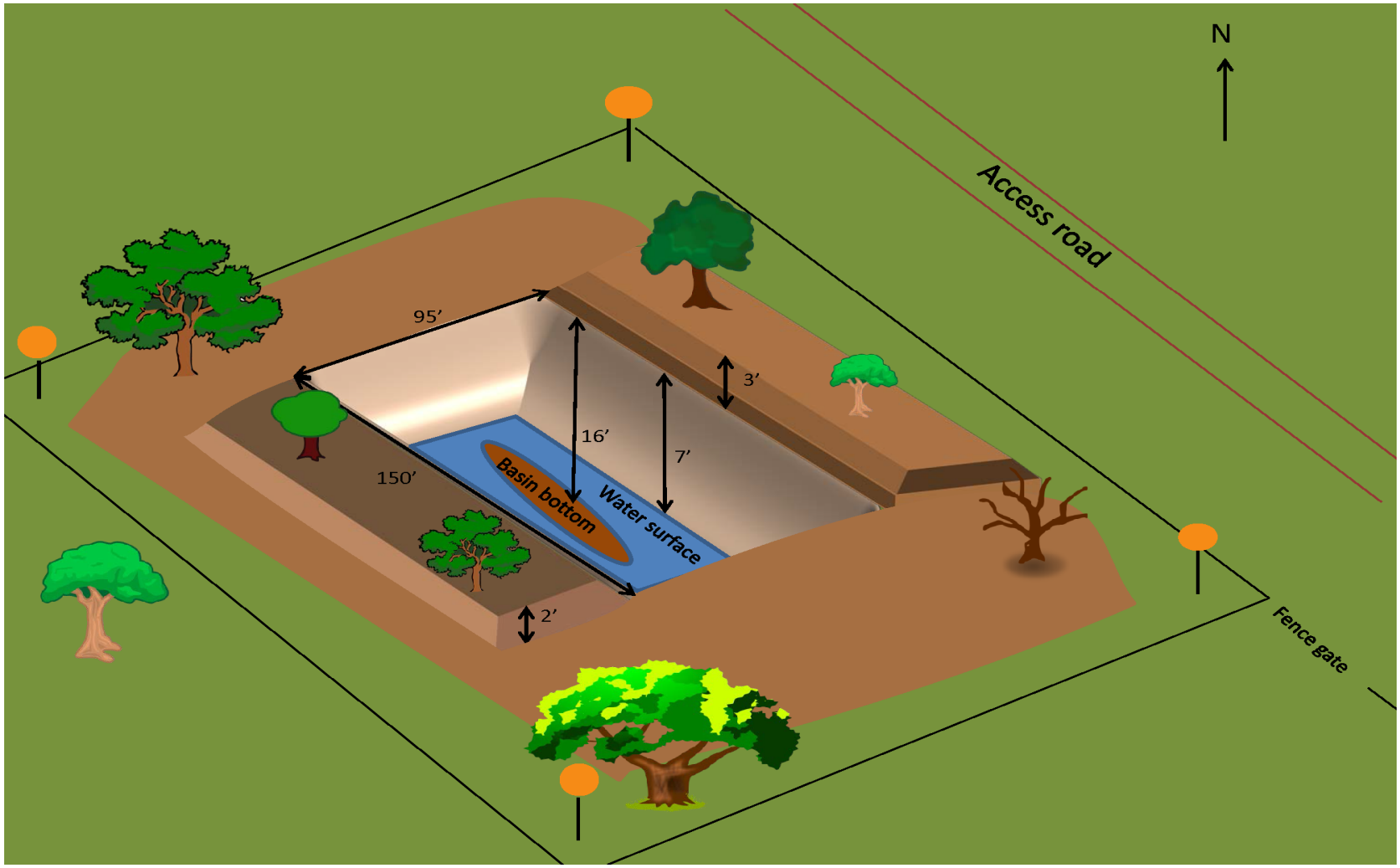


Figure 3. Schematic Diagram of the GOSB

Figure 4. Photograph of the GOSB (February 2017)

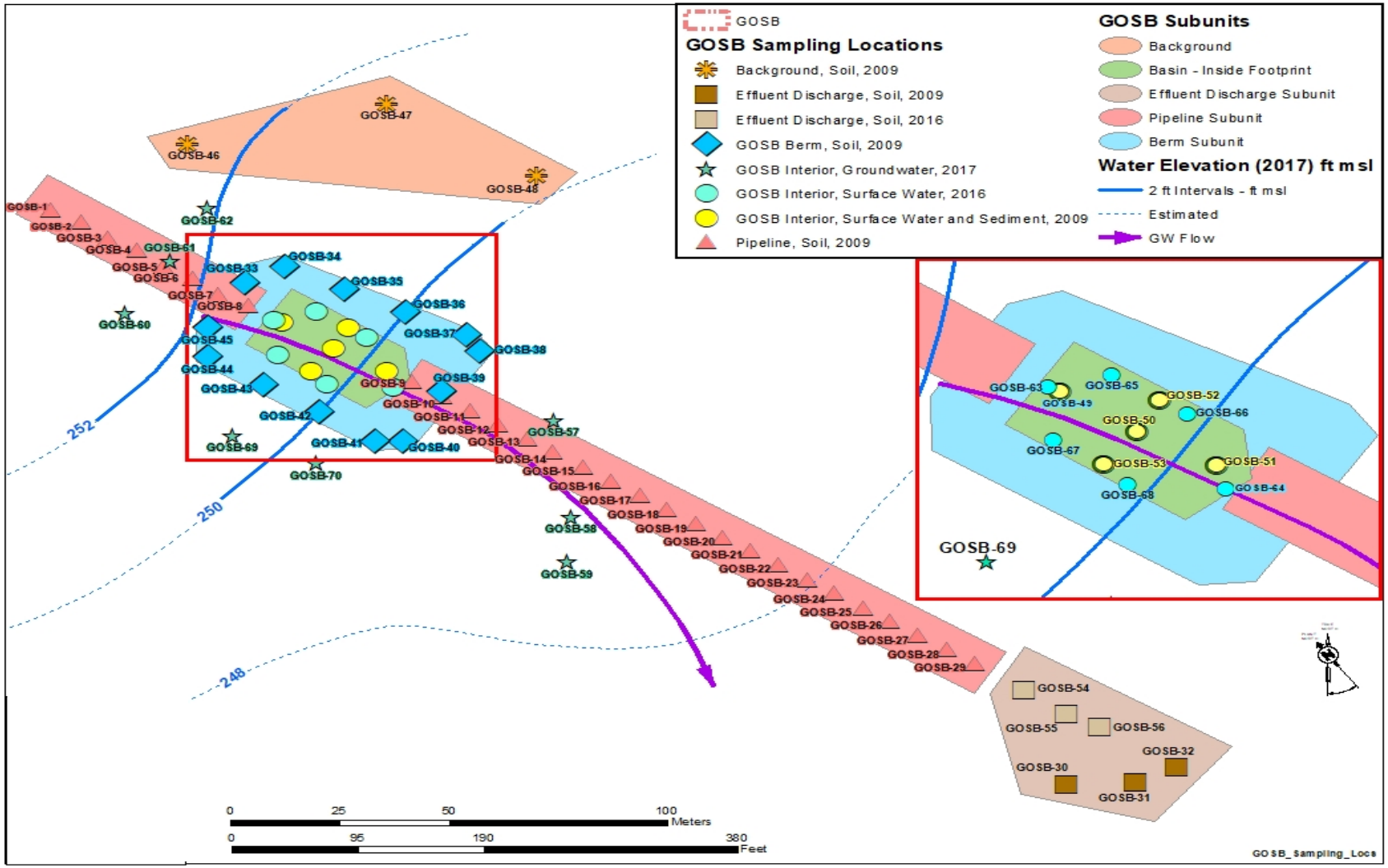


Figure 5. GOSB OU Subunits and Sampling Locations

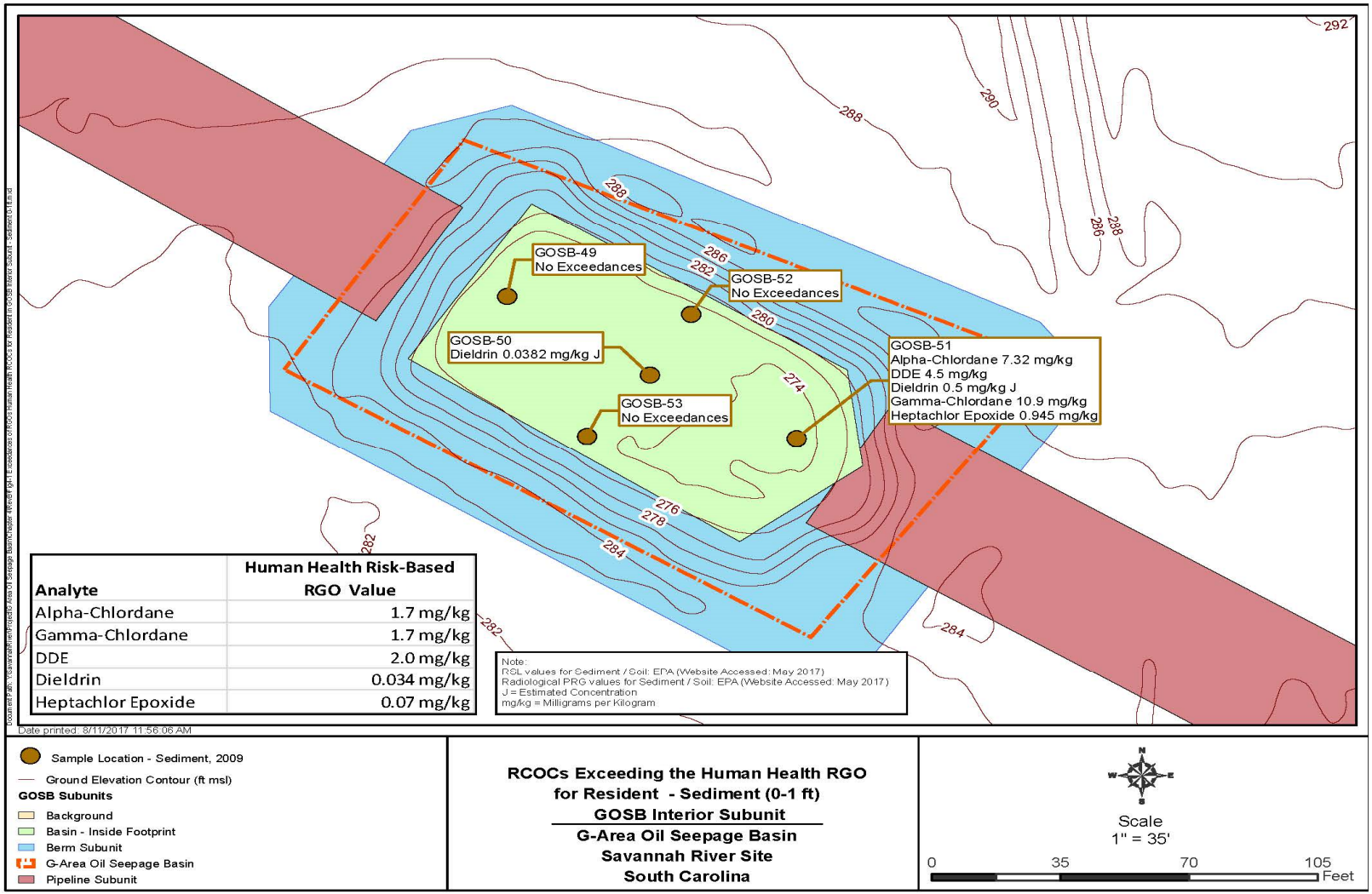


Figure 6. RCOCs Exceeding the Human Health RGOs for Future Resident Scenario – Sediment (0 to 1 ft)

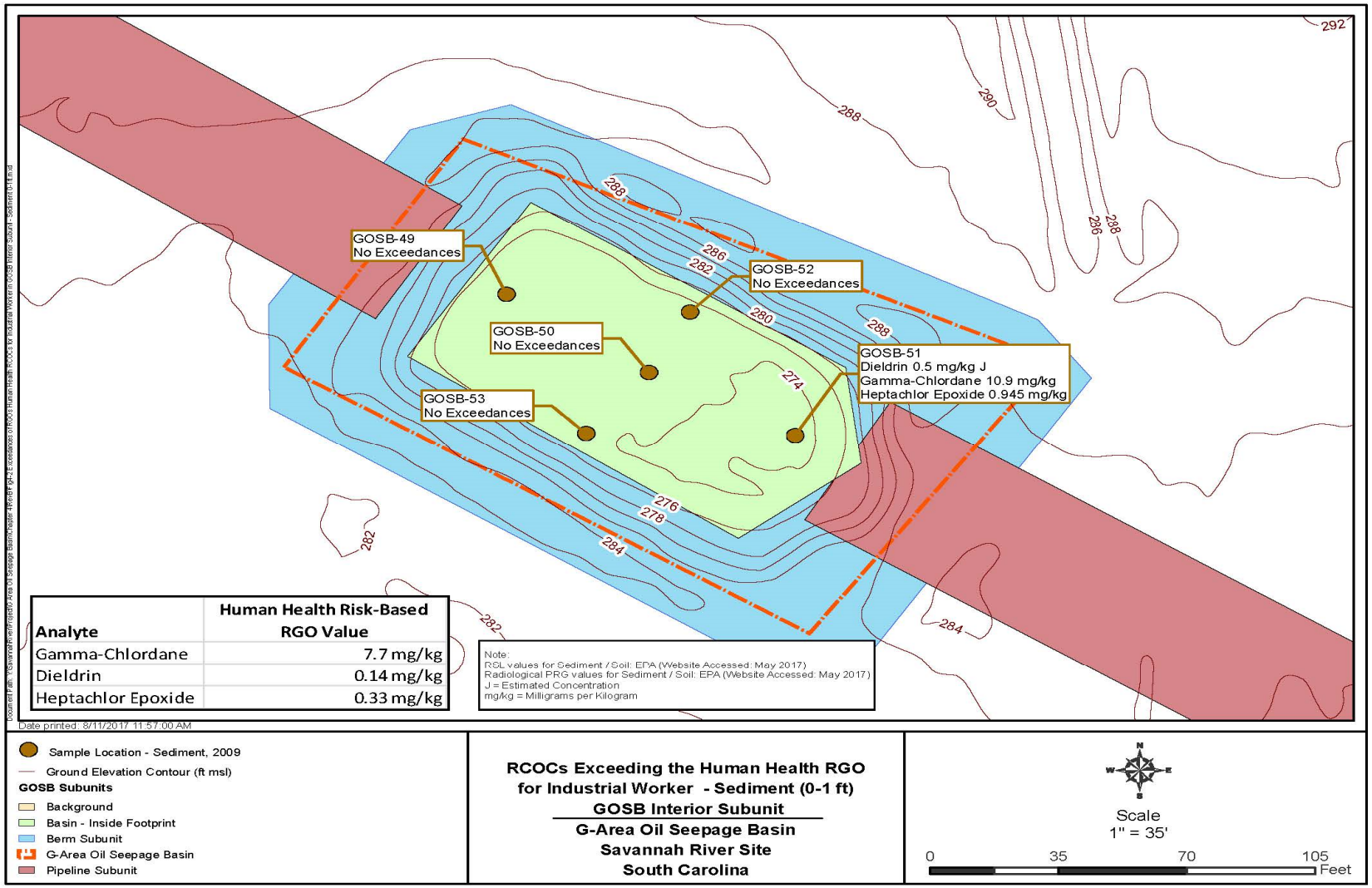


Figure 7. RCOCs Exceeding Human Health RGOs for Future Industrial Worker Scenario – Sediment (0 to 1 ft)

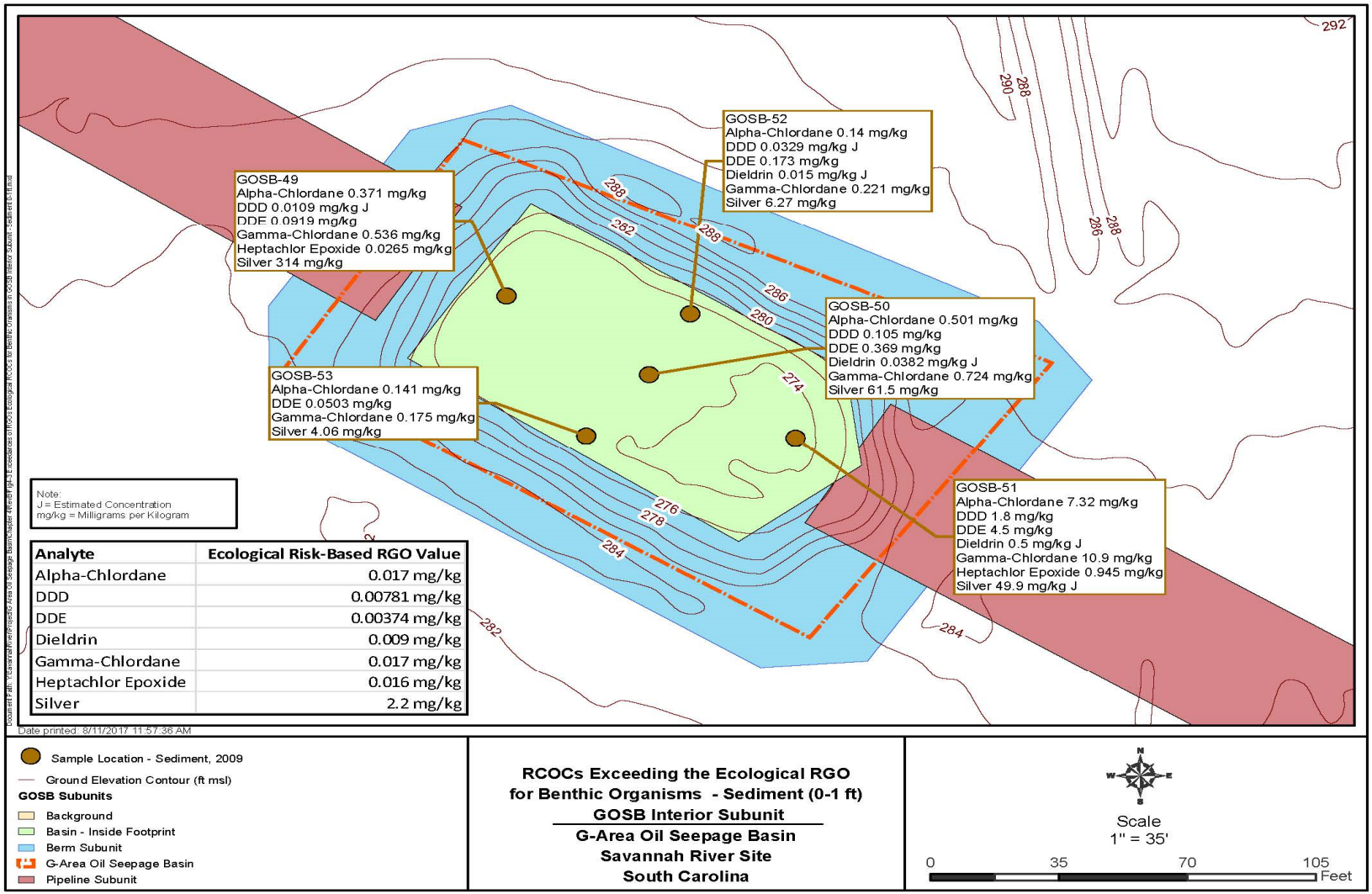


Figure 8. RCOCs Exceeding the Ecological RGOs for Benthic Organisms – Sediment (0 to 1 ft)

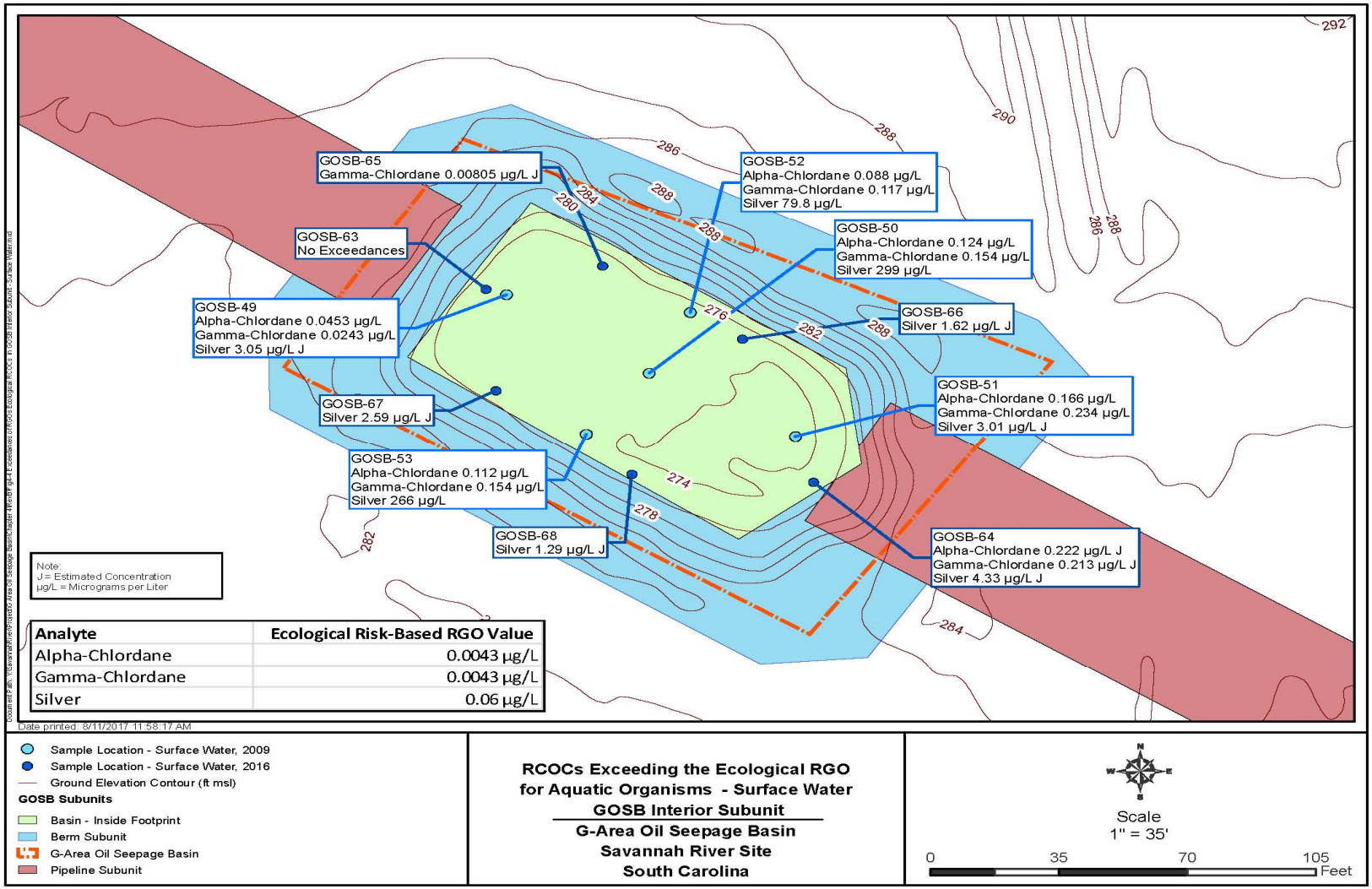


Figure 9. RCOCs Exceeding the Ecological RGOs for Aquatic Organisms – Surface Water

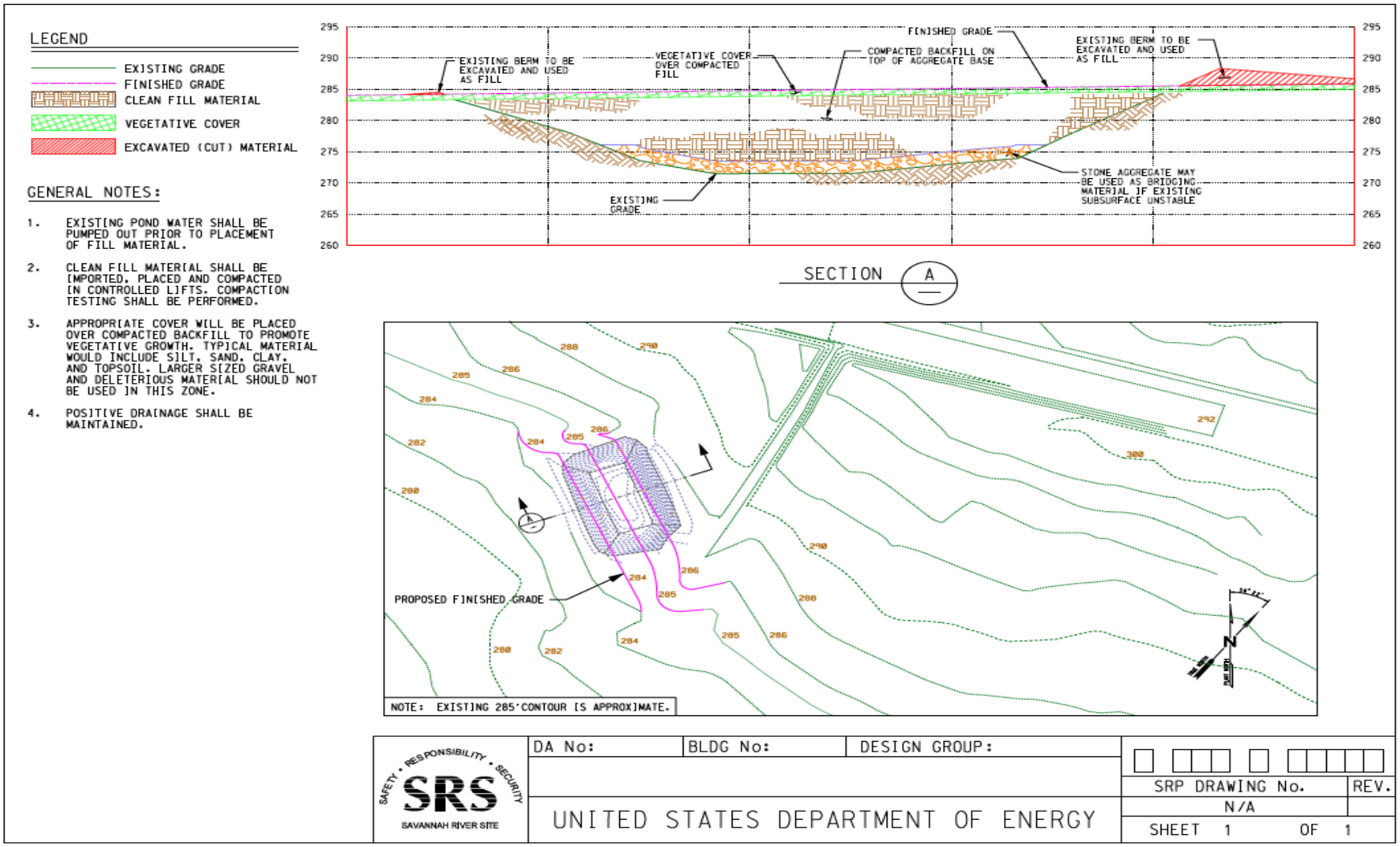
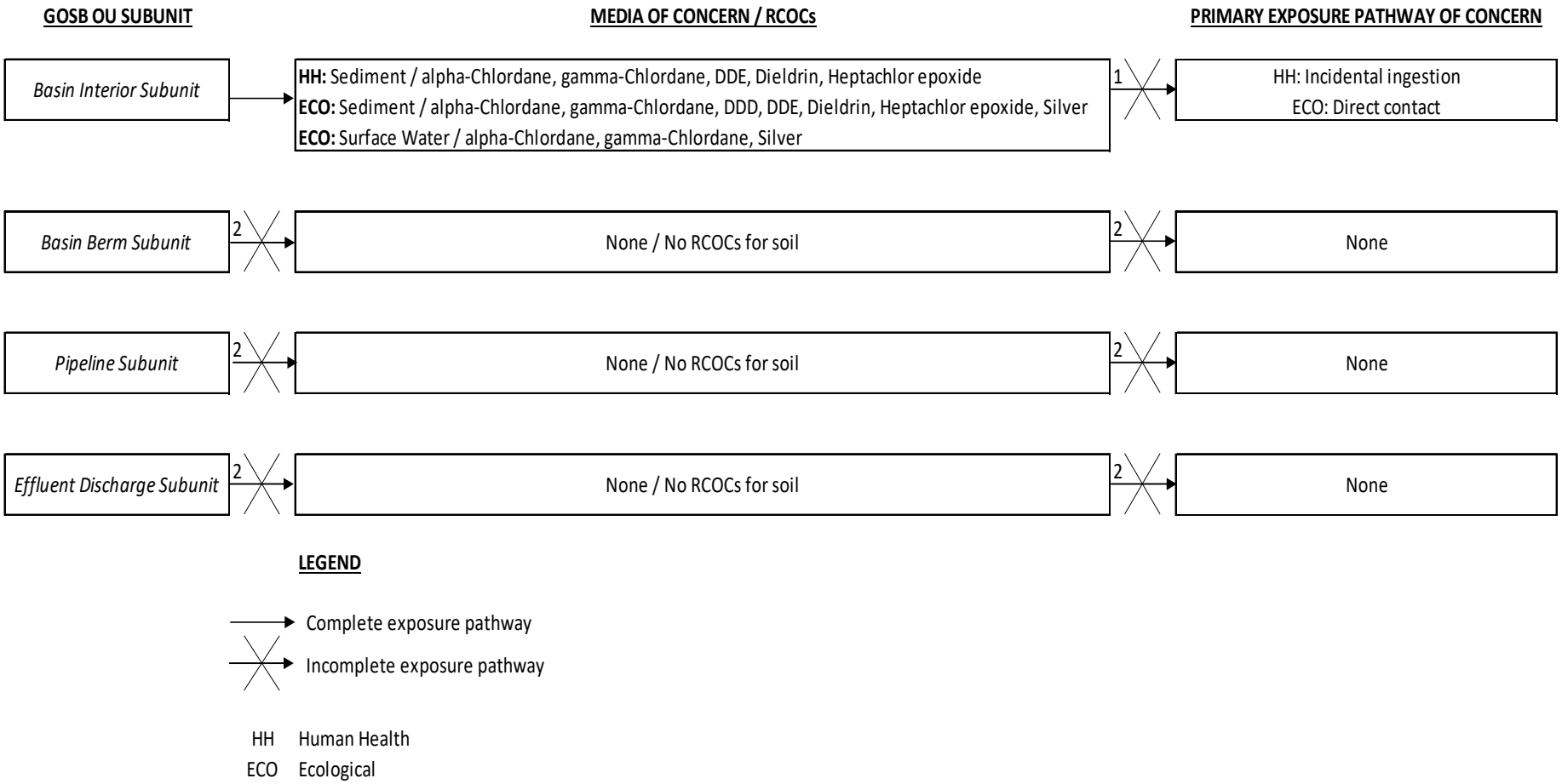


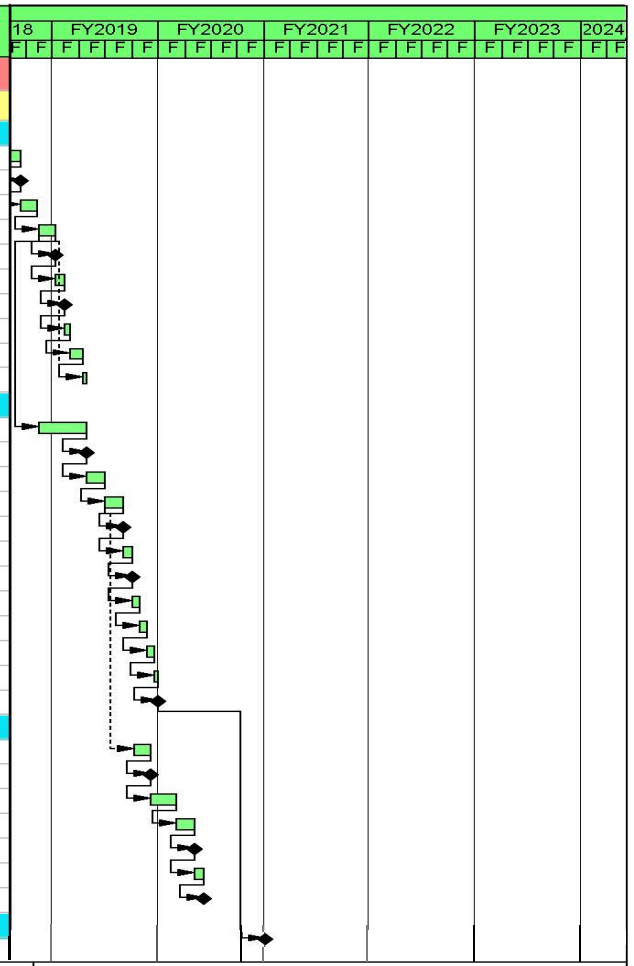
Figure 10. Basin Cross-Section – Alternative #4



1. Alternative 4: Backfill Basin and Manage Surface Water prevents exposure of human health and ecological receptors to pesticides buried at depth, qualifies for unrestricted land use (no LUCs).
2. No problems warranting action identified (No Action), qualifies for unrestricted land use (no LUCs).

Figure 11. GOSB OU Generic Conceptual Site Model after Completion of Final Remedial Action

Activity Name	Original Duration	Start	Finish
Four Mile Branch WS	1353	05-Apr-18	17-Dec-21
G-Area Oil Seepage Basin Implementation Sche	1353	05-Apr-18	17-Dec-21
Statement of Basis/Proposed Plan (SB/PP)	299	05-Apr-18	28-Jan-19
SRS Prepare SB/PP (Rev.0)	68	05-Apr-18	11-Jun-18
SRS Submit SB/PP (Rev.0) to EPA/SCDHEC	0		11-Jun-18
EPA/SCDHEC Review of SB/PP (Rev.0)	60	12-Jun-18	10-Aug-18
SRS Incorporate EPA/SCDHEC Comments	60	13-Aug-18	11-Oct-18
SRS Submit SB/PP (Rev.1) to EPA/SCDHEC	0		11-Oct-18
EPA/SCDHEC Final Review/Approval	33	12-Oct-18	13-Nov-18
Approval of SB/PP	0		13-Nov-18
Notification of SB/PP Public Comment	14	14-Nov-18	27-Nov-18
Public Comment Period	45	28-Nov-18	11-Jan-19
Develop Responsiveness Summary	15	14-Jan-19	28-Jan-19
ROD	414	13-Aug-18	30-Sep-19
SRS Develop ROD (Rev.0)	169	13-Aug-18	28-Jan-19
SRS Submit ROD (Rev.0) to EPA/SCDHEC	0		28-Jan-19
EPA/SCDHEC Review of ROD (Rev.0)	60	29-Jan-19	29-Mar-19
SRS Incorporate EPA/SCDHEC Comments	60	01-Apr-19	30-May-19
Submit ROD (Rev.1) to EPA/SCDHEC	0		30-May-19
EPA/SCDHEC Final Review/Approval	32	31-May-19	01-Jul-19
Approval of ROD	0		01-Jul-19
DOE Obtain Signature on ROD	25	02-Jul-19	26-Jul-19
SCDHEC Obtain Signature on ROD	25	29-Jul-19	22-Aug-19
EPA Obtain Signature on ROD	25	23-Aug-19	16-Sep-19
Prepare Public Notice	14	17-Sep-19	30-Sep-19
Issue ROD	0		30-Sep-19
CMI/RAIP	241	08-Jul-19	04-Mar-20
SRS Develop CMI/RAIP (Rev.0)	60	08-Jul-19*	05-Sep-19
SRS Submit CMI/RAIP (Rev.0) to EPA/SCDHEC	0		05-Sep-19
EPA/SCDHEC Review of (CMI/RAIP Rev.0)	90	06-Sep-19	04-Dec-19
SRS Incorporate EPA/SCDHEC Comments	61	05-Dec-19	03-Feb-20
SRS Submit CMI/RAIP (Rev.1) to EPA/SCDHEC	0		03-Feb-20
EPA/SCDHEC Final Review/Approval	30	04-Feb-20	04-Mar-20
Approval of CMI/RAIP	0		04-Mar-20
RA Start	0	30-Sep-20	30-Sep-20
RA Start	0	30-Sep-20	



GOSB Implementation Schedule

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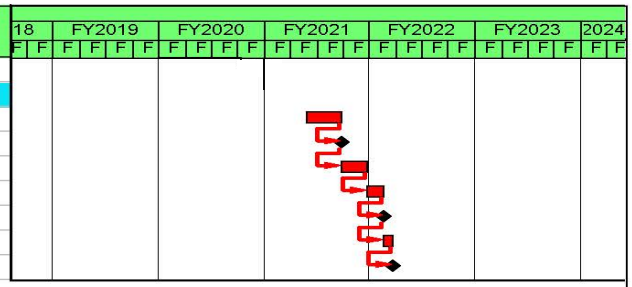
Figure 12. Implementation Schedule for the GOSB OU

Activity Name	Original Duration	Start	Finish
PCR/CMIR/RACR	298	23-Feb-21	17-Dec-21
SRS Develop PCR/CMIR/RACR (Rev.0)	120	23-Feb-21*	22-Jun-21
SRS Submit PCR/CMIR/RACR (Rev.0) to EPA/SCDHEC	0		22-Jun-21
EPA/SCDHEC Review of PCR/CMIR/RACR (Rev.0)	90	23-Jun-21	20-Sep-21
SRS Incorporate EPA/SCDHEC Comments	60	21-Sep-21	19-Nov-21
SRS Submit PCR/CMIR/ACR (Rev.1) to EPA/SCDHEC	0		19-Nov-21
EPA/SCDHEC Final Review/Approval	28	20-Nov-21	17-Dec-21
Approval of PCR/CMIR/RACR	0		17-Dec-21



GOSB Implementation Schedule

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Figure 12. Implementation Schedule for the GOSB OU *(Continued/End)*

Table 1. GOSB OU Risk Summary

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 = Medium not present in the subunit

Table 2. Summary of Constituents of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: G-Area Oil Seepage Basin (GOSB) Interior Subunit
Exposure Medium: Surface Sediment (0-1 ft)

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Sediment Onsite – Direct Contact	alpha-Chlordane	0.14	7.32	mg/kg	5/5	4.494	mg/kg	95% UCL
	gamma-Chlordane	0.175	10.9	mg/kg	5/5	10.9	mg/kg	Max
	DDE	0.0503	4.5	mg/kg	5/5	4.5	mg/kg	Max
	Dieldrin	ND	0.5	mg/kg	3/5	0.3398	mg/kg	95% UCL
	Heptachlor epoxide	ND	0.945	mg/kg	3/5	0.6348	mg/kg	95% UCL

Key:
Min = minimum detected concentration
Max = maximum detected concentration
mg/kg = milligrams per kilogram
95% UCL = 95% upper confidence limit of the mean concentration
ND = non-detect

Table 3. Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal						
Constituent of Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence/Cancer Guideline Description**	**Source**	**Date** *(mo/yr)*
alpha-Chlordane	3.5E-01	---	$(mg/kg\text{-}day)^{-1}$	B2	USEPA	May 2016
gamma-Chlordane	3.5E-01	---	$(mg/kg\text{-}day)^{-1}$	B2	USEPA	May 2016
DDE	3.4E-01	---	$(mg/kg\text{-}day)^{-1}$	B2	USEPA	May 2016
Dieldrin	1.6E+01	---	$(mg/kg\text{-}day)^{-1}$	B2	USEPA	May 2016
Heptachlor epoxide	9.1E+00	---	$(mg/kg\text{-}day)^{-1}$	B2	USEPA	May 2016

Pathway: Inhalation							
Constituent of Concern	**Unit Risk**	**Units**	**Inhalation Cancer Slope Factor**	**Units**	**Weight of Evidence/Cancer Guideline Description**	**Source**	**Date** *(mo/yr)*
alpha-Chlordane	1.0E-01	$(\mu g/m^3)^{-1}$	---	---	B2	USEPA	May 2016
gamma-Chlordane	1.0E-04	$(\mu g/m^3)^{-1}$	---	---	B2	USEPA	May 2016
DDE	9.7E-05	$(\mu g/m^3)^{-1}$	---	---	B2	USEPA	May 2016
Dieldrin	4.6E-03	$(\mu g/m^3)^{-1}$	---	---	B2	USEPA	May 2016
Heptachlor epoxide	2.6E-03	$(\mu g/m^3)^{-1}$	---	---	B2	USEPA	May 2016

Pathway: External (Radiation)						
Constituent of Concern	**Cancer Slope or Conversion Factor**	**Exposure Route**	**Units**	**Weight of Evidence/Cancer Guideline Description**	**Source**	**Date** *(mo/yr)*
None	NA	NA	NA	NA	NA	NA

Key:
--- = no information available
B2 = probable human carcinogen
NA = not applicable
mg/kg = milligram per kilogram
$\mu g/m^3$ = micrograms per cubic meter

USEPA, 2016. *Regional Screening Levels* website, United States Environmental Protection Agency (May 2016) https://www.epa.gov/risk/regional-screening-levels-rsls. Website accessed May 2017.

Table 4. Resident Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
GOSB Interior Subunit	Surface Sediment	Ingestion, Inhalation, Dermal Contact	alpha-Chlordane	NC	NC	NC	NA	2.6E-06
		Ingestion, Inhalation, Dermal Contact	gamma-Chlordane	NC	NC	NC	NA	6.4E-06
		Ingestion, Inhalation, Dermal Contact	DDE	NC	NC	NC	NA	2.3E-06
		Ingestion, Inhalation, Dermal Contact	Dieldrin	NC	NC	NC	NA	1.0E-05
		Ingestion, Inhalation, Dermal Contact	Heptachlor epoxide	NC	NC	NC	NA	9.1E-06
							Resident Total Cumulative Risk =	**3.0E-05**

Key:
NA = not applicable.
NC = not calculated. Risk was not calculated separately for each exposure pathway. The USEPA regional screening levels (RSLs) for nonradionuclides that were used to calculate risk are risk-based concentrations that are derived from standardized equations which combine all of the exposure pathways and assumptions with USEPA toxicity data. Use of the RSL provides an exposure routes total risk estimate for each constituent.

USEPA, 2016. *Regional Screening Levels* website, United States Environmental Protection Agency (May 2016) https://www.epa.gov/risk/regional-screening-levels-rsls. Website accessed May 2017.

Table 5. Industrial Worker Risk Characterization Summary – Carcinogens

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
GOSB Interior Subunit	Surface Sediment	Ingestion, Inhalation, Dermal Contact	gamma-Chlordane	NC	NC	NC	NA	1.4E-06
		Ingestion, Inhalation, Dermal Contact	Dieldrin	NC	NC	NC	NA	2.4E-06
		Ingestion, Inhalation, Dermal Contact	Heptachlor epoxide	NC	NC	NC	NA	1.9E-06
							Industrial Worker Total Cumulative Risk =	**5.7E-06**

Key:
NA = not applicable.
NC = not calculated. Risk was not calculated separately for each exposure pathway. The USEPA regional screening levels (RSLs) for nonradionuclides that were used to calculate risk are risk-based concentrations that are derived from standardized equations which combine all of the exposure pathways and assumptions with USEPA toxicity data. Use of the RSL provides an exposure routes total risk estimate for each constituent.

USEPA, 2016. *Regional Screening Levels* website, United States Environmental Protection Agency (May 2016) https://www.epa.gov/risk/regional-screening-levels-rsls. Website accessed May 2017.

Table 6. Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Yes or No)	Receptor	Endangered/ Threatened Species Flag (Yes or No)	Exposure Routes	Assessment Endpoints	Measurement Endpoints
G-Area Oil Seepage Basin (GOSB) Interior Subunit Sediment	No	Benthic organisms	No	Ingestion, respiration, and direct contact with chemicals in sediment	Protection of benthic invertebrate (sediment dwelling organisms) communities from toxic effects of contaminants to maintain species diversity, biomass, and nutrient cycling (trophic structure).	Measured concentration in sediment compared to literature-based toxicity threshold values, expressed as an HQ calculation.
G-Area Oil Seepage Basin (GOSB) Interior Subunit Surface Water	No	Aquatic organisms	No	Ingestion, respiration, and direct contact with chemicals in surface water	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.	Measured concentration in surface water compared to chronic AWQC, expressed as an HQ calculation.

Table 7. COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors

Habitat Type/ Name	Exposure Medium	RCOC (HQ)	Protective Level	Units	Basis	Assessment/ Measurement Endpoint
G-Area Oil Seepage Basin (GOSB) Interior Subunit	Sediment	alpha-Chlordane (HQ = 100)	0.017	mg/kg	HQ = 1 (LANL 2015)[1]	Protection of benthic invertebrate (sediment dwelling organisms) communities from toxic effects of contaminants to maintain species diversity, biomass, and nutrient cycling (trophic structure). Measured concentration in sediment compared to sediment toxicity threshold values, expressed as an HQ calculation.
		gamma-Chlordane (HQ = 148)	0.017	mg/kg	HQ = 1 (LANL 2015)[1]	
		DDD (HQ = 50)	0.00781	mg/kg	HQ = 1 (USEPA 2015)[3]	
		DDE (HQ = 278)	0.00374	mg/kg	HQ = 1 (USEPA 2015)[3]	
		Dieldrin (HQ = 12)	0.009	mg/kg	HQ = 1 (LANL 2015)[2]	
		Heptachlor epoxide (HQ = 12)	0.016	mg/kg	HQ = 1 (USEPA 2015)[3]	
		Silver (HQ = 40)	2.2	mg/kg	HQ = 1 (USEPA 2015)[3]	
	Surface Water	alpha-Chlordane (HQ = 9)	0.0043	µg/L	HQ = 1 (USEPA 2015)[4] (SCDHEC 2014)[5]	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. Measured concentration in surface water compared to chronic AWQC, expressed as an HQ calculation.
		gamma-Chlordane (HQ = 9)	0.0043	µg/L	HQ = 1 (USEPA 2015)[4] (SCDHEC 2014)[5]	
		Silver (HQ = 30)	0.06	µg/L	HQ = 1 (USEPA 2015)[4]	

1. Los Alamos National Laboratory Low Effect Ecological Screening Level for sediment (LANL 2015).
2. Los Alamos National Laboratory Low Effect Ecological Screening Level for soil (LANL 2015).
3. USEPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft, Table 2a, Refinement Screening Value (USEPA 2015).
4. USEPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft, Table 1a, chronic values for freshwater aquatic life (USEPA 2015).
5. SCDHEC, R61-68, Water Classification and Standards, chronic values for freshwater aquatic life (SCDHEC 2014).

Table 8. Remedial Goals

Medium	Constituent	Receptor	Human Health RGO[1] (mg/kg)	Ecological RGO[2] (mg/kg or µg/L)	Background[3] (mg/kg or µg/L)	RG[4] (mg/kg or µg/L)
Sediment	alpha-Chlordane	Resident	1.7		NA	0.017
		Benthic Organism		0.017		
	DDD	Benthic Organism		0.00781	NA	0.00781
	DDE	Resident	2		NA	0.00374
		Benthic Organism		0.00374		
	Dieldrin	Resident	0.034		NA	0.009
		Industrial Worker	0.14			
		Benthic Organism		0.009		
	gamma-Chlordane	Resident	1.7		NA	0.017
		Industrial Worker	7.7			
		Benthic Organism		0.017		
	Heptachlor epoxide	Resident	0.07		NA	0.016
		Industrial Worker	0.33			
		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

[1] human health RGO = concentration set at risk = 1E-06
[2] ecological RGO = concentration set at HQ = 1
[3] Background = range from minimum detect to maximum detect from Background Soils Statistical Summary Report for the Savannah River Site, Appendix B-2 (all depths interval) (WSRC 2006)
[4] RG = RG is the lesser of the human health or ecological RGOs
NA = not available

Table 9. ARARs for the Selected Remedial Alternative for the GOSB OU

Action	Requirements	Prerequisite	Citation
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing storm water runoff from land-disturbing activities	Must comply with the substantive requirements for stormwater management and sediment control of *NPDES General Permit No. SCR100000*.	Large and small construction activities (as defined in R. 61-9) of more than 0.40 hectare (1 acre) of land – **applicable**	S.C. R. 61-9.122.26(c) NPDES General Permit No. SCR100000
	The requirements of R.72-305 and R.72-307 will apply.	For land disturbing activities involving 0.80 ha (2 ac) or less of actual land disturbance – **applicable**	S.C. R. 72-305.B.(1)
	The stormwater management and sediment control plan shall contain at a minimum a sketched plan to accompany the narrative which shall include: a) A site location drawing of the proposed project, indicating the location of the proposed project in relation to roadways, jurisdictional boundaries, streams and rivers; b) The boundary lines of the site on which the work is to be performed; c) The location of temporary & permanent vegetative & structural stormwater management and sediment control measures.	Land disturbance activities involving 0.80 ha (2 aca) or less which are not part of a larger common plan of development or sale – **applicable**	S.C. R. 72-307 H – *South Carolina Storm Water Management and Sediment Reduction Regulations* S.C. R. 72-307 H.(5)(a) S.C. R. 72-307 H.(5)(b) S.C. R. 72-307 H.(5)(d)
Managing fugitive dust emissions from land disturbing activities	Emissions of fugitive particulate matter shall be controlled in such a manner and to the degree that it does not create an undesirable level of air pollution.	Activities that will generate fugitive particulate matter (Statewide) – **applicable**	S.C. R. 61-62.6 Section III(a)- *Control of Fugitive Particulate Matter Statewide*
Disposal of Wastes (e.g. trees, bushes, etc.)			
Disposal of *solid waste* off--SRS	Disposal of solid waste at facilities and/or sites permitted or registered by the Department for processing or disposal of that waste stream. Waste must meet state classification system for the permitted facilities NOTE: All waste generated from this remedial action will be managed as non-hazardous, due to the known characteristics of the operable unit.	Generation of solid waste intended for off-SRS disposal – **applicable**	SCDHEC R. 61-107.15

Table 9. ARARs for the Selected Remedial Alternative for the GOSB OU *(Continued)*

Action	Requirements	Prerequisite	Citation
Dewatering/Irrigation of G-Area Oil Seepage Basin Contained Stormwater			
On-site Land Application	The regulatory provisions contained in R.61-9 122 and 124 implement the National Pollutant Discharge Elimination System (NPDES) Program under sections 318, 402, and 405 of the Clean Water Act (CWA) (Public Law 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117, and Pub. L. 100-4; 33 U.S.C. 1251 et seq.) and the South Carolina Pollution Control Act, S.C. Code Ann. 48-1-10, et seq.	Land application of pollutants (including toxic substances) in the State of South Carolina – **relevant and appropriate**	S.C. R. 61-9 122.1(a)(1)
	Information Requirements: 1) Provide location of the WWTP and land disposal sites: Provide a map or maps showing the location of the WWTP and land disposal site(s). 2) Provide description of waste to be land applied: Provide a description of the wastewater or sludge to be land applied. State whether the waste is domestic and/or industrial wastewater. If the wastewater is not strictly domestic, give a detailed characterization of the wastewater. 3) Provide volume and quantity of waste to be land applied: Provide the volume in gallons per day and the quantity in pounds per day of the waste to be land applied to each disposal site. 4) Provide frequency of application: Provide the proposed frequency application in times per day, week or other period for each disposal site. 5) Provide site application rate(s): Provide the proposed application rate in inches per week, pounds per acre per day (use annual rates for crop uptake) for sludge disposal, or other units as appropriate for each disposal site, whichever is the limiting factor. 6) Provide hazardous substances: Identify whether or not the discharge contains a substance that could be considered hazardous as defined under section 101(14) of CERCLA. Provide the substance name, concentration and source.	Same as above	S.C. R. 61-9 505.21(f)(9) S.C. R. 61-9 505.21(f)(10) S.C. R. 61-9 505.21(f)(11) S.C. R. 61-9 505.21(f)(12) S.C. R. 61-9 505.21(f)(13) S.C. R. 61-9 505.21(f)(16)
	Irrigation of treated wastewater including methods of surface application, including but not limited to, fixed gun application, travelling or mobile gun application, or center pivot application.	Additional conditions applicable to specified categories of Land Application permits and State permits for irrigation of treated wastewater. **relevant and appropriate**	S.C. R. 61-9 505.42(b)

Table 9. ARARs for the Preferred Remedial Alternative for the GOSB OU *(Continued/End)*

Action	Requirements	Prerequisite	Citation
Dewatering/Irrigation of G-Area Oil Seepage Basin Contained Stormwater – cont'd			
	Spray field slopes shall not exceed 10 percent unless approved by the Department. The Department may require that slopes be less than 10% based on site conditions.	Same as above	S.C. R. 61-9 505.42(b)(1)
	The new or expanding spray field shall be at least 200 feet from surface waters of the State, occupied buildings and potable water wells. The new or expanding spray field shall be at least 100 feet from the property boundary.	Same as above	S.C. R. 61-9 505.42(b)(8)
Protection of Migratory Birds	No person may take, possess, import, export, transport, sell, purchaser, barter or offer for sale, purchase or barter, any migratory bird, or the parts, nests, or eggs of such bird except as under the terms of a valid permit.	Migratory bird populations may be present in the vicinity – **applicable**	16 USC 703-704 – *Migratory Bird Treaty Act*

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
EPA = U.S. Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act of 1976
S.C. R. = South Carolina Department of Health and Environmental Control Regulation

Table 10. Description of CERCLA Evaluation Criteria

Threshold Criteria:

- *Overall Protectiveness of Human Health and the Environment* determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
- *Compliance with ARARs* evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site. There are no ARAR RCOCs identified for media (i.e., soil, sediment, and surface water) within the GOSB OU.

Primary Balancing Criteria:

- *Long-Term Effectiveness and Permanence* considers the ability of an alternative to maintain protection of human health and the environment over time. It evaluates magnitude of residual risk and adequacy of reliability of controls.
- *Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment* evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
- *Short-Term Effectiveness* considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
- *Implementability* considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
- *Cost* includes estimated capital and annual operations and maintenance costs, as well as PW cost. PW cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

Modifying Criteria:

- *State Support/Agency Acceptance* considers whether USEPA and SCDHEC agree with the analyses and recommendations by the USDOE. Approval of the Record of Decision constitutes approval of the selected alternative by the regulatory agencies.
- *Community Acceptance* considers whether the local community agrees with the Preferred Alternative. Comments received on the Statement of Basis/Proposed Plan during the public comment period are an important indicator of community acceptance. Comments from the public are considered in the final remedy selection in the Record of Decision.

Table 11. Comparison of Alternatives Against the CERCLA Evaluation Criteria

Criteria	Alternative A-1 No Action	Alternative A-3 Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water	Alternative A-4 Backfill Basin and Manage Surface Water	Alternative A-5 Excavate and Manage Surface Water
Overall Protection of Human Health and the Environment				
Protection of Human Health	Not protective	Protective	Protective	Protective
Protection of the Environment	Not protective	Protective	Protective	Protective
Compliance with ARARs				
Chemical-specific	Not preferred	None identified	None identified	None identified
Action-specific	Not preferred	Compliant	Compliant	Compliant
Location-specific	Not preferred	Compliant	Compliant	Compliant
Long-Term Effectiveness and Permanence				
Magnitude of Residual Risks	Not applicable. Risk remains unchanged.	Effective in reducing risk of exposure to contaminated media by breaking exposure pathway.	Effective in reducing risk of exposure to contaminated media by breaking exposure pathway.	Risks are removed by complete removal of contaminated media.
Adequacy of Controls	Not adequate	Adequate	Adequate	Adequate
Permanence	Not permanent	Permanent	Permanent	Permanent
Reduction of Toxicity, Mobility, or Volume Through Treatment				
Treatment Process	No treatment	No treatment	No treatment	No treatment
Degree of Expected Reduction in Toxicity, Mobility, or Volume	None	None	None	None
Short-Term Effectiveness				
Risk to Remedial Workers	Not applicable; no remedial action involved	None	Remedial workers managing surface water would be exposed to contaminated media.	Remedial workers removing sediment and managing surface water would be exposed to contaminated media.
Risk to Community	Not applicable; no remedial action involved	None	None.	None
Risk to Environment	Not applicable; no remedial action involved	None	None	None
Estimated Time Frame to Achieve RAOs or RGs	Not applicable; no remedial action involved	Months	Months	Months

Table 11. Comparison of Alternatives Against the CERCLA Evaluation Criteria *(Continued/End)*

Criteria	Alternative A-1	Alternative A-3	Alternative A-4	Alternative A-5
	No Action	**Place 0.6-m (2-ft) Clean Fill Layer and Manage Surface Water**	**Backfill Basin and Manage Surface Water**	**Excavate and Manage Surface Water**
Implementability				
Availability of materials, equipment, and skilled labor	No implementation	Readily implemented	Readily implemented	Readily implemented
Ability to construct and operate remedial technology	Not Applicable	Readily available	Readily available	Readily available
Ability to obtain permits/approvals from Agencies	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Ease of undertaking additional actions	Compatible	Compatible	Compatible	Compatible
Time to implement	Readily Implementable	Months	Months	Months
Cost				
Total Present-Worth Costs	$0	$3,071,600	$1,827,100	$1,715,900
State Support/Agency Acceptance	Not acceptable	Not preferred	Acceptable	Not preferred
Community Acceptance	Not acceptable	Not preferred	Acceptable	Not preferred

Table 12. Comparative Alternative Analysis for the 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 Score (1-16)
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	($3.1M)	9
A-4 Backfill Basin and Manage Surface Water	Yes	Yes	3	1	4	2	($1.8M)	10
A-5 Excavate and Manage Surface Water	Yes	Yes	4	1	1	1	($1.7M)	7

Table 13. Summary of Present-Value Costs for the Selected Remedy

GOSB Interior Alternative A-4 – Backfill Basin and Manage Surface Water

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Subcontractor Mobilization/Demobilization	1	ea.	$ 29,010.00	$ 29,010.00
Site Surveys	1	ea.	$ 4,325.00	$ 4,325.00
Clearing	0.67	acres	$ 4,197.00	$ 2,811.99
Access Road Improvements	3,200	linear feet	$ 33.96	$ 108,672.00
Dewatering of 415,000 gals of Rainwater	415,000	gals	$ 0.60	$ 249,000.00
Install BMPs	1,000	ft	$ 5.00	$ 5,000.00
Excavation of Berms and Stockpiling	334	BCY	$ 9.53	$ 3,183.02
Clean Fill/Top Soil Sampling & Analyses	2	ea.	$ 1,500.00	$ 3,000.00
Hauling/Placement/Compaction of Backfill from SRS Borrow	5,200	BCY	$ 20.72	$ 107,744.00
Compaction Testing/Reporting	15	hrs	$ 150.00	$ 2,250.00
Hauling/Placement of Top Soil from off SRS	300	CY	$ 35.00	$ 10,500.00
Sod Installation	1,700	yd^2	$ 5.00	$ 8,500.00
Subtotal – Direct Capital Cost				$ 533,996.00
Mobilization/Demobilization	25%	of subtotal direct capital		$ 133,499.00
Site Preparation/Site Restoration	25%	of subtotal direct capital		$ 133,499.00
Total Direct Capital Cost				**$ 800,994.00**
Indirect Capital Costs				
Engineering & Design	14%	of direct capital		$ 112,139.00
Project/Construction Management	25%	of direct capital		$ 200,249.00
Health & Safety	6%	of direct capital		$ 48,060.00
Overhead	30%	of direct capital + indirect capital		$ 348,432.00
Contingency	20%	of direct capital + indirect capital		$ 301,975.00
Total Indirect Capital Cost				**$ 1,010,854.00**
Total Estimated Capital Cost				**$ 1,811,848.00**
Direct O&M Costs	-0.3%	Real Interest Rate from OMB Circular No. A-94[2]		
Annual Costs (Existing System during Post-ROD Design & Const.)	5	years O&M		
Access Controls	1	ea.	$ 750.00	$ 750.00
Subtotal – Annual Costs				$ 750.00
Present-Worth Annual Costs (-0.3% Discount Rate)				$ 3,784.00
Total Present-Worth Direct O&M Cost				**$ 3,784.00**
Indirect O&M Costs				
Project/Admin Management	151%	of direct O&M		$ 5,714.00
Health & Safety	18%	of direct O&M		$ 681.00
Overhead	30%	of direct O&M + indirect O&M		$ 3,054.00
Contingency	15%	of direct O&M + indirect O&M		$ 1,985.00
Total Present-Worth Indirect O&M Cost				**$ 11,434.00**
Total Estimated Present-Worth O&M Cost				**$ 15,217.00**
TOTAL ESTIMATED COST				**$ 1,827,066.00**

1. Managing the surface water includes dewatering the basin prior to excavation and constructing and spray field
2. Interest rate from OMB Circular No. A-94 (December 12, 2016)

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APPENDIX A

RESPONSIVENESS SUMMARY

Responsiveness Summary

The 45-day public comment period for the *Statement of Basis/Proposed Plan for the G-Area Oil Seepage Basin (761-13G) Operable Unit* began on November 28, 2018, and ended on January 11, 2019.

Public Comments

No comments were received from the public.

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APPENDIX B

SPRAY IRRIGATION TO LAND SURFACE RISK EVALUATION

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The RFI/RI/BRA/CMS/FS (SRNS 2018) identified only ecological refined constituents of concern (RCOCs) in the surface water media within the Basin Interior subunit of the GOSB. Based on a comparison to maximum contaminant levels (MCLs), no human health (HH) RCOCs for surface water nor contaminant migration to groundwater concerns were identified. Therefore, land application of the GOSB surface water does not pose a contaminant migration to groundwater concern.

Ecological (ECO) RCOCs were identified in surface water media due to an unacceptable risk potential to aquatic organisms. Since land application of the surface water media will be conducted in such a manner as to prevent any surface runoff from entering or leaving the spray irrigation site, the threshold levels to protect aquatic organisms are no longer applicable (i.e., will not impact another surface water body). However, application of the surface water to the land surface introduces a potential risk concern to both human and terrestrial ecological receptors based on direct exposure to the soil media that needs to be evaluated. Table B1, as explained below, presents the Spray Irrigation Evaluation: Projected Soil Concentrations Compared to Human Health and Ecological Threshold Levels.

The evaluation employs a very conservative approach. The maximum detected concentration of each constituent in the GOSB surface water is used to estimate constituent concentrations in the soil media following land application of the water. The evaluation assumes that the concentration measured in the water would be found in the soil media (i.e., mg/L [ppm] water = mg/kg [ppm] soil). This is considered a conservative, worst-case scenario since any concentration adjustments in the soil media due to chemical or physical processes are not considered.

For the HH evaluation, the projected soil concentrations are compared to the residential Regional Screening Levels (RSLs) for soil media (USEPA 2018). No constituent concentrations exceeded the residential RSL. For the ECO evaluation, the projected soil concentrations are compared to the ecological refinement screening values (RSVs) for soil media from Appendix D, Ecological Risk Assessment, presented in the RFI/RI/BRA/CMS/FS for the GOSB OU (SRNS 2018). No constituents exceeded the ecological RSV for terrestrial receptors. Therefore, land application of the GOSB surface water does not pose a threat to human or ecological receptors. The concentrations of the RCOCs in surface water (prior to land application) that would be protective of human and ecological receptors for soil media after land application are derived in Table B2 and summarized below:

Protective concentration of alpha-chlordane = 1.7 mg/L (ppm); maximum detect in surface water = 0.000222 mg/L

Protective concentration of gamma-chlordane = 1.7 mg/L (ppm); maximum detect in surface water = 0.000234 mg/L

Protective concentration of silver = 26 mg/L (ppm); maximum detect in surface water = 0.299 mg/L

SRNS 2018. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment and Corrective Measures Study for the G-Area Oil Seepage Basin (GOSB) (U),* Rev. 1, SRNS-RP-2017-00281, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USEPA 2018. *USEPA Regional Screening Levels,* U.S. Environmental Protection Agency, May 2018, https://www.epa.gov/risk/regional-screening-levels-rsls

Table B1. Spray Irrigation Evaluation: Project Soil Concentrations Compared to Human Health and Ecological Threshold Levels

Analyte	Maximum Result Surface Water[1]	Maximum Result Surface Water Conversion[2]	Projected Soil Concentration[3]	Human Health Residential RSL[4]	Projected Soil Concentration > HH RSL?	Ecological RSV[5]	Projected Soil Concentration > ECO RSV?
	(µg/L)	(mg/L)	(mg/kg)			(mg/kg)	
Inorganics							
Aluminum	3.32E+04	3.32E+01	3.32E+01	7.70E+04	no	NA	no
Antimony	3.62E+00	3.62E-03	3.62E-03	3.10E+01	no	2.40E+01	no
Barium	3.05E+02	3.05E-01	3.05E-01	1.50E+04	no	2.60E+02	no
Beryllium	1.40E+00	1.40E-03	1.40E-03	1.60E+02	no	2.50E+01	no
Cadmium	2.31E+01	2.31E-02	2.31E-02	7.10E+01	no	2.70E+00	no
Calcium	1.35E+04	1.35E+01	1.35E+01	NA[6]	no	NA[6]	no
Chromium	1.47E+02	1.47E-01	1.47E-01	3.00E-01	no	2.80E+02	no
Cobalt	1.36E+01	1.36E-02	1.36E-02	2.30E+01	no	1.30E+02	no
Copper	8.05E+02	8.05E-01	8.05E-01	3.10E+03	no	4.60E+01	no
Cyanide	5.27E+00	5.27E-03	5.27E-03	2.30E+01	no	1.00E+00	no
Iron	2.55E+04	2.55E+01	2.55E+01	5.50E+04	no	NA	no
Lead	1.31E+02	1.31E-01	1.31E-01	4.00E+02	no	2.80E+01	no
Magnesium	2.08E+03	2.08E+00	2.08E+00	NA[6]	no	NA[6]	no
Manganese	3.40E+02	3.40E-01	3.40E-01	1.80E+03	no	1.10E+03	no
Mercury	2.37E-01	2.37E-04	2.37E-04	1.10E+01	no	3.50E-03	no
Nickel	1.28E+02	1.28E-01	1.28E-01	8.20E+02	no	1.90E+01	no
Potassium	5.53E+03	5.53E+00	5.53E+00	NA[6]	no	NA[6]	no
Silver	2.99E+02	2.99E-01	2.99E-01	3.90E+02	no	2.60E+01	no
Sodium	8.70E+03	8.70E+00	8.70E+00	NA[6]	no	NA[6]	no
Vanadium	6.88E+01	6.88E-02	6.88E-02	3.90E+02	no	NA[6]	no
Zinc	3.80E+03	3.80E+00	3.80E+00	2.30E+04	no	4.80E+02	no
Organics							
Acetone	4.02E+00	4.02E-03	4.02E-03	6.10E+04	no	6.30E+00	no
Caprolactam	3.64E+01	3.64E-02	3.64E-02	3.10E+04	no	NA[6]	no
Toluene	5.06E+00	5.06E-03	5.06E-03	4.90E+03	no	2.30E+02	no
Pesticides/PCBs							
Alpha-Chlordane	2.22E-01	2.22E-04	2.22E-04	1.70E+00	no	2.70E+00	no
Alpha-Benzene Hexachloride	1.23E-02	1.23E-05	1.23E-05	2.10E-01	no	5.80E+02	no
Beta-Benzene Hexachloride	3.48E-02	3.48E-05	3.48E-05	2.10E-01	no	1.30E+00	no
DDD	4.08E-02	4.08E-05	4.08E-05	1.90E+00	no	3.30E-02	no
DDE	8.04E-02	8.04E-05	8.04E-05	2.00E+00	no	5.50E-01	no
DDT	2.28E-02	2.28E-05	2.28E-05	1.90E+00	no	2.20E-01	no
Dieldrin	1.16E-02	1.16E-05	1.16E-05	3.40E-02	no	9.00E-03	no
Gamma-Chlordane	2.34E-01	2.34E-04	2.34E-04	1.70E+00	no	2.20E+01	no

1 Maximum detected concentration in GOSB Interior Subunit, surface water media
2 Surface water conversion from ug/L to mg/L
3 Projected soil concentration assumes 1 mg/L (ppm) water = 1 mg/kg (ppm) soil
4 HH residential RSL for soil media from USEPA Regional Screening Levels table, May 2018
5 ECO refinement screening value (RSV) for soil media from Appendix D of the RFI/RI/BRA/CMS/FS for the GOSB OU (SRNS-RP-2017-00218) April 2018
6 NA = not available, a screening threshold level is not available for this constituent

Table B2. Protective Levels for RCOCs in Surface Water

RCOC[1]	HH RSL[2]	ECO RSV[3]	Lesser of RSL/RSV	Surface Water Threshold[4]
	(mg/kg)			*(mg/L)*
alpha-Chlordane	1.70E+00	2.70E+00	1.70E+00	1.70E+00
gamma-Chlordane	1.70E+00	2.20E+01	1.70E+00	1.70E+00
Silver	3.90E+02	2.60E+01	2.60E+01	2.60E+01

1 Surface water RCOCs identified in RFI/RI/BRA/CMS/FS for the GOSB OU

2 Human Health (residential) regional screening level for soil media (USEPA 2018)

3 Ecological refinement screening value for soil media (SRNS 2018)

4 Surface water threshold assumes concentration in surface water (mg/L) = concentration in soil (mg/kg).

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