ARF-021429

Savannah River
NUCLEAR SOLUTIONS℠
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

Fifth Five-Year Remedy Review Report for Savannah River Site Operable Units with Geosynthetic or Stabilization/Solidification Cover Systems (U)

Aiken, South Carolina

SRNS-RP-2016-00610

Revision 1.1

December 2017

RECEIVED
FEB 20 2018
SITE ASSESSMENT,
REMEDIATION &
REVITALIZATION

SAVANNAH RIVER SITE • AIKEN, SOUTH CAROLINA

DISCLAIMER

Printed in the United States of America

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

2/12/18
Date

A. A. Holmes
Angelia A. Holmes
Acting Assistant Manager for Infrastructure
and Environmental Stewardship
U. S. Department of Energy
Savannah River Operations Office

3/1/18
Date

Daphne G. Neel
Daphne G. Neel
Bureau Chief
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control

3/7/18
Date

Franklin E. Hill
Director
Superfund Division
U. S. Environmental Protection Agency - Region 4

This page is intentionally left blank.

EXECUTIVE SUMMARY

This document presents the results of a technical evaluation of fifteen environmental remedies that implemented geosynthetic or stabilization/solidification cover systems at Savannah River Site (SRS). The remedies are evaluated to determine whether they are functioning as designed and whether they are protective of human health and the environment. This evaluation is required under Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. CERCLA requires that remedial actions that result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a remedy review every five years.

Previous five-year remedy review reports combined all SRS operable units (OUs) that had implemented a remedial action into a single document. A recommendation was made by SRS in the Fourth Five-Year Remedy Review Report that future reviews should be conducted in phases based on OU groupings with similar remedies. This phased approach not only reduces the volume of future remedy reports, but also is more effective in identifying and resolving issues for similar remedies. For this reason, the Fifth Five-Year Remedy Review Report will be conducted in five phases with OUs grouped by the following remedy types: (1) native soil covers and/or land use controls; (2) groundwater; (3) engineered cover systems; (4) geosynthetic or stabilization/solidification systems; and (5) operating equipment. This report presents the fourth phased review for fifteen SRS OUs that selected geosynthetic or stabilization/solidification cover systems as the final remedy.

According to the data reviewed and the site inspections, the fifteen remedies evaluated in this report are functioning as intended. The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid. No new information has come to light that calls into question the protectiveness of any of the remedies evaluated. The fifteen remedies have been determined to be protective of human health and the environment.

This report presents the issues and recommendations that have resulted from the remedy review. SRS identified the following recommendation:

- SRS recommends redeveloping the BMW wells at B-Area OU prior to the next sampling event in order to decrease the turbidity in the wells and provide more accurate groundwater measurements, followed by filtering of samples and speciation as needed for radionuclides.

- SRS recommends reevaluation of the installation and maintenance activities for stormwater runoff covers for the E-Area Low-Level Waste Facility (LLWF). Interim stormwater runoff covers at the E-Area LLWF slit trench disposal units are showing signs of wear that are likely to result in higher than anticipated maintenance costs and installation modifications for new covers in the future. Continued discussion with U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) of how these activities impact future covers is needed.

- SRS recommends reducing the analyte list for P-Area OU (PAOU) to radionuclides that have the fastest travel times as predicted by the model (i.e., carbon-14, chlorine-36, technetium-99). An evaluation of the contaminant migration constituents of concern (CMCOCs) that were included as part of the groundwater monitoring to verify the effectiveness of the *in situ* decommissioning remedy was conducted. Ten radionuclides and lead are identified as CMCOCs. However, none of these radionuclides are predicted to impact groundwater before the year 2230, and many are not predicted to impact groundwater over 1,000 years. Many of the radionuclides require specialized analytical methods. All results from the first quarter 2012 sampling event were non-detect. The change to the monitoring strategy will be documented in an addendum to the PAOU Effectiveness Monitoring Plan.

- SRS recommends that Appendix A of the SRS Federal Facility Agreement (FFA) Annual Progress Report be revised to include the E-Area LLWF and F-Area Tank Farm OUs to demonstrate long term protectiveness through the SRS facility security and administrative controls. The report is required by the FFA and includes an annual certification by the U.S. Department of Energy SRS Site Manager that the listed OUs are in compliance with land use requirements.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site Name: Savannah River Site

EPA ID: SC1890008989

Region: 4	**State: SC**	**City/County:** Aiken/Aiken

SITE STATUS

NPL Status: Final

Multiple OUs?: Yes	**Has the Site achieved Construction Completion?:** No

REVIEW STATUS

Lead Agency: Other Federal Agency
If "Other Federal Agency" was selected above, enter Agency Name:
U.S. Department of Energy

Author Name (Federal or State Project Manager: N/A

Author Affiliation: Savannah River Nuclear Solutions, LLC

Review Period: May 1, 2016 – January 21, 2018 (Phase 4: SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems)

Date of Site Inspections: August 2016 - November 2016 (Phase 4: SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems)

Type of Review: Statutory

Review Number: 5

Triggering Action Date: January 21, 2014

Due Date (Five Years after Triggering Action Date): January 21, 2019 (includes all 5 Phases)

ISSUES/RECOMMENDATIONS

OU(s) without Issues/Recommendations Identified in the Five-Year Review

CERCLIS #: 16, 17, 32, 43, 55, 60, 65, 66, 67, 96

Issues and Recommendations Identified in the Five-Year Review

OU(s): 23	**Issue Category**: Reporting
	Issue: Unit specific LUCs for the F-Area Tank Farm (FTF) OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) have been deferred until final closure of the entire FTF OU. SRS facility security and administrative controls that restrict unauthorized access to the FTF OU were not previously recognized as part of the interim remedy. Therefore, the interim remedy was not considered as long-term protective.
	Recommendation: Revise the FFA Annual Progress Report to include the FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls.

Five-Year Review Summary Form *(continued)*

<table>
<tr><th colspan="5">ISSUES/RECOMMENDATIONS</th></tr>
<tr><th colspan="5">Issues and Recommendations Identified in the Five-Year Review</th></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Federal Facility</td><td>USEPA/SCDHEC</td><td>September 2018</td></tr>
<tr><td rowspan="3">OU(s): 48</td><td colspan="4">Issue Category: Monitoring</td></tr>
<tr><td colspan="4">Issue: Elevated gross alpha concentrations were detected in the BMW groundwater wells at the B-Area OU likely due to turbidity issues.</td></tr>
<tr><td colspan="4">Recommendation: Redevelop the BMW wells prior to the next sampling event to reduce turbidity, followed by filtering the samples and speciation, as needed, for radionuclides.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Federal Facility</td><td>USEPA/SCDHEC</td><td>Third Quarter of 2021</td></tr>
<tr><td rowspan="3">OU(s): 86</td><td colspan="4">Issue Category: Monitoring</td></tr>
<tr><td colspan="4">Issue: Interim stormwater runoff covers at the E-Area LLWF slit trench disposal units are showing signs of wear that are likely to result in higher than anticipated maintenance costs and installation modifications for new covers in the future.</td></tr>
<tr><td colspan="4">Recommendation: Revaluate the installation and maintenance activities for stormwater runoff covers. Further discussion of how these issues impact future covers is needed with USEPA/SCDHEC.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Federal Facility</td><td>USEPA/SCDHEC</td><td>N/A</td></tr>
<tr><td rowspan="3">OU(s): 86</td><td colspan="4">Issue Category: Reporting</td></tr>
<tr><td colspan="4">Issue: Unit specific LUCs for the E-Area LLWF (Slit Trench Disposal Units 1-5) have been deferred until final closure of the entire E-Area LLWF. SRS facility security and administrative controls that restrict unauthorized access to the E-Area LLWF were not previously recognized as part of the interim remedy. Therefore, the interim remedy was not considered as long-term protective.</td></tr>
<tr><td colspan="4">Recommendation: Revise the FFA Annual Progress Report to include the E-Area LLWF (Slit Trench Disposal Units 1-5) to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>No</td><td>No</td><td>Federal Facility</td><td>USEPA/SCDHEC</td><td>September 2018</td></tr>
</table>

Five-Year Review Summary Form *(continued)*

ISSUES/RECOMMENDATIONS				
Issues and Recommendations Identified in the Five-Year Review				
OU(s): 94	**Issue Category**: Monitoring			
	Issue: Ten radionuclides identified as CMCOCs for the P-Area OU are not predicted to impact groundwater before the year 2230. Many of these radionuclides require specialized analytical methods.			
	Recommendation: Reduce analyte list to radionuclides that have the fastest travel times as predicted by the groundwater model (i.e., carbon-14, chlorine-36, technetium-99).			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Federal Facility	USEPA/SCDHEC	September 2018

PROTECTIVENESS STATEMENT(S)		
Operable Unit: B-Area Operable Unit (BAOU), CERCLIS #48	***Protectiveness Determination:*** Protective	***Addendum Due Date (if applicable):*** N/A
Protectiveness Statement: The remedy at the BAOU is protective of human health and the environment.		
Operable Unit: C-Area Reactor Seepage Basins (CRSB) (904-66G and 904-68G) OU, CERCLIS #60	***Protectiveness Determination:*** Protective	***Addendum Due Date (if applicable):*** N/A
Protectiveness Statement: The remedy at the CRSB OU is protective of human health and the environment.		
Operable Unit: D-Area Expanded Operable Unit (DEXOU) [Consisting of D-Area Ash Basin (488-D) and D-Area Rubble Pit (431-2D)], CERCLIS #67	***Protectiveness Determination:*** Protective	***Addendum Due Date (if applicable):*** N/A
Protectiveness Statement: The remedy at the DEXOU is protective of human health and the environment.		
Operable Unit: E-Area Low-Level Waste Facility (LLWF) (643-26E), CERCLIS #86	***Protectiveness Determination:*** Short-term Protective	***Addendum Due Date (if applicable):*** N/A
Protectiveness Statement: The remedy at the E-Area LLWF is protective of human health and the environment.		
Operable Unit: F-Area Retention Basin (FRB) (281-3F) OU, CERCLIS #23	***Protectiveness Determination:*** Protective	***Addendum Due Date (if applicable):*** N/A
Protectiveness Statement: The remedy at the FRB OU is protective of human health and the environment.		

Five-Year Review Summary Form *(continued)*

<table>
<tr><th colspan="3">PROTECTIVENESS STATEMENT(S)</th></tr>
<tr><td><i>Operable Unit:</i>
F-Area Tank Farm (FTF) OU, CERCLIS #23</td><td><i>Protectiveness Determination:</i>
Short-term Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the FTF OU (Waste Tanks 5, 6, 17, 18, 19, and 20) is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
General Separations Area Consolidation Unit (GSACU) [Including Old Radioactive Waste Burial Ground (ORWBG) (643-E) and Old Solvent Tanks (OST) (650-1E through 650-22E)], CERCLIS #32</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the GSACU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
K-Area Reactor Seepage Basin (KRSB) OU (904-65G), CERCLIS #55</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the KRSB OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
L-Area Oil and Chemical Basin (LAOCB) OU (904-83G and 904-79G), CERCLIS #17</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the LAOCB OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
L-Area and C-Area Reactor Seepage Basins (LRSB and CRSB) OU (904-64G and 904-67G), CERCLIS #65, 60</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the LRSB and CRSB OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
Old F-Area Seepage Basin (OFASB) OU (904-49G), CERCLIS #16</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the OFASB OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
P-Area Operable Unit (PAOU), CERCLIS #94</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the PAOU is protective of human health and the environment.</td></tr>
</table>

Five-Year Review Summary Form *(continued/end)*

<table>
<tr><th colspan="3">PROTECTIVENESS STATEMENT(S)</th></tr>
<tr><td><i>Operable Unit:</i>
P-Area Reactor Seepage Basins (PRSB) OU (904-61G, 904-62G, and 904-63G), CERCLIS #66</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the PRSB OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
R-Area Burning/Rubble Pits (131-R and 131-1R) and R-Area Rubble Pile (631-25G) (RBRP/RRP) OU, CERCLIS #43</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the RBRP/RRP OU is protective of human health and the environment.</td></tr>
<tr><td><i>Operable Unit:</i>
T-Area Operable Unit (TAOU), CERCLIS #96</td><td><i>Protectiveness Determination:</i>
Protective</td><td><i>Addendum Due Date (if applicable):</i>
N/A</td></tr>
<tr><td colspan="3"><i>Protectiveness Statement:</i>
The remedy at the TAOU is protective of human health and the environment.</td></tr>
</table>

This page is intentionally left blank.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
488-DAB	488-D Ash Basin
AEA	Atomic Energy Act
ARRA	American Recovery and Reinvestment Act of 2009
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BAOU	B-Area Operable Unit
BGC	Burial Ground Complex
BRA	Baseline Risk Assessment
CCRTs	Cask Car Railroad Tracks
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
Ci	Curies
cm	Centimeter or centimeters
CM	contaminant migration
cm/s	centimeter per second
CMI/RAIP	Corrective Measures Implementation/Remedial Action Implementation Plan
CMIR	Corrective Measures Implementation Report
CMS/FS	Corrective Measures Study/Feasibility Study
COC	constituent of concern
CRSB	C-Area Reactor Seepage Basins (904-66G, 904-67G, and 904-68G)
+D	plus daughter
DCPRB	D-Area Coal Pile Runoff Basin (489-D)
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEXOU	D-Area Expanded Operable Unit
DNAPL	Dense non-aqueous phase liquid
DRP	D-Area Rubble Pit (431-2D)
DSVA	Dead and Stressed Vegetation Area
EAROD	Early Action Record of Decision
EC&ACP	Environmental Compliance and Area Completion Projects
ECA	Environmental Compliance Authority
ECO	ecological
ECODS	Early Construction and Operational Disposal Sites

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

EIS	Environmental Impact Statement
EMP	Effectiveness Monitoring Plan
ESD	Explanation of Significant Difference
FFA	Federal Facility Agreement
FRB	F-Area Retention Basin (281-3F)
FRR	Final Remediation Report
ft	foot or feet
ft^3	cubic foot or cubic feet
FTF	F-Area Tank Farm
FY	fiscal year
gal	Gallon or gallons
GSA	General Separations Area
GSACU	General Separations Area Consolidated Unit
HAZWOPER	hazardous waste operations
HCA	High Contamination Area
HH	human health
HH-res	human health resident only
HQ	hazard quotient
HRB	H-Area Retention Basin (281-3H)
HTF	H-Area Tank Farm
HWCTR	Heavy Water Components Test Reactor (770-U)
in	inch or inches
IPSL	inactive process sewer lines
IRA	interim remedial action
IROD	Interim Record of Decision
ISD	in situ decommissioning
KRSB	K-Area Reactor Seepage Basin (904-65G)
km	Kilometer or kilometers
km^2	square kilometer or square kilometers
L	Liter or liters
LAACB	L-Area Acid/Caustic Basin (904-79G)
LAHS	L-Area Hot Shops (717-G)
LAOCB	L-Area Oil and Chemical Basin (904-83G)
LASG	L-Area Southern Groundwater
lbs	pounds
LDG	Lower Discharge Gully
LLC	Limited Liability Company
LLWF	Low-Level Waste Facility
LOAEL	lowest observe adverse effects level
LRSB	L-Area Reactor Seepage Basin (904-64G)

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

LUC	land use control
LUCAP	Land Use Controls Assurance Plan
LUCIP	Land Use Controls Implementation Plan
m	Meter or meter
m^3	cubic meter or cubic meters
MCL	maximum contaminant level
mi	mile or miles
mi^2	square mile or square miles
µg/kg	microgram per kilogram
µg/L	microgram per Liter
mg/kg	milligram per kilogram
MCL	maximum contaminant level
MNA	monitored natural attenuation
msl	mean sea level
MWMF	Mixed Waste Management Facility
MZ	mixing zone
N/A	not applicable
NBN	no building number
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	non-detect
NFA	No Further Action
NOU	Notice of Unacceptability
NPL	National Priorities List
NRDC	National Resources Defense Council
NTCR	non-time critical removal
O&M	operation and maintenance
OD	Outfall Delta
OFASB	Old F-Area Seepage Basin (904-49G)
ORWBG	Old Radioactive Waste Burial Ground (643-E)
OSR	Off-Site Rule
OST	Old Solvent Tanks
OU	operable unit
PA	Performance Assessment
PAGW	P-Area Groundwater
PAH	polyaromatic hydrocarbons
PAOU	P-Area Operable Unit
PAR	P and R
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
ρCi/g	picoCuries per gram
ρCi/mL	picoCuries per milliliter
ρCi/L	picoCuries per liter

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

PCR	Post Construction Report
PRG	Preliminary Remediation Goal
PRSB	P-Area Reactor Seepage Basin (904-61G, 904-62G, 904-63G)
PSA	Potential Source Area
psi	pounds per square inch
PSL	process sewer line
PTSM	principal threat source material
RAO	remedial action objective
RAR	Removal Action Report
RBC	risk-based concentrations
RBRP	R-Area Burning Rubble Pit (131-R and 131-1R)
RCOC	refined constituent of concern
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RG	remedial goal
RGO	remedial goal option
RI	Remedial Investigation
ROD	Record of Decision
RRP	R-Area Rubble Pile (631-25G)
RSER/EE/CA	Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis
RSL	regional screening level
S/S	Stabilization/Solidification
SARA	Superfund Amendments and Reauthorization Act of 1986
SCA	soil contamination area
SCDHEC	South Carolina Department of Health and Environmental Control
SOF	sum-of-fractions
SPRG	Surface Preliminary Remediation Goals
SRR	Savannah River Remediation, LLC
SRS	Savannah River Site
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions, LLC
SSHASP	site-specific health and safety plan
SVE	soil vapor extraction
SWM	Solid Waste Management
TAOU	T-Area Operable Unit
TBG	TNX Burying Ground
TCE	trichloroethylene
TER	Technical Evaluation Report
UCS	unconfirmed compressive strength
URMA	underground radiological materials area
USDOE	United States Department of Energy

LIST OF ACRONYMS AND ABBREVIATIONS *(continued/end)*

USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WSRC	Washington Savannah River Company
WSRC	Westinghouse Savannah River Company
yd	yard or yards
yd^3	cubic yard or cubic yards

This page is intentionally left blank.

SAVANNAH RIVER SITE SUMMARY

I. INTRODUCTION

Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a five-year remedy review. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) further provides that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure be reviewed every five years to ensure protection of human health and the environment. The purpose of five-year remedy reviews is to evaluate the implementation and performance of the selected remedy at an operable unit (OU) to determine if the remedy is protective of human health and the environment. The evaluation of the remedy and the determination of protectiveness should be based on and sufficiently supported by data and visual inspections. The methods, findings, and conclusions of remedy reviews are documented in Five-Year Remedy Review Reports. The reports also identify any issues found during the review and provides recommendations to address the issues.

The U.S. Department of Energy (USDOE) prepared this fifth five-year remedy review for Savannah River Site (SRS) OUs that selected geosynthetic or stabilization/solidification (S/S) cover systems as the remedial action pursuant to CERCLA Section 121 and as amended by SARA and the NCP. During implementation of the five-year remedy review process at the SRS, the U.S. Environmental Protection Agency (USEPA), the South Carolina Department of Health and Environmental Control (SCDHEC), and the USDOE recognized that remedial action decision document(s) would be issued for multiple OUs. Rather than generate individual five-year remedy review reports for each OU, the USDOE and regulatory agencies determined that it would be more cost effective to conduct a remedy review for all applicable OUs on the same five-year cycle. The First Five-Year

Remedy Review was issued in August 1997 (WSRC 1997) and evaluated 23 remedy decision documents. The Second Five-Year Remedy Review was issued in February 2004 (WSRC 2003) and evaluated 30 remedy decision documents. Forty-five remedy decision documents were evaluated in the Third Five-Year Remedy Review issued in January 2009 (WSRC 2008). The Fourth Five-Year Remedy Review was issued in February 2014 (SRNS 2014) and evaluated 52 remedy decision documents.

The size of each report has grown considerably since 1997 due to the number of OU remedies evaluated, and the level of detail required for data reviews, site inspection reporting, and document formatting based on USEPA guidance. To allow for a more even distribution of resources, a recommendation was made by SRS in the Fourth Five-Year Remedy Review Report (SRNS 2014) that future reviews should be conducted in phases based on OU groupings with similar remedies. In addition to a reduction in the total volume for future remedy review reports, evaluating similar remedies in the same review period would support easier identification and resolution of similar issues and allow for more efficient implementation of similar initiatives. The USDOE, USEPA, and SCDHEC agreed to segregate the Fifth Five-Year Remedy Review Report into five OU groupings (grouped by remedy similarity) with a different group submitted annually on a five-year cycle. The SRS OUs are grouped by the following remedy types:

(1) Native Soil Covers and/or Land Use Controls (LUCs);
(2) Groundwater;
(3) Engineered Cover Systems;
(4) Geosynthetic or Stabilization/Solidification Cover Systems; and
(5) Operating Equipment.

The trigger date for submittal of the next five-year remedy review report to the regulatory agencies is based on the USEPA signature date of the previous report. The final signature for the last grouping of Fifth Five-Year Remedy Review Report is due no later than January 21, 2019. Prior to implementing the five annual remedy review submittals, a transitional period is necessary to prevent exceeding the five-year limit required between decision document reviews in order to remain in compliance with CERCLA and the NCP. Issuance dates for the Fifth Five-Year Remedy Review Report during the transitional period will occur over a four-year period (2016 to 2019). The first five-year phased report for native soil covers and/or LUCs was issued in 2015 (SRNS 2015a). The second five-year phased report for groundwater remedial actions was issued in 2017 (SRNS 2015b). A more detailed discussion of the phased reviews and transition schedule are provided in Appendix A.

This report documents the Fifth Five-Year Remedy Review for the fourth grouping of OUs with geosynthetic or S/S cover systems selected as the remedy and includes a review of fifteen remedy decision documents for sixteen USEPA Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) units at the SRS. CERCLIS is a database maintained by the USEPA as part of the Superfund program that assigns a unique tracking number to hazardous waste sites considered for cleanup under CERCLA. Remedy decision documents may include more than one CERCLIS unit and/or SRS OU. For this remedy review, the sixteen CERCLIS units are equivalent to the fifteen remedy decision documents reviewed.

The SRS OUs evaluated in this document were grouped together because of similar remedies. Table 1 identifies the OU name, CERCLIS number, remedial action(s), and issuance date of the remedy decision document for each of the OUs reviewed in this document. The issuance date represents the date the public was notified that the signed remedy decision document was available. Figure 1 identifies the location of the SRS OUs evaluated in this document. The data evaluation and visual inspections for the SRS OUs with geosynthetic or S/S cover system remedies were conducted from August 2016 through November 2016.

This report was prepared using the Comprehensive Five-Year Review Guidance (USEPA 2001) and is supplemented by the Recommended Evaluation of Institutional Controls: Supplement to the “Comprehensive Five-Year Review Guidance” (USEPA 2011a) and Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews (USEPA 2012). The updated USEPA 5-Year Review Summary Form was implemented (USEPA 2011b). This report summarizes common elements for the entire SRS. The fifteen remedy reviews are included as Appendix C through Appendix Q.

II. SITE CHRONOLOGY

The National Resources Defense Council (NRDC) Consent Decree (Civil Action No. 1:85-2583-6) was an agreement between the NRDC and other interested parties, SCDHEC, and USDOE to amend Parts A and B of the Resource Conservation and Recovery Act (RCRA) Permit Application to include the Metallurgical Laboratory Basin (904-11G) and associated Carolina Bay, the Acid/Caustic Basin (904-74G, 904-75G, 904-78G, and 904-80G), and the Mixed Waste Management Facility (904-28G) to include closure, groundwater monitoring and post-closure activities. The Savannah River Laboratory Seepage Basins (904-53G, 904-54G, and 904-55G) and New TNX Basin (904-120G) were also included in the Consent Decree for closure in a RCRA-like manner. The Consent Decree was signed on May 26, 1988. On December 21, 1989, SRS was included on the National Priorities List (NPL). The inclusion created a need to integrate the established RCRA Facility Investigation program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA 42 United States Code Section 9620, the USDOE has negotiated a Federal Facility Agreement (FFA) (FFA 1993) with the USEPA and the SCDHEC to coordinate remedial activities at SRS into one comprehensive program which 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.

A chronology of site events including the effective dates for the Consent Decree, the FFA, and the NPL Listing is provided in Appendix A. Table 1 provides a chronology of the decision documents for the SRS OUs with geosynthetic or S/S cover systems evaluated in this report. Chronologies of significant activities and regulatory milestones for individual OUs are included in the site-specific remedy review reports (Appendix C through Appendix Q).

III. BACKGROUND

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 are by-products of 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 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 portion of the RCRA permit mandates corrective action requirements for non-regulated solid waste management units subject to RCRA 3004(u).

Physical Characteristics

SRS occupies approximately 802.9 km^2 (310 mi^2) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is located approximately 40 km (25 mi) southeast of Augusta, Georgia, and 32 km (20 mi) south of Aiken, South Carolina. Approximately 90 percent of SRS land consists of natural and managed forests. The locations at SRS where nuclear materials were produced, stored, and disposed are clustered into distinct industrial areas that are separated by large areas of forest. OUs are generally contained within or adjacent to these industrial areas.

SRS is located on the Atlantic Coastal Plain. Subsurface and groundwater contamination associated with OUs is located in unconsolidated sands and clays. The depth to the water table at SRS varies from just below the surface in wetlands and near streams to approximately 39 m (130 ft) below ground surface. Recharge to the aquifers underlying the SRS is primarily through rainfall. Groundwater flows toward and discharges into site streams and the floodplain of the Savannah River.

Land and Resource Use

For nearly 40 years, USDOE and its predecessor agencies produced nuclear materials for the nation's defense programs at SRS. Today, the focus of the USDOE has shifted to environmental stewardship, clean energy initiatives, and national security.

The future land use for all of the OUs at SRS is anticipated to be industrial with the USDOE maintaining control of the land. According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of SRS land should be prohibited.

SRS manages its own drinking and process water supply from groundwater located beneath the SRS. SRS domestic and process water systems are supplied from a network of approximately 40 wells in widely scattered locations across the site, of which eight wells supply the primary drinking water system. Virtually all site process and drinking water is pumped from the deeper Crouch Branch and McQueen Branch aquifers. The SRS domestic water systems meet state and federal drinking water standards. There is no current or projected future use of surface water or shallow aquifer groundwater as a drinking water source at the SRS.

History of Contamination

During the early 1950s, SRS began to produce materials used in nuclear weapons, primarily tritium, plutonium-239, and other special nuclear materials for national defense and the space program. Chemical and radioactive wastes are by-products of nuclear material production processes. These wastes have been treated, stored, and in some cases disposed of at SRS. Hazardous substances, as defined by the CERCLA, are currently present in the environment at SRS, with past disposal practices resulting in soil and groundwater contamination.

Initial Response

After SRS was placed on the NPL in 1989, the SRS Site Evaluation program was initiated to identify potential release sites present at SRS that would require investigation and potential remediation under CERCLA. Five hundred fifteen (515) potential release sites have been identified. The FFA includes a schedule for the investigation and remedial action (if needed) for each potential release site.

A core team process for sharing and interpreting information and working together to reach agreement on key remedial decisions among USDOE, USEPA, and SCDHEC was implemented at SRS in 2000. The core team process has made environmental cleanup at SRS efficient and has allowed remediation at many OUs to be accomplished on an accelerated schedule.

The collaborative efforts of the USDOE, USEPA, and SCDHEC support a consistent approach to site characterization, human health and ecological risk analyses, remedy selection, establishment of remedial goals and remedy implementation for individual OUs at SRS. Technical and administrative protocols have been established to promote the consistent implementation of USEPA guidance at OUs across SRS. An environmental database is used to track sampling, analysis, and results of environmental characterization and monitoring. An SRS Area Completion Strategy (WSRC 2006) was developed which allowed for the simultaneous characterization and cleanup of multiple OUs and potential sources of contamination in congested industrial areas.

During the period from April 2009 to September 2012, funds for accelerated environmental cleanup became available as part of the national economic stimulus package authorized by the American Recovery and Reinvestment Act of 2009 (ARRA). To take advantage of this additional funding, environmental cleanup under CERCLA was expedited by performing removal actions at a number of OUs using the administrative vehicle of Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis reports. Early action remedial decisions were also implemented under ARRA.

Table 1 provides a summary of the remedial actions implemented to date for the OUs with geosynthetic or S/S cover system remedies evaluated in this report. Remedial actions include removal actions and remedial actions conducted prior to an interim or final Record of Decision (ROD).

Basis for Taking Action

The most prevalent soil contaminants at SRS are cesium-137 and organic chemicals (volatile or semi-volatile). Other radionuclides, metals, polychlorinated biphenyls, and pesticides are present, but less common, at levels that exceed human health risk-based standards at a variety of units.

Based on the remedial investigations and technical evaluations, the OUs addressed in this remedy review were determined to contain hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. The specific contaminants and remedial actions for each OU are described in greater detail in the OU-specific appendices (Appendix C through Appendix Q).

IV. REMEDIAL ACTIONS

Remedial actions may target source areas, soil, vadose zone, and/or groundwater. Remedial goals are defined for individual OUs, but in general, remedial action objectives (RAOs) at SRS are:

- Prevent exposure of trespassers, industrial workers, and hypothetical residents to soils or groundwater containing unacceptable levels of contaminants.
- Prevent exposure of ecological receptors to soils or groundwater containing unacceptable levels of contaminants.
- Prevent or minimize the migration of contaminants to groundwater at levels that exceed maximum contaminant levels (MCLs).
- Prevent or minimize the discharge of contaminated groundwater to surface water at levels that exceed MCLs.

As previously discussed, the Fifth Five-Year Remedy Review Report will be conducted in five phases based on the remedy type. A general description of the five remedy types is provided in Appendix A.

Systems Operation and Maintenance

A site-wide maintenance program is in place to care for cover systems, signs, monitoring wells, and other infrastructure associated with environmental remediation. Operation and maintenance (O&M) of cover systems consist of growing grass, mowing, managing surface stormwater drainage, inspections, and repair of erosion or subsidence as necessary. Identifying signs must remain legible.

The costs of the O&M activities for the individual OUs have been compiled as part of this five-year remedy review. As part of the process of selecting the most appropriate action for each OU, the cost of implementing each of the remedies was estimated and reported in the respective remedy decision documents. Table 2 compares the actual costs incurred at SRS OUs with geosynthetic or S/S cover systems over the time period from fiscal year (FY) 2012 to FY2016 to the estimated costs from the remedy decision documents projected for the same time period. The review for the actual costs incurred (i.e., FY2012 to FY2016) is based on the time-period since the last review for these OUs was conducted in the Fourth Five-Year Remedy Review Report (SRNS 2014). Site-specific details concerning costs incurred are included for each OU in Appendix C through Appendix Q.

V. PROGRESS SINCE LAST REVIEW

For the fifteen remedy reviews evaluated in this review, the previous protectiveness statements from the Fourth Five-Year Remedy Review Report (SRNS 2014) concluded that the remedies for these OUs were found to be protective.

Recommendations from the Fourth Five-Year Remedy Review Report that impact the OUs with geosynthetic or S/S cover systems evaluated in this report are as follows:

- Five-year remedy reviews will be conducted in phases with OUs grouped by remedy types. This report presents the fourth phased review for fifteen OUs that selected geosynthetic or S/S cover systems as the final remedy.
- SRS recommended that the cover inspection frequency for ten OUs be reduced to annual. This reduction would provide adequate monitoring and consistency since the majority of OU covers are currently inspected annually. For this report, this recommendation pertains to the following OUs: F-Area Retention Basin, General Separations Area Consolidation Unit, L-Area Oil and Chemical Basin, and P-Area Reactor Seepage Basins.
- SRS recommended optimization of groundwater monitoring and reporting at some OUs, consistent with the results of the SRS Groundwater Monitoring Optimization Report (SRNS 2012). For this report, this recommendation pertains to the R-Area Burning/Rubble Pits and R-Area Rubble Pile OU.
- SRS recommended that the installation and maintenance activities for stormwater runoff covers at the E-Area Low-Level Waste Facility (LLWF) be reevaluated because the current geosynthetic covers are not expected to meet the original project life of 25 years and high maintenance and replacement costs are anticipated. A meeting and field walkdown was held on December 6, 2013 with the USDOE, USEPA, and SCDHEC to discuss the maintenance issues and a path forward for installation of future stormwater runoff covers. USDOE recommended that the need for stormwater runoff covers be evaluated on an as-needed basis depending on the waste type or curie content. In lieu of a low permeability membrane, USDOE recommended that soil covers and/or vegetative covers that are graded for positive flow or other low permeability materials with less maintenance issues be considered. The USDOE recommended that discussions continue with the USEPA and SCDHEC on the type of cover system needed for future slit trench disposal units.

VI. FIVE-YEAR REMEDY REVIEW PROCESS

USDOE has implemented the Fifth Five-Year Remedy Review for SRS OUs with geosynthetic or S/S cover systems. The review specifically evaluated remedies by comparing them to the OU-specific decision documents. The following actions were taken to perform the Fifth Five-Year Remedy Review for this category:

- Conducted a scoping meeting on August 30, 2016 with USDOE, USEPA, and SCDHEC to discuss the scope of the report and to establish the review and approval schedule for the report;
- Publication of an announcement on September 22, 2016 that the USDOE is conducting the Fifth Five-Year Remedy Review in phases;
- Reviewed appropriate data, documentation (i.e., including RODs, Early Action RODs [EARODs], Interim RODs [IRODs], Explanation of Significant Differences [ESDs]), and Land Use Control Implementation Plan required field inspection checklists, etc. The specific data and document references used to review each remedy decision are listed in the OU-specific reports located in Appendix C through Appendix Q;
- Confirmed protectiveness of the remedial actions through inspections and interviews. Cognizant personnel were interviewed as to the status and success of the current remedial systems. The results of the inspections and interviews are documented in the Site Inspection Checklist included with the OU-specific reports located in Appendix C through Appendix Q;
- Reviewed changes in standards and to-be-considered guidance that would call into question whether the prescribed remedy was meeting the newer standards or guidance. Any problems or discrepancies are reported in the Section VII (Technical Assessment), Section VIII (Issues), and Section IX (Recommendations and Follow-up Actions) of the OU-specific appendices; and
- Submitted an initial Fact Sheet for review with Revision 0 of the Fifth Five-Year Remedy Review Report for SRS OUs with Geosynthetic or S/S Cover Systems.

USEPA and SCDHEC performed site inspections of OUs with geosynthetic or S/S cover systems with issued RODs or IRODs on February 22, 23, and 28, 2017. The Revision 0 report was submitted on December 20, 2016. USDOE addressed comments received from USEPA and SCDHEC on the Revision 0 report and provided the Revision 1 report for USEPA and SCDHEC approval. After the USEPA and SCDHEC approve the report and USDOE, USEPA, and SCDHEC sign this report, a notice of its availability will be published in newspapers in Aiken, Columbia, Barnwell, and Allendale, South Carolina, and in Augusta, Georgia. Additionally, the availability of the report will be announced in *The Savannah River Site Environmental Bulletin*, which will be sent to the SRS mailing list. The report will be made available to the public at four information repositories. A briefing to the Citizens Advisory Board will be conducted prior to finalizing the report.

VII. TECHNICAL ASSESSMENT

The technical assessment of the environmental cleanup program at SRS in general and each of the OU-specific remedies evaluated in this report (Appendices C through Q) is described by answers to the following three questions posed by the USEPA.

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question A: Is the remedy functioning as intended by the decision documents?

SRS geosynthetic or S/S cover systems are functioning as intended as demonstrated below.

- In-situ deactivation and decommissioning of the P-Reactor building and the Heavy Water Components Test Reactor (770-U) has successfully broken the pathways for industrial worker exposure to radioactively contaminated material and contaminant migration to groundwater.

- Contaminated material has been excavated and consolidated or left in place under protective cover systems breaking the pathway for worker exposure and for the migration of contaminants to groundwater.
- The cover system maintenance program and LUCs have been effective in maintaining the integrity of the cover systems at SRS OUs. The inspection reports indicate no significant deficiencies.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid for all of the OUs included in this report. An evaluation of changes in chemical and radiological standards that were in place when the last five-year remedy review was initiated in 2012 to the standards applicable in 2016 was conducted to determine if there were any changes that would affect the protectiveness of the selected remedies. There were no changes in chemical and radiological specific standards that would affect the protectiveness of the remedies. There were no changes in action-specific or location-specific requirements that would impact any remedy. This evaluation is included in Appendix B and described in the OU-specific appendices.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information that could call into question the protectiveness of the selected remedies and no outstanding issues have been identified in this Fifth Five-Year Remedy Review. For all OUs, land use at SRS remains consistent with assumptions in the respective decision documents.

Technical Evaluation Summary

According to the data reviewed, the site inspections, and interviews, the remedies selected for the SRS OUs included in this report are functioning as intended by the decision documents. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid for all of the OUs included in this report. No new information has come to light that calls into question the protectiveness of the remedies.

VIII. ISSUES

Remedial actions evaluated in this Five-Year Remedy Review for SRS remain protective of human health and the environment and are functioning as intended.

Although the stormwater runoff covers at the E-Area LLWF continue to be protective, maintenance of the cover system continues to be problematic. Subsidence beneath the stormwater runoff covers at Slit Trench Disposal Units 4 and 5 and water pooling in these locations has been observed. During wind events, the covers have been observed to lift substantially, resulting in mechanical stresses to the cover materials. Subsidence and weathering of the stormwater runoff covers is anticipated to result in significant repairs, and the covers are not expected to meet the original project life of 25 years.

The E-Area LLWF and FTF OUs are currently in the operational phase and OU-specific LUCs have been deferred until final closure of the entire facilities. SRS facility security and administrative controls that restrict unauthorized access to the E-Area LLWF and FTF OUs are not part of the interim remedies and therefore not recognized as long-term protective.

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

SRS recommends redeveloping the BMW wells at B-Area OU prior to the next sampling event in order to decrease the turbidity in the wells and provide more accurate groundwater measurements, followed by filtering of samples and speciation as needed for radionuclides.

SRS recommends that the installation and maintenance activities for stormwater runoff covers at the E-Area LLWF be reevaluated because the current geosynthetic covers are not expected to meet the original project life of 25 years and high maintenance and replacement costs are anticipated. The USDOE recommends that discussions continue with the USEPA and SCDHEC on the type of cover system needed for future slit trench disposal units. No new slit trench disposal units have been operationally closed since issuance of the previous five-year remedy review report (SRNS 2014).

SRS recommends reducing the analyte list for P-Area OU (PAOU) to radionuclides that have the fastest travel times as predicted by the model (i.e., carbon-14, chlorine-36, technetium-99). An evaluation of the contaminant migration constituents of concern (CMCOCs) that were included as part of the groundwater monitoring to verify the effectiveness of the *in situ* decommissioning remedy was conducted. Ten radionuclides and lead are identified as CMCOCs. However, none of these radionuclides are predicted to impact groundwater before the year 2230, and many are not predicted to impact groundwater over 1,000 years. Many of the radionuclides require specialized analytical methods. All results from the first quarter 2012 sampling event were non-detect. The change to the monitoring strategy will be documented in an addendum to the PAOU Effectiveness Monitoring Plan.

SRS recommends that Appendix A of the FFA Annual Progress Report be revised to include the E-Area LLWF and FTF OUs to demonstrate long term protectiveness through the SRS facility security and administrative controls. The report is required by the FFA and includes an annual certification by the USDOE SRS Manager that the listed OUs are in compliance with land use requirements.

X. PROTECTIVENESS STATEMENT(S)

The protectiveness statements for each remedy are based on the recommended language from the *Comprehensive Five-Year Review Guidance* (USEPA 2001) and the supplemental guidance, *Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews* (USEPA 2012).

For the OUs evaluated in this Five-Year Remedy Review, the geosynthetic or S/S cover system remedies have been determined to be protective of human health and the environment. LUCs are part of all final remedial actions where hazardous substances, pollutants, or contaminants remain on-site above levels that allow for unlimited use and unrestricted exposure. For the OUs evaluated in this report, pathways for contaminants to reach human and ecological receptors have been successfully broken by the selected remedies including LUCs.

LUCs are not part of the interim remedial actions at the E-Area LLWF and the F-Area Tank Farm (FTF) OUs. Because the E-Area LLWF and FTF OUs are currently in the operational phase, unit specific LUCs have been deferred until final closure of these OUs. The interim remedial actions at the E-Area LLWF and FTF OUs are currently protective of human health and the environment because access is controlled by SRS facility security and administrative controls. Long-term protectiveness will be achieved by revising the FFA Annual Progress Report to include the E-Area LLWF and FTF OUs and the SRS facility security and administrative controls that restrict unauthorized access. The report is required by the FFA and includes an annual certification by the USDOE Savannah River Site Manager that the listed OUs are in compliance with land use requirements.

A protectiveness statement for the OUs evaluated in this report is included in the OU-specific remedy review located in Appendix C through Appendix Q. The protectiveness statements are also provided in the Five-Year Review Summary Form located in the Executive Summary.

XI. NEXT REVIEW

As established in Section 121 of CERCLA, as amended by the SARA and the NCP, periodic reviews are required at least every five years for sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure following the completion of all remedial actions. Barring a change in the governing laws, another review should be completed within five years from the signature date of this document. The Fifth Five-Year Remedy Review will be conducted in five phases. The final signature date for the last grouping of the Fifth Five-Year Remedy Review Report is due no later than January 21, 2019.

XII. OU-SPECIFIC FIVE-YEAR REMEDY REVIEW REPORTS

The OU-specific Five-Year Remedy Reviews for the remedies evaluated in this document are included in Appendix C through Appendix Q.

XIII. REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site*, Administrative Docket Number 89-05-FF (Effective Date: August 16, 1993)

SRNS, 2012. EC&ACP Groundwater Monitoring Optimization Report: A Comprehensive, Technical Approach for the Evaluation and Optimization of Groundwater Monitoring and Reporting (U), SRNS-RP-2012-0196, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina*, SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015a. Fifth Five-Year Remedy Review Report for the Savannah River Site Operable Units with Native Soil Covers and/or Land Use Controls (U) Aiken, South Carolina, SRNS-RP-2014-00902, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015b. Fifth Five-Year Remedy Review Report for the Savannah River Site Operable Units with Groundwater Remedies (U) Aiken, South Carolina, SRNS-RP-2015-00609, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USEPA, 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007, OSWER No. 9355.7-03B-P, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response

USEPA, 2011a. *Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance"*, OSWER Directive 9355.7-18, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response

USEPA, 2011b. *Transmittal of the Updated Five-Year Review Summary Form*, OSWER Directive 9200.2-105, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response

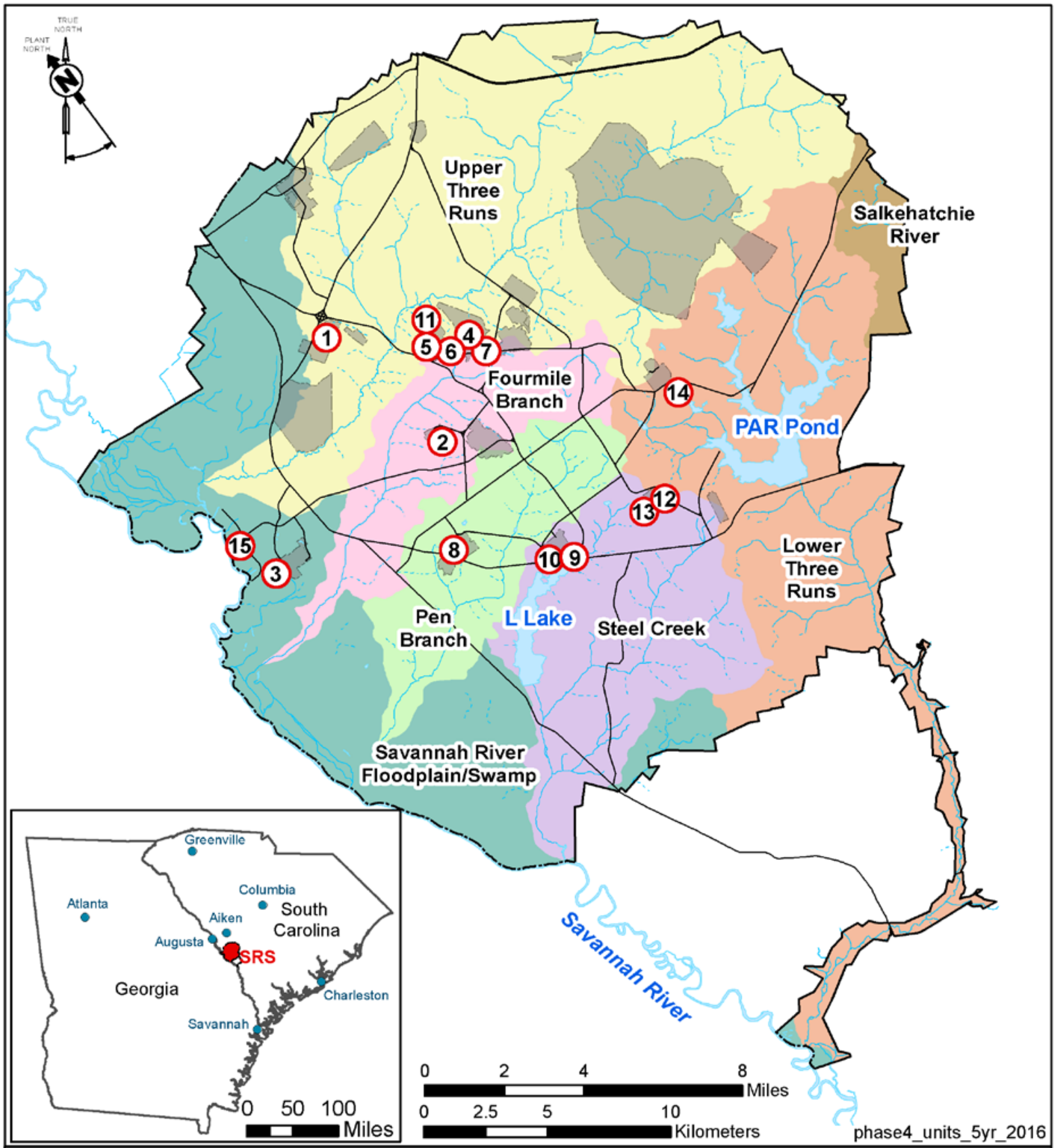
USEPA, 2012. Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews, OSWER Directive 9200.2-111, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response

WSRC, 1997. *Five-Year Review of Records of Decision Report (U),* WSRC-RP-97-403, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003. *Second Five-Year Review Report for the Savannah River Site (U),* WSRC-RP-2001-4163, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Area Completion Strategy for the Savannah River Site (U)*, ERD-EN-2005-0084, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008. *Third Five-Year Remedy Review Report for the Savannah River Site (U)*, WSRC-RP-2007-4063, Revision 1.1, Washington Savannah River Company, Savannah River Site, Aiken, SC



1. B-Area Operable Unit
2. C-Area Reactor Seepage Basins (904-66G, 904-67G, and 904-68G)
3. D-Area Expanded Operable Unit
4. E-Area Low-Level Waste Facility (643-26E)
5. F-Area Tank Farm
6. F-Area Retention Basin (281-3F)
7. General Separations Area Consolidation Unit
8. K-Area Reactor Seepage Basin (904-65G)
9. L-Area Oil and Chemical Basin (904-83G)
10. L-Area Reactor Seepage Basin (904-64G)
11. Old F-Area Seepage Basin (904-49G)
12. P-Area Operable Unit
13. P-Area Reactor Seepage Basin (904-61G, 904-62G, and 904-63G)
14. R-Area Burning/Rubble Pits (131-R and 131-1R) and R-Area Rubble Pile (631-25G)
15. T-Area Operable Unit

Figure 1. Location Map for SRS OUs with Groundwater Remedies

This page is intentionally left blank.

Table 1. SRS OUs with Geosynthetic or S/S Cover Systems

#	Appendix	Operable Unit	CERCLIS No.	Remedy Decision Document	Decision Document Issuance Year	Remedial Action	Area Covered (acres)	LUCs (acres)
1	C	B-Area Operable Unit (BAOU)	48	ROD	2013	In Situ S/S, Concrete Cover, Groundwater Monitoring, LUCs	0.15	2
2	D	C-Area Reactor Seepage Basins (CRSB) (904-66G and 904-68G)	60	ESD	2000	In Situ S/S, Soil Cover, LUCs	3.5	3.1
3	E	D-Area Expanded Operable Unit (DEXOU) [Consisting of D-Area Ash Basin (488-D) and D-Area Rubble Pit (431-2D)]	67	ROD	2004	Excavation, Soil Cover, Groundwater Monitoring, LUCs	25	43
4	F	E-Area Low-Level Waste Facility (LLWF) (643-26E)	86	IROD ESD	2010 2010	Interim Stormwater Runoff Covers	13.6	N/A
5	G	F-Area Retention Basin (FRB) (281-3F)	23	ROD ESD	1999 2001	In Situ S/S, Soil Cover, Groundwater Monitoring, LUCs	0.6	1.07
6	H	F-Area Tank Farms (FTF) Operable Unit	23	IROD ESD ESD	2013 2013 2014	Annual Visible Engineered Barriers Inspection and Maintenance	N/A	N/A
7	I	General Separations Area Consolidation Unit (GSACU) [including Old Radioactive Waste Burial Ground (ORWBG) (643-E) and Old Solvent Tanks (OST) (650-1E through 650-22E)]	32	ROD	2002	Excavation, Consolidation, Low Permeability Cover, LUCs	77.3	86

Table 1. SRS OUs with Geosynthetic or S/S Cover Systems (continued/end)

#	Appendix	Operable Unit	CERCLIS No.	Remedy Decision Document	Decision Document Issuance Year	Remedial Action	Area Covered (acres)	LUCs (acres)
8	J	K-Area Reactor Seepage Basin (KRSB) (904-65G)	55	ESD	2002	In Situ S/S, Soil Cover, LUCs	0.2	0.7
9	K	L-Area Oil and Chemical Basin (LAOCB) (904-83G and 904-79G)	17	ROD	1998	In Situ S/S, Soil Cover, LUCs	0.45	1.3
10	L	L-Area and C-Area Reactor Seepage Basins (LRSB, CRSB) (904-64G and 904-67G)	65, 60	ROD Amendment	2002	Soil Cover, LUCs	1.7	1.7
11	M	Old F-Area Seepage Basin (OFASB) (904-49G)	16	ROD ESD ROD Amendment	1997 1998 2004	In Situ S/S, Groundwater Mixing Zone (GWMZ), LUCs	1.8	1.8
12	N	P-Area Operable Unit (PAOU)	94	EAROD ESD ROD	2009 2009 2010	Removal Actions (In-Situ Decommissioning [ISD] of P-Reactor Building [105-P], Excavation, Cover), Soil Fracturing with Chemical Oxidation, Soil Vapor Extraction (SVE), LUCs	18.2	126
13	O	P-Area Reactor Seepage Basin (PRSB) OU (904-61G, 904-62G, and 904-63G)	66	ESD	2003	In Situ S/S , Consolidation, Soil Cover, LUCs	2.3	3.1
14	P	R-Area Burning/Rubble Pits (131-R, 131-1R) and Rubble Pile (631-25G) (RBRP/RRP)	43	ROD	2004	Excavation, Soil Cover, LUCs	0.32	0.44
15	Q	T-Area Operable Unit	96	ROD	2006	Cover, Excavation, Soil Amendments, LUCs	9.4	48

Table 2. Operation and Maintenance Cost Comparison for SRS OUs with Geosynthetic or S/S Cover Systems

Operable Unit	Main Remedy	Remedy Decision Document Year[a]	FY2012-FY2016 O&M Estimated Cost	FY2012-FY2016 O&M Actual Cost	% of Estimate	Comments
B-Area Operable Unit (BAOU)	In Situ S/S, Concrete Cover, Groundwater Monitoring, LUCs	2013	$11,500	$25,052	218%	Actual costs are higher than expected because routine site maintenance costs were underestimated in the ROD. No unexpected costs have been incurred.
C-Area Reactor Seepage Basins (CRSB) (904-66G and 904-68G)	In Situ S/S, Soil Cover, LUCs	2000	$47,505	$67,454	142%	Actual costs were higher than expected because the cost for access controls was not included in the estimate in the ROD Amendment. No unexpected costs have been incurred.
D-Area Expanded Operable Unit (DEXOU) [Consisting of D-Area Ash Basin (488-D) and D-Area Rubble Pit (431-2D)]	Excavation, Soil Cover, Groundwater Monitoring, LUCs	2004	$59,000	$97,122	165%	Actual costs were higher than expected because the ROD estimated costs did not include LUCs. No unexpected costs have been incurred.
E-Area Low-Level Waste Facility (LLWF) (643-26E)	Interim Stormwater Runoff Covers	2010 2010	$92,500	N/A	N/A	Actual O&M costs are not available. No repairs have been performed and estimated costs are considered representative of expected actual costs.
F-Area Retention Basin (FRB) (281-3F)	In Situ S/S, Soil Cover, Groundwater Monitoring, LUCs	1999 2001	$35,500	$49,404	139%	Actual costs are higher than expected because costs for routine site maintenance and preparation of five-year remedy reviews were underestimated in the ROD. No unexpected costs have been incurred.
F-Area Tank Farms (FTF) Operable Unit	Annual Visible Engineered Barriers Inspection and Maintenance	2013 2013 2014	$16,000	$15, 800	99%	Actual costs are as expected.
General Separations Area Consolidation Unit (GSACU) [including Old Radioactive Waste Burial Ground (ORWBG) (643-E) and Old Solvent Tanks (OST) (650-1E through 650-22E)]	Excavation, Consolidation, Low Permeability Cover, LUCs	2002	$195,750	$283,688	145%	Actual costs are higher than expected because costs for routine site maintenance and preparation of five-year remedy reviews were underestimated in the ROD. No unexpected costs have been incurred.

Table 2. Operation and Maintenance Cost Comparison for SRS OUs with Geosynthetic or S/S Cover Systems (continued/end)

Operable Unit	Main Remedy	Remedy Decision Document Year[a]	FY2012-FY2016 O&M Estimated Cost	FY2012-FY2016 O&M Actual Cost	% of Estimate	Comments
K-Area Reactor Seepage Basin (KRSB) (904-65G)	In Situ S/S, Soil Cover, LUCs	2002	$131,060	$47,778	36%	Actual costs were lower than expected because no cover repairs were necessary.
L-Area Oil and Chemical Basin (LAOCB) (904-83G and 904-79G)	In Situ S/S, Soil Cover, LUCs	1998	$149,900	$52,501	35%	Actual costs are lower than expected because the estimated cost for five-year remedy reviews were significantly overestimated in the ROD.
L-Area and C-Area Reactor Seepage Basins (LRSB, CRSB) (904-64G and 904-67G)	Soil Cover, LUCs	2002	$117,250	$59,133	50%	The actual O&M costs are less than expected because no cover repairs were necessary and inspections are performed annually instead of monthly as originally estimated.
Old F-Area Seepage Basin (OFASB) (904-49G)	In Situ S/S, GWMZ, LUCs	1997 1998 2004	$170,000	$55,952	33%	The actual O&M costs are less than expected because the estimated cost for five-year remedy reviews were significantly overestimated.
P-Area Operable Unit (PAOU)	Removal Actions (ISD of P-Reactor Building [105-P], Excavation, Cover), Soil Fracturing with Chemical Oxidation, SVE, LUCs	2009 2009 2010	$901,200	$541,096	60%	The actual costs are lower than estimated because the estimated costs in the ROD extended beyond the end of SVE activities in 2013.
P-Area Reactor Seepage Basin (PRSB) OU (904-61G, 904-62G, and 904-63G)	In Situ S/S , Consolidation, Soil Cover, LUCs	2003	$117,250	$92,965	79%	Actual costs are as expected.
R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) (RBRP/RRP)	Excavation, Soil Cover, LUCs	2004	$30,000	$58,972	196%	The actual O&M costs are higher than expected because costs for groundwater monitoring and well maintenance were not included in the ROD estimate.
T-Area Operable Unit	Cover, Excavation, Soil Amendments, LUCs	2006	$322,808	$360,934	112%	Actual costs are as expected.

FIFTH FIVE-YEAR REMEDY REVIEW REPORT PHASED REVIEWS

I. FIVE-YEAR REMEDY REVIEW PHASES

The size of the Savannah River Site (SRS) five-year remedy review report has grown considerably since the first report was issued in 1997 with respect to the number of operable unit (OU) remedies evaluated and the level of detail required. For the Fifth Five-Year Remedy Review Report, the U.S. Department of Energy, U.S. Environmental Protection Agency (USEPA), and South Carolina Department of Health and Environmental Control (SCDHEC) agreed to segregate the OUs into five groupings based on remedy similarity with a different group submitted annually on a five-year cycle. This phased approach not only reduces the volume of future remedy reports, but is also more effective in identifying and resolving issues for similar remedies.

The SRS OUs are grouped by the following remedy types:

(1) Native Soil Covers and/or Land Use Controls (LUCs);
(2) Groundwater Remedies;
(3) Engineered Cover Systems;
(4) Geosynthetic or Stabilization/Solidification Cover Systems; and
(5) Operating Equipment.

The trigger date for submittal of the next five-year remedy review report to the regulatory agencies is based on the USEPA signature date of the previous report. The final signature for the last grouping of the Fifth Five-Year Remedy Review Report is due no later than January 21, 2019. Prior to implementing the five annual remedy review submittals, a transitional period is necessary to prevent exceeding the five-year limit required between decision document reviews in order to remain in compliance with Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan. Issuance dates for the Fifth Five-Year Remedy Review Report during the transitional period are scheduled to occur over a four-year period (2016 to 2019). Table A-1 provides an overview of the number of years between remedy reviews for the five OU remedy groupings beginning with the transitional period between the fourth, fifth, and sixth reports until the five-year cycle is fully established between the sixth and seventh year reports.

A list of the SRS OUs with remedy decision documents grouped into one of the five phased reviews is provided in Table A-2. Table A-2 will be updated in future remedy review reports as additional remedy decision documents are approved. A general description of the five remedy types is provided below.

Phase 1: Native Soil Covers and/or LUCs

For purposes of the fifth five-year phased remedy review, SRS OUs with native soil covers and/or LUCs as the selected remedy are grouped under the Native Soil Covers and/or LUCs category.

Native soil covers are often implemented at SRS to protect against human and/or ecosystem exposure to waste or contaminated material left in place. Native soil covers are appropriate when water infiltration and leaching of contaminants to groundwater is not a concern. A typical soil cover is 0.30 m to 0.61 m (12 to 24 in) thick and is usually vegetated to minimize erosion. Native soil covers are usually low in cost and construction and materials are readily available from SRS local sources. Native soil covers may be combined with other remedial actions, but require LUCs as a component of the remedy. For these units, native soil covers were in place prior to selection of the remedial action. For this reason, only LUCs were required as the final remedial action for the nine OUs with existing soil covers discussed in the Native Soil Covers and/or LUCs report.

LUCs are maintained for all OUs where hazardous substances, pollutants, or contaminants remain on-site or have been left in place above levels that are acceptable for unlimited use and unrestricted exposure. LUCs may be implemented as a stand-alone remedy or combined with other remedial actions. LUCs involve institutional controls (i.e., administrative controls) and engineering controls and can include monitoring, maintenance, reporting, access restrictions, signage, fencing, and land use restrictions. In older SRS remedy documents, the term "institutional controls" was often used in place of the broader LUC term.

Phase 2: Groundwater Remedies

For purposes of the fifth five-year phased remedy review, SRS OUs that have similar groundwater monitoring activities, primarily associated with Monitored Natural Attenuation (MNA) or a Mixing Zone (MZ) permit, are grouped in the Groundwater category.

SRS uses a graded approach to groundwater remediation. The selection of groundwater remediation technologies for a specific contamination area is based on the size, contaminant type, contaminant concentration, and configuration of the plume. These attributes are the result of the nature and mass of the source of contamination and the subsurface characteristics in the area of the plume. Many large plumes consist of several zones that are most efficiently addressed with separate complementary corrective action/remedial technologies. The highest concentrations of contaminants are found in the source zone. The most robust, high-mass-removal technologies are best suited for remediation of the source zone. In the primary plume zone, active remedies such as pump-and-treat may be necessary to remove contaminants and exert hydraulic control of the plume. In the dilute fringe zone, contaminants are generally low in concentration and can often be treated with passive techniques.

Enhanced-passive remedial systems are used extensively at SRS for groundwater remediation. These systems are low-energy-consumption, low-carbon-emission systems that are not completely passive. These "green" technologies leverage natural systems to protect and remediate groundwater. Many existing soil vapor extraction (SVE) systems have been converted from active vacuum extraction powered by fossil fuel to enhanced-passive systems powered by natural non-fossil-fuel energy sources. BaroBall™ and MicroBlower^{TM} systems are two types of enhanced-passive SVE systems currently in operation at SRS. BaroBalls™ rely on natural fluctuations in barometric pressure to pump volatile organic compounds (VOCs) from the subsurface to the atmosphere at individual

SVE wells. SVE wells with MicroBlowers^{TM} are designed to use solar power to generate a vacuum that exhausts VOC vapors from individual wells. Both MicroBlowers^{TM} and BaroBalls^{TM} are low-energy-consumption, low-carbon-emission devices that remove VOC contaminants from the subsurface.

MNA is a passive groundwater remedial action where the fringe and dilute areas of a plume degrade by natural biogeochemical or physical processes such as biodegradation, radioactive decay, dilution, and simple dispersion. MNA remedies must be accompanied by source control and a technical justification that conditions are favorable for natural attenuation. In addition, the groundwater plume should not be expanding significantly, and surface water standards cannot be exceeded at the groundwater discharge point. MNA remedy justifications are supported by groundwater modeling and a commitment to continued monitoring and reporting. When only the uppermost aquifer is impacted, SCDHEC may issue a MZ permit that is essentially a permit for an MNA remedy. SRS has a mixture of CERCLA Record of Decisions (RODs) that require MNA as the final action for groundwater under CERCLA, and RODs that require SCDHEC MZ permits to implement the MNA remedy.

Phase 3: Engineered Cover Systems

For purposes of the fifth five-year phased remedy review, SRS OUs that selected an engineered cover system or similar cover system as the remedy are grouped in the Engineered Cover Systems category.

The function of an engineered cover system is similar to native soil covers to protect against human and/or ecosystem exposure to waste or contaminated material left in place. Although engineered covers do not prevent infiltration, they can achieve very low permeabilities if well compacted. Compaction is important to reduce damage from differential settlement and is often used at SRS to remediate OUs that contain diverse waste material such as rubble pits/piles. Another objective of using engineered cover systems is to promote more effective surface drainage and to minimize runoff.

SRS OUs were placed in this grouping if the selected cover features exceeded those of a basic native soil cover. For example, an OU with a remedy that selected cover and/or fill material with a higher clay content in order to minimize infiltration or for drainage and slope contouring was included in this category even if the clay material did not have engineering compaction requirements.

Phase 4: Geosynthetic or Stabilization/Solidification Cover Systems

For purposes of the fifth five-year phased remedy review, SRS OUs that installed a geosynthetic or stabilization/solidification cover system are grouped in the Geosynthetic or Stabilization/Solidification Cover Systems category.

Many cover systems are designed to protect groundwater by minimizing the infiltration of rainwater through the contaminated material left in place. Geosynthetic cover systems are constructed at SRS OUs when there is a concern that contamination left in place may leach to groundwater above acceptable levels. A typical cross section of a geosynthetic cover system consists of a vegetative/soil protective layer, a geosynthetic drainage layer, an impermeable geosynthetic liner, and compacted common fill placed over the contaminated material. A specific hydraulic conductivity to reduce stormwater infiltration, usually 1E-07 cm/s or less, is specified in the design. Low permeability covers are often paired with SVE units that remove VOCs from the subsurface soil beneath the OU to prevent migration of contaminants to groundwater.

In some cases, radioactively contaminated soils have been stabilized with in-situ grouting followed by installation of a low permeability cover (i.e., compacted clay, concrete, etc.) to deter migration of contaminants to the groundwater. Not only does a stabilization/solidification technology stabilize waste left in place, the in-situ containment also provides another layer of protection to prevent intrusion and exposure to contaminated material.

Phase 5: Operating Equipment

For purposes of the fifth five-year phased remedy review, SRS OUs that have ongoing active remediation systems are grouped under the Operating Equipment category.

A range of active remediation systems are used at SRS. SVE systems are used to remove VOCs from vadose zone source areas before the contaminants can migrate to the water table. Air strippers are employed to remove VOC contaminants from the source zone while active recirculation well systems remove VOC contaminants from primary VOC plumes. Pump and treat systems are used to remove contaminant mass and exert hydraulic control over contaminated groundwater plumes. Thermal technologies have been employed in several areas to mobilize dense non-aqueous phase liquid (DNAPL) VOCs in the vadose zone and groundwater. Dynamic Underground Stripping is a technology employed at SRS that utilizes steam injection to enhance removal from large DNAPL source zones. Electrical Resistance Heating has been used in smaller DNAPL source zones.

A more detailed discussion of active remediation systems will be provided during Phase 5 of the fifth five-year phased remedy review.

II. SRS OUS WITH REMEDIAL DECISIONS

The following tables are included for information only and provide a tracking for all SRS OUs with approved remedial decisions, including No Action sites [i.e., RODs, Early Actions RODs (EARODs), Interim RODs (IRODs), ROD Amendments, and Explanation of Significant Differences (ESDs)].

- Table A-3 chronologically lists all SRS issued decision documents. Document numbers are provided for reference;
- Table A-4 provides a summary of the no remedial actions selected in the decision documents; and
- Table A-5 provides the OU subunits with issued remedial decision documents and their associated Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) number.

Table A-1. Phased Five-Year Remedy Review Report Schedule

Fourth Five-Year Review		Fifth Five-Year Review		Sixth Five-Year Review		Seventh Five-Year Review	
Issuance Year	Years Between Reviews	Issuance Year	Years Between Reviews	Issuance Year	Years Between Reviews	Issuance Year	Remedy Type
2014	2	2016[a]	4	2020	5	2025	Phase 1: Native Soil Covers and/or LUCs
2014	3	2017	4	2021	5	2026	Phase 2: Groundwater Remedies
2014	4	2018	4	2022	5	2027	Phase 3: Engineered Cover Systems
2014	4	2018[b]	5	2023	5	2028	Phase 4: Geosynthetic or Stabilization/ Solidification (S/S) Cover Systems
2014	5	2019	5	2024	5	2029	Phase 5: Operating Equipment

[a] The Fifth Five-Year Remedy Review Report for SRS OUs with Native Soil Covers and LUCs was issued ahead of schedule in November 2015.

[b] Indicates the issue year for this report: Fifth Five-Year Remedy Review Report for SRS OUs with Geosynthetic or S/S Cover Systems.

This page is intentionally left blank.

Table A-2. Fifth Five-Year Remedy Review Report Phases for SRS OUs

Native Soil Covers and/or LUCs		**Groundwater**		**Engineered Cover Systems**		**Geosynthetic or Stabilization/Solidification Cover Systems**		**Operating Equipment**	
Submittal Date[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***
2014	**2015**	**2015**	**2017**	**2016**	**2018**	**2016**	**2018**	**2017**	**2019**
C-Area Operable Unit[b]		C-Area Groundwater		Central Shops Burning/Rubble Pits (631-1G and 631-3G)		B-Area Operable Unit		A-Area Burning/Rubble Pits (731-A/731-1A) and Rubble Pit (731-2A), Miscellaneous Chemical Basin (731-4A) and Metals Burning Pit (731-5A)	
C-, K-, and L-Reactor Complexes		Chemicals, Metals, and Pesticides Pit (080-170G, 080-171G, 080-180G, 080-181G, 080-182G, 080-183G, and 080-190G)		D-Area Burning/Rubble Pits (431-D and 431-1D)		C-Area Reactor Seepage Basins (904-66G and 904-68G)		A/M Area Groundwater	
Early Construction and Operational Disposal Site (ECODs) L-1, N-2, P-2, and R-1A, -1B, -1C		D-Area Oil Seepage Basin (631-G)		F-Area Hazardous Waste Management Facility (904-41G, 904-42G, and 904-43G)		D-Area Expanded Operable Unit (Consisting of D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D])		A-Area Miscellaneous Rubble Pile (731-6A)	
F-Area Burning/Rubble Pits (231-F, 231-1F, and 231-2F)		L-Area Burning/Rubble Pit (131-L)		Ford Building Seepage Basin (904-91G)		E-Area Low-Level Waste Facility (643-26E)		C-Area Burning/Rubble Pits (131-C)	
Gunsite 012		L-Area Southern Groundwater		H-Area Hazardous Waste Management Facility (904-44G, 904-45G, 904-46G, and 904-56G)		F-Area Tank Farm		D-Area Operable Unit	
Heavy Equipment Wash Basin (No Building Number [NBN])		R-Area Operable Unit		K-Area Burning/Rubble Pit and K-Area Rubble Pile (131-K and 631-20G)		F-Area Retention Basin (281-3F)		F-Area Groundwater Operable Unit	
K-Area Bingham Pump Outage Pit (643-1G)		R-Area Reactor Seepage Basins (904-57G, 904-58G, 904-59G, 904-60G, 904-103G, and 904-104G) and 108-4R Overflow Basin		M-Area Hazardous Waste Management Facility (904-51G and 904-112G)		General Separations Area Consolidation Unit		H-Area Groundwater Operable Unit	
L-Area and P-Area Bingham Pump Outage Pits (643-2G, 643-3G, and 643-4G)				Metallurgical Laboratory Hazardous Waste Management Facility (904-110G)		H-Area Tank Farm[d]		M-Area Inactive Process Sewer Lines (081-M)	

Table A-2. Fifth Five-Year Remedy Review Phases for SRS OUs (*continued/end*)

Native Soil Covers and/or LUCs		**Groundwater**		**Engineered Cover Systems**		**Geosynthetic or Stabilization/Solidification Cover Systems**		**Operating Equipment**	
Submittal Date[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***	***Submittal Date***[a]	***Issuance Year***
2014	**2015**	**2015**	**2017**	**2016**	**2018**	**2016**	**2018**	**2017**	**2019**
PAR Pond (685-G) (Including the Pre-Cooler Ponds and Canals) and Lower Three Runs Integrator Operable Unit (IOU) Tail Portion (Middle and Lower Subunits)				Mixed Waste Management Facility (643-28E)		K-Area Reactor Seepage Basin (904-65G)		M-Area Operable Unit	
R-Area Bingham Pump Outage Pits (643-8G, 643-9G and 643-10G) and R-Area Unknown Pits #1, #2, and #3				SRL Seepage Basins (904-53G1, 904-53G2, 904-54G, and 904-55G)		L-Area Oil and Chemical Basin (904-83G)		P-Area Burning/Rubble Pit (131-P)	
Silverton Road Waste Unit (731-3A)						L-Area Reactor Seepage Basin (904-64G) and C-Area Reactor Seepage Basin (904-67G)		TNX Area Operable Unit	
Wetland Area at Dunbarton Bay in Support of Steel Creek IOU[c]						Old F-Area Seepage Basin (904-49G)			
						P-Area Operable Unit			
						P-Area Reactor Seepage Basin (904-61G, 904-62G, and 904-63G)			
						R-Area Burning/Rubble Pits (131-R and 131-1R) and R-Area Rubble Pile (631-25G)			
						T-Area Operable Unit			

a Represents December submittal date of the Revision 0 document for each five-year remedy review report.

b C-Area Operable Unit EAROD was issued in September 2015. This OU is not included in the first phase of the fifth five-year remedy review (i.e. native soil covers and/or LUCs) because the decision document was issued during development of the report and a remedy evaluation was premature.

c ROD was approved in 2014, but document has not been issued. This OU is not included in the first phase of the fifth five-year remedy review (i.e., native soil covers and/or LUCs) because the remedy has not been implemented.

d H-Area Tank Farm (Waste Tank 16) IROD was issued in August 2016. H-Area Tank Farm (Waste Tank 12) ESD to the IROD was issued in April 2017. A remedy evaluation in this report is premature

Table A-3. Chronological Listing of SRS Issued Decision Documents

Document Title[a]	Document Number	Rev	Issuance Date[b]
Consent Decree Signed			***May 26, 1988***
NPL Listing Effective Date			***December 21, 1989***
A/M Area Groundwater Interim ROD (RCRA)	WSRC-RP-92-744	0	September 16, 1992
M-Area Hazardous Waste Management Facility (904-51G and 904-112G) IROD (RCRA)	WSRC-RP-92-743	0	September 16, 1992
Metallurgical Laboratory Hazardous Waste Management Facility (904-110G) IROD (RCRA)	WSRC-RP-92-745	0	September 16, 1992
Federal Facility Agreement Declared Effective			***August 16, 1993***
F-Area Hazardous Waste Management Facility (904-41G, 904-42G, and 904-43G) ROD (RCRA)	WSRC-RP-93-1042	1	October 1, 1993
H-Area Hazardous Waste Management Facility (904-44G, 904-45G, 904-46G, and 904-56G) ROD (RCRA)	WSRC-RP-93-1043	1	October 1, 1993
Mixed Waste Management Facility (643-28E) ROD (RCRA)[c]	WSRC-RP-93-1511	1	September 23, 1994
Tank 105-C Hazardous Waste Management Facility ROD (RCRA)[c]	WSRC-RP-94-106	1	September 23, 1994
TNX Groundwater Operable Unit IROD[c]	WSRC-TR-94-0375	1	November 16, 1994
PAR Pond (685-G) IROD[c]	WSRC-RP-93-1549	0	February 16, 1995
F-Area Groundwater Operable Unit IROD (RCRA)[c]	WSRC-RP-94-1162	1	April 13, 1995
H-Area Groundwater Operable Unit IROD (RCRA)[c]	WSRC-RP-94-1163	1	April 13, 1995
M-Area West Unit (631-21G) ROD[c]	WSRC-RP-95-626	0	September 29, 1995
Old Radioactive Waste Burial Ground (643-E) IROD	**WRSC-RP-96-102**	**0**	**July 25, 1996**
Burma Road Rubble Pit (231-4F) ROD	WSRC-RP-96-101	1	July 25, 1996
D-Area Burning/Rubble Pits (431-D and 431-1D) ROD	WSRC-RP-96-867	1	July 3, 1997
F-Area Burning/Rubble Pits (231-F, 231-1F, and 231-2F) ROD	WSRC-RP-96-868	1	July 3, 1997
Grace Road Site (631-22G) ROD	WSRC-RP-96-160	1	July 3, 1997
Gunsite 113 Access Road Unit (631-24G) ROD	WSRC-RP-96-833	1	July 3, 1997
Gunsite 720 Rubble Pit Unit (631-16G) ROD	WSRC-RP-96-832	1	July 3, 1997
Silverton Road Waste Unit (713-3A) ROD	WSRC-RP-96-171	1	July 3, 1997
Central Shops Burning/Rubble Pit (631-6G) ROD	WSRC-RP-96-873	1	July 3, 1997
Old F-Area Seepage Basin (904-49G) ROD	**WRSC-RP-96-872**	**1.1**	**July 3, 1997**

Table A-3. Chronological Listing of SRS Issued Decision Documents *(continued)*

Document Title[a]	Document Number	Rev	Issuance Date[b]
First Five-Year Remedy Review	***WSRC-RP-97-403***	***0***	***August 27, 1997***
TNX Groundwater Operable Unit ESD	WSRC-RP-97-169	1	October 10, 1997
K-Area Bingham Pump Outage Pit (643-1G) ROD	WSRC-RP-97-178	1	June 11, 1998
C-, F-, K-, and P-Area Coal Pile Runoff Basins (189-C, 289-F, 189-K, 189-P) ROD[c]	WSRC-RP-97-850	1	November 10, 1998
L-Area Oil and Chemical Basin and L-Area Acid/Caustic Basin (904-83G and 904-79G) ROD	**WSRC-RP-97-143**	**1**	**November 10, 1998**
716-A Motor Shops Seepage Basin (904-101G) ROD	WSRC-RP-97-840	0	November 16, 1998
Fire Department Hose Training Facility (904-113G) ROD	WSRC-RP-97-171	1	November 16, 1998
Old F-Area Seepage Basin (904-49G) ESD	**WSRC-RP-98-4123**	**1**	**December 16, 1998**
D-Area Oil Seepage Basin (631-G) ROD	WSRC-RP-97-402	1	May 7, 1999
C-Area Burning/Rubble Pit (131-C) IROD	WSRC-RP-98-4039	0	May 7, 1999
F-Area Retention Basin (281-3F) ROD	**WSRC-RP-97-145**	**1.1**	**May 19, 1999**
Ford Building Waste Site (643-11G) ROD	WSRC-RP-98-4066	1	October 13, 1999
Chemicals, Metals, and Pesticides Pits (080-170G, 080-171G, 080-180G, 080-181G, 080-182G, 080-183G, and 080-190G) IROD	WSRC-RP-98-4192	1.1	January 19, 2000
SRL Seepage Basins (904-51G1, 904-52G2, 904-52G, and 904-55G) ROD	WSRC-RP-97-848	1.1	April 26, 2000
C-Area Reactor Seepage Basins (904-66G, 904-67G, and 904-68G) Plug-In ROD ESD	**WSRC-RP-2000-4032**	**0**	**October 18, 2000**
L & P Bingham Pump Outage Pits (643-2G, 643-3G, and 643-4G) ROD	WSRC-RP-98-4015	1	October 18, 2000
Burma Road Rubble Pit (231-4F) ESD[c]	WSRC-RP-98-4170	1	February 6, 2001
A-Area Burning/Rubble Pits (731-A and 731-1A) and Rubble Pit (731-2A) IROD	WSRC-RP-2000-4001	1	February 9, 2001
Miscellaneous Chemical Basin (731-4A)/Metals Burning Pit (731-5A) IROD	WSRC-RP-98-4031	1.1	February 9, 2001
West of SRL "Georgia Fields" Site (631-19G) ROD	WSRC-RP-99-4164	0	February 22, 2001
F-Area Retention Basin (281-3F) ESD[c]	**WSRC-RP-2000-4079**	**1**	**June 7, 2001**
K-Area Burning/Rubble Pit (131-K) and K-Area Rubble Pile (631-20G) ROD[c]	WSRC-RP-97-862	1	August 20, 2001
Old Radioactive Waste Burial Ground Old Solvent Tanks (650-01E - 22E) IROD	**WSRC-RP-2000-4193**	**1**	**September 27, 2001**
Ford Building Seepage Basin (904-91G) ROD	WSRC-RP-2000-4156	1	April 5, 2002

Table A-3. Chronological Listing of SRS Issued Decision Documents *(continued)*

Document Title[a]	Document Number	Rev	Issuance Date[b]
Chemical, Metals, and Pesticides Pits (080-170G, 080-171G, 080-181G, 080-182G, 080-183G, and 080-190G) IROD Amendment	WSRC-RP-2000-4158	1.2	April 8, 2002
K-Area Reactor Seepage Basin ESD[c]	**WSRC-RP-99-4200**	**1.1**	**September 16, 2002**
General Separations Area Consolidation Unit ROD	**WSRC-RP-2002-4002**	**0**	**October 25, 2002**
Central Shops Sludge Lagoon (080-24G) ROD	WSRC-RP-2000-4189	1	November 15, 2002
C-Area Reactor Seepage Basin (904-67G) & L-Area Reactor Seepage Basin (904-64G) ROD Amendment	**WSRC-RP-2002-4063**	**1**	**December 5, 2002**
R-Area Acid/Caustic Basin (904-77G) ROD	WSRC-RP-2002-4015	1	February 10, 2003
L-Area Burning/Rubble Pit (131-L) & L-Area Rubble Pile (131-3L) & Gas Cylinder Disposal Facility (131-2L) ROD	WSRC-RP-98-4195	1.1	February 17, 2003
A-Area Burning/Rubble Pits (731-A and 731-1A) and Rubble Pit (731-2A) ESD	WSRC-RP-2001-4281	1	March 10, 2003
R-Area Bingham Pump Outage Pits (643-8G, 643-9G and 643-10G) and R-Area Unknown Pits #1, #2, and #3 ROD	WSRC-RP-2001-4129	1.1	April 28, 2003
TNX Area Groundwater Operable Unit ESD[c]	WSRC-RP-2001-00764	0	May 19, 2003
Central Shops Burning/Rubble Pits (631-1G and 631-3G) ROD	WSRC-RP-2001-4265	1.1	June 30, 2003
P-Area Burning/Rubble Pit (131-P) ROD	WSRC-RP-2000-4197	1	August 8, 2003
A-Area Miscellaneous Rubble Pile (731-6A) ROD	WSRC-RP-2001-4197	1.3	August 11, 2003
P-Area Reactor Seepage Basin (904-61G, 904-62G, and 904-63G) Plug-In ROD ESD	**WSRC-RP-2002-4105**	**1.1**	**October 2, 2003**
Chemical, Metals, and Pesticides Pits (080-170G, 080-171G, 080-181G, 080-182G, 080-183G, and 080-190G) Second IROD Amendment	WSRC-RP-2001-4232	1.1	October 21, 2003
L-Area Hot Shop (717-G) ROD	WSRC-RP-2002-4025	1.1	November 3, 2003
Road A Chemical Basin (904-111G) ROD	WSRC-RP-2002-4153	0	November 3, 2003
Second Five-Year Remedy Review[c]	***WSRC-RP-2001-4163***	***1.1***	***February 12, 2004***
R-Area Reactor Seepage Basins (904-57G, 904-58G, 904-59G, 904-60G, 904-103G, and 904-104G) and 108-4R Overflow Basin ROD	WSRC-RP-2003-4093	1	March 18, 2004
TNX Burying Ground (643-G), New TNX Seepage Basin, Old TNX Seepage Basin and TNX Groundwater (082-G) ROD	WSRC-RP-2003-4017	1	April 7, 2004
SRL Oil Test Site (808-16G) ROD	WSRC-RP-2003-4164	1	September 20, 2004

Table A-3. Chronological Listing of SRS Issued Decision Documents *(continued)*

Document Title[a]	Document Number	Rev	Issuance Date[b]
R-Area Burning/Rubble Pits (131-R and 131-1R) and R-Area Rubble Pile (631-25G) ROD	**WSRC-RP-2004-4004**	**1**	**September 28, 2004**
C-Area Reactor Groundwater IROD	WSRC-RP-2004-4022	1	October 15, 2004
D-Area Expanded Operable Unit (Consisting of D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) ROD	**WSRC-RP-2004-4007**	**1**	**December 17, 2004**
Old F-Area Seepage Basin (904-49G) ROD Amendment	**WSRC-RP-2003-4136**	**1**	**December 17, 2004**
Heavy Equipment Wash Basin and Central Shops Burning/Rubble Pit (631-5G) ROD	WSRC-RP-2003-4185	1.1	January 28, 2005
Chemical, Metals, and Pesticides Pits (080-170G, 080-171G, 080-181G, 080-182G, 080-183G, and 080-190G) ROD	WSRC-RP-2004-4090	1	May 10, 2005
Silverton Road Waste Unit (731-3A) ESD	WSRC-RP-2004-4092	1.1	June 16, 2005
TNX Area Operable Unit ESD	WSRC-RP-2005-4030	1	November 7, 2005
Hydrofluoric Acid Spill (631-4G) ROD	WSRC-RP-2005-4000	0	December 28, 2005
T-Area Operable Unit ROD	**WSRC-RP-2004-4070**	**1**	**January 4, 2006**
K-Area Sludge Land Application Site (761-4G) and PAR Pond Sludge Land Application Site (761-5G) ROD	WSRC-RP-2005-4064	1	June 30, 2006
211-FB Pu-239 Release (081-F) ROD	WSRC-RP-2005-4090	1	September 18, 2006
M-Area Inactive Process Sewer Lines (081-M) ROD	WSRC-RP-2006-4001	1	April 26, 2007
L-Area Southern Groundwater ROD	WSRC-RP-2006-4052	1.1	May 9, 2007
A-Area Burning/Rubble Pits and Rubble Pit (731-A, 731-1A and 731-2A) and the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A and 731-5A) ROD	WSRC-RP-2005-4095	1.1	August 2, 2007
C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) ROD	WSRC-RP-2007-4082	1	July 9, 2008
Third Five-Year Remedy Review	***WSRC-RP-2007-4063***	***1.1***	***January 28, 2009***
P-Area Operable Unit EAROD	**WSRC-RP-2008-4037**	**1.1**	**January 29, 2009**
M-Area Operable Unit ROD	WSRC-RP-2008-4030	1	February 5, 2009
M-Area Operable Unit ESD	SRNS-RP-2009-00406	1	July 9, 2009
P-Area Operable Unit EAROD ESD	**SRNS-RP-2009-00704**	**1**	**October 27, 2009**
C-, K-, L- and R-Reactor Complexes EAROD	SRNS-RP-2009-00707	1	December 8, 2009
E-Area Low Level Waster Facility (Slit Trench Disposal Units 1 and 2) IROD	**SRNS-RP-2009-00538**	**1**	**January 22, 2010**

Table A-3. Chronological Listing of SRS Issued Decision Documents *(continued/end)*

Document Title[a]	Document Number	Rev	Issuance Date[b]
Early Construction and Operational Disposal Site L-1, N-2, P-2, R-1A, R-1B, R-1C ROD	SRNS-RP-2009-00072	1	March 30, 2010
E-Area Low Level Waste Facility (Slit Trench Disposal Units 3 through 5) ESD to the IROD	**SRNS-RP-2009-01128**	**1**	**April 22, 2010**
P-Area Operable Unit ROD	**SRNS-RP-2009-01368**	**1**	**July 22, 2010**
Gunsite 218 Rubble Pile ROD	SRNS-RP-2010-00051	1	October 22, 2010
R-Area Operable Unit ROD	SRNS-RP-2010-01062	1	April 20, 2011
L-Area Northern Groundwater ROD	SRNS-RP-2011-00134	1	June 20, 2011
Gunsite 012 (including ECODS G-3) ROD	SRNS-RP-2010-01232	1	June 27, 2011
D-Area Operable Unit EAROD	SRNS-RP-2010-00162	1.2	September 26, 2011
PAR Pond Unit: Lower Three Runs IOU Tail Portion (Middle and Lower Subunits) ESD	SRNS-RP-2012-00121	1	September 13, 2012
B-Area Operable Unit ROD	**SRNS-RP-2012-00354**	**1**	**April 16, 2013**
F-Area Tank Farm (Waste Tanks 17 and 20) IROD	**SRR-CWDA-2013-00111**	**1**	**April 30, 2013**
TNX Area Operable Unit Second ESD to the ROD	SRNS-RP-2012-00205	1	June 12, 2013
F-Area Tank Farm (Tanks 18 and 19) ESD to the IROD	**SRR-CWDA-2013-00007**	**1.1**	**September 23, 2013**
Fourth Five-Year Remedy Review	***SRNS-RP-2012-00011***	***1.1***	***February 4, 2014***
Wetland Area at Dunbarton Bay in Support of Steel Creek IOU ROD	SRNS-RP-2013-00730	1	April 21, 2014[d]
L-Area Southern Groundwater Operable Unit ESD to the ROD	SRNS-RP-2012-00736	1	September 10, 2014
F-Area Tank Farm (Tanks 5 and 6) ESD to the IROD	**SRR-CWDA-2014-00008**	**1**	**September 11, 2014**
C-Area Operable Unit EAROD	SRNS-RP-2014-00836	1	September 2, 2015
Fifth Five-Year Remedy Review for SRS OUs with Native Soil Covers and/or LUCs	***SRNS-RP-2014-00902***	***1***	***November 30, 2015***
H-Area Tank Farm (Waste Tank 16) IROD	**SRR-CWDA-2015-00157**	**1**	**August 16, 2016**
Fifth Five-Year Remedy Review for SRS OUs with Groundwater Remedies	***SRNS-RP-2015-00419***	***1***	***February 2, 2017***
H-Area Tank Farm (Waste Tank 12) ESD to the IROD	**SRR-CWDA-2016-00107**	**0**	**April 20, 2017**

[a] Shaded text identifies the SRS OUs evaluated in this report for the fourth phase of the fifth five-year review (i.e., geosynthetic or stabilization/solidification cover systems).

[b] Unless otherwise noted, the Issuance Date represents the date that the public was notified that the Three-Party signed document was available.

[c] This is the last signature date instead of the Issuance Date.

[d] Revision 1 ROD for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit was approved on April 11, 2014 by SCDHEC and April 21, 2014 by USEPA. Date shown is for the last approval date because the ROD has not been issued.

Table A-4. Summary of No Remedial Actions at SRS OUs

Operable Unit	Remedial Action
No Action/No Further Action	
211-FB Pu-239 Release (081-F)	No Action
716-A Motor Shops Seepage Basin (904-101G)	No Action
Burma Road Rubble Pit (231-4F)	No Action
Central Shops Burning/Rubble Pit (631-6G)	No Action
Central Shops Sludge Lagoon (080-24G)	No Action
C-, F-, K-, and P-Area Coal Pile Runoff Basins (189-C, 289-F, 189-K, and 189-P)	No Further Action
Fire Department Hose Training Facility (904-113G)	No Action
Ford Building Waste Site (643-11G)	No Further Action (Removal)
Grace Road Site (631-22G)	No Action
Gunsite 113 Access Road Unit (631-24G)	No Action
Gunsite 218 Rubble Pile (621-23G)	No Action
Gunsite 720 Rubble Pit Unit (631-16G)	No Action
Hydrofluoric Acid Spill (631-4G)	No Action
K-Area and PAR Pond Sludge Land Application Site (761-4G and 761-5G)	No Action
L-Area Hot Shop (717-G)	No Further Action
L-Area Northern Groundwater (NBN)	No Action
M-Area West Unit (631-21G)	No Action
R-Area Acid/Caustic Basin (904-77G)	No Action
Road A Chemical Basin (904-111G)	No Action
SRL Oil Test Site (080-16G)	No Action
West of SRL “Georgia Fields” Site (631-19G)	No Action
No Action/No Further Action OUs Associated with OUs Requiring Remedial Action	
108-4R Overflow Basin (108-4R)[1]	No Further Action
Central Shops Burning/Rubble Pit (631-5G)[2]	No Action
ECODS B-3 and B-5 (NBN)[3]	No Further Action
ECODS G-3 (Adjacent to Gunsite 012) (NBN)[4]	No Action
Gas Cylinder Disposal Facility (131-2L)[5]	No Action
L-Area Rubble Pile (131-3L)[5]	No Action
L-Area Acid/Caustic Basin (904-79G)[6]	No Action
Rubble Pile Across from Gunsite 012 (NBN)[4]	No Action
RCRA Units that are No Further Action under CERCLA	
H-Area Hazardous Waste Management Facility (904-44G, 904-45G, 904-46G, and 904-56G)	No Further Action (Low Permeability Cap)
Tank 105-C Hazardous Waste Management Facility (NBN)	No Further Action
F-Area Hazardous Waste Management Facility (904-41G, 904-42G, and 904-43G)	No Further Action (Low Permeability Cap, In Situ S/S)
Mixed Waste Management Facility (643-28E)	No Further Action (Low Permeability Cap)

1 – Included with R-Reactor Seepage Basins (904-103G, 904-104G, 904-57G, 904-58G, 904-59G, 904-60G)
2 – Included with Heavy Equipment Wash Basin (NBN)
3 – Included with B-Area Operable Unit
4 – Included with Gunsite 012
5 – Included with L-Area Burning/Rubble Pit (131-L)
6 – Included with L-Area Oil and Chemical Basin (904-83G)

Table A-5. List of OU Subunits with Remedial Actions

#	OU Subunits^{a,b}	CERCLIS #
1	A-Area Burning/Rubble Pit, 731-1A	28
	A-Area Burning/Rubble Pit, 731-A	
	A-Area Rubble Pit, 731-2A	
	Miscellaneous Chemical Basin, 731-4A	
	Metals Burning Pit, 731-5A	
2	A-Area Miscellaneous Rubble Pile, 731-6A	30
3	A/M Area Groundwater	36
4	B-Area Operable Unit	53
5	C-Area Burning/Rubble Pit, 131-C	31
	Old C-Area Burning/Rubble Pit, NBN	
6	C-Area Groundwater	82
7	C-Area Process Sewer Line as Abandoned, NBN	79
	C-Area Reactor Area Cask Car Railroad Tracks as Abandoned, NBN	
	C-Reactor Discharge Canal, NBN	
	ECODS C-1 (Near C-Area Reactor Discharge Canal), NBN	
	Potential Release from C-Area Disassembly Basin, NBN	
	Potential Release from C-Area Reactor Cooling Water System, 186/190-C	
8	C-Area Reactor Seepage Basin, 904-66G	60
	C-Area Reactor Seepage Basin, 904-67G	
	C-Area Reactor Seepage Basin, 904-68G	
9	Central Shops Burning/Rubble Pit, 631-1G	50
	Central Shops Burning/Rubble Pit, 631-3G	
10	CMP Pit, 080-170G	24
	CMP Pit, 080-171G	
	CMP Pit, 080-180G	
	CMP Pit, 080-181G	
	CMP Pit, 080-182G	
	CMP Pit, 080-183G	
	CMP Pit, 080-190G	
11	C-, K-, L-Reactor Complexes	79, 90, 91
12	D-Area Burning/Rubble Pit, 431-D	15
	D-Area Burning/Rubble Pit, 431-1D	
13	D-Area Ash Basin, 488-D	67
	D-Area Rubble Pit, 431-2D	
14	D-Area Oil Seepage Basin, 631-G	27
15	D-Area Coal Pile Runoff Basin, 489-D	63
	D-Area Waste Oil Facility, 484-10D	
	D-Area Asbestos Pit, 080-20G	
	Combined Spills from 483-D and Associated Areas, NBN	
	D-Area Process Sewer Lines as Abandoned, NBN	
16	E-Area Low Level Waste Facility, 643-26E	86
17	ECODS L-1, NBN	22
	ECODS P-2, NBN	
	ECODS R-1A, R-1B, R-1C, NBN	
	ECODS N-2, NBN	

Table A-5. List of OU Subunits with Remedial Actions *(continued)*

#	OU Subunits^{a,b}	CERCLIS #
18	F-Area Burning/Rubble Pit, 231-1F	14
	F-Area Burning/Rubble Pit, 231-2F	
	F-Area Burning/Rubble Pit, 231-F	
19	F-Area Groundwater Operable Unit	8
20	F-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-41G)	6
	F-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-42G)	
	F-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-43G)	
21	F-Area Retention Basin, 281-3F	23
22	F-Area Tank Farm, Waste Tanks 17 and 20	
	F-Area Tank Farm, Waste Tanks 18 and 19	
	F-Area Tank Farm, Waste Tanks 5 and 6	
23	Ford Building Seepage Basin, 904-91G	58
24	General Separations Area Consolidation Unit including Old Radioactive Waste Burial Ground(643-E) and Old Solvent Tanks (650-01E through 650-22E)	32
	Warner’s Pond, 685-23G and Spill on 03/08/1978 of Unknown Seepage Basin Pipe Leak in H-Area Seepage Basin, NBN and Spill on 02/08/1978 of Unknown H-Area Process Sewer Line Cave-In, NBN	
	H-Area Retention Basin, 281-3H and Spill on 05/01/1956 of Unknown Amount of Retention Basin Pipe Leak, NBN	
	HP-52 Ponds, NBN	
25	H-Area Tank Farm, Waste Tank 12[c]	89
	H-Area Tank Farm, Waste Tank 16[c]	
26	Gunsite 012 Rubble Pile, NBN	78
	Rubble Pile across from Gunsite 012, NBN	
27	H-Area Groundwater OU	9
28	H-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-44G)	7
	H-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-46G)	
	H-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-45G)	
	H-Area Hazardous Waste Management Facility (F-Area Seepage Basin, 904-56G)	
29	Heavy Equipment Wash Basin, NBN	25
30	K-Area Bingham Pump Outage Pit, 643-1G	20
31	K-Area Burning/Rubble Pit, 131-K	40
	K-Area Rubble Pile, 631-20G	
32	K-Area Reactor Seepage Basin, 904-65G	55
33	L-Area Bingham Pump Outage Pit, 643-2G	26
	L-Area Bingham Pump Outage Pit, 643-3G	
	P-Area Bingham Pump Outage Pit, 643-4G	39
34	L-Area Burning/Rubble Pit, 131-L	56
35	L-Area Oil Chemical Basin, 904-83G	17
36	L-Area Reactor Seepage Basin, 904-64G	65
37	L-Area Southern Groundwater, NBN	77
38	M-Area Hazardous Waste Management Facility: Lost Lake, 904-112G	1
	M-Area Hazardous Waste Management Facility: M-Area Settling Basin, 904-51G	
39	M-Area Settling Basin Inactive Process Sewers to Manhole 1, 081-M	19

Table A-5. List of OU Subunits with Remedial Actions *(continued)*

#	OU Subunits[a,b]	CERCLIS #
40	Inactive Clay Process Sewer Lines (Including Potential Release of TCT, TET, TCE, HNO_3, U, Heavy Metals from 321-M Abandoned Sewer Line), NBN	92
	Salvage Yard, 741-A	
	M-Area Underground Sump 321-M #001	
	M-Area Underground Sump 321-M #002	
	M-Area Test Pile Facility, 305-A	
41	Metallurgical Laboratory Hazardous Waste Management Facility, 904-110G	2
42	Mixed Waste Management Facility, 643-28E	33
43	Old F-Area Seepage Basin, 904-49G	16
44	PAR Pond (including the Pre-Cooler Ponds and Canals), 685-G	35
	PAR Pond: Lower Three Runs Integrator Operable Unit Tail Portion (Middle and Lower Subunits)	
45	P-Area Burning/Rubble Pit, 131-P	59
46	P-Area Ash Basin (including Outfall P-007), 188-P	94
	Potential Release from P-Area Disassembly Basin, NBN	
	Potential Release from P-Area Reactor Cooling Water System, 186/190-P	
	P-Area Reactor Area Cask Car Railroad Tracks as Abandoned, NBN	
	P-Area Process Sewer Lines as Abandoned, NBN and Spill on 3/15/79 of 5500 Gallons of Contaminated Water, NBN	
47	P-Area Reactor Seepage Basin, 904-61G	66
	P-Area Reactor Seepage Basin, 904-62G	
	P-Area Reactor Seepage Basin, 904-63G	
48	R-Area Bingham Pump Outage Pit, 643-10G	38
	R-Area Bingham Pump Outage Pit, 643-8G	
	R-Area Bingham Pump Outage Pit, 643-9G	
	R-Area Unknown Pit #1 (Runk-1), NBN	
	R-Area Unknown Pit #2 (Runk-2), NBN	
	R-Area Unknown Pit #3 (Runk-3), NBN	
49	R-Area Burning/Rubble Pit, 131-1R	43
	R-Area Burning/Rubble Pit, 131-R	
	R-Area Rubble Pit, 631-25G	
50	Area on the North Side of Building 105-R	95
	Laydown Area North of 105-R	
	R-Area Cooling Water Effluent Sump, 107-R	
	Potential Release of NaOH/H_2SO_4 from 183-2R, NBN	
	R-Area Ash Basin, 188-R	
	Potential Release from R-Area Disassembly Basin, NBN	
	R-Area Reactor Area Cask Car Railroad Tracks as Abandoned, NBN	
	Release from the Decontamination of R-Reactor Disassembly Basin, NBN	
	Combined Spills North of Building 105-R, NBN	
	R-Area Process Sewer Lines as Abandoned, NBN	
	R-Area Reactor Building, 105-R	

Table A-5. List of OU Subunits with Remedial Actions *(continued/end)*

#	OU Subunits[a,b]	CERCLIS #
51	R-Area Reactor Seepage Basin, 904-103G	25
	R-Area Reactor Seepage Basin, 904-104G	
	R-Area Reactor Seepage Basin, 904-57G	
	R-Area Reactor Seepage Basin, 904-58G	
	R-Area Reactor Seepage Basin, 904-59G	
	R-Area Reactor Seepage Basin, 904-60G	
52	Silverton Road Waste Unit, 731-3A	13
53	SRL Seepage Basin, 904-53G1	47
	SRL Seepage Basin, 904-53G2	
	SRL Seepage Basin, 904-54G	
	SRL Seepage Basin, 904-55G	
54	Neutralization Sump, 678-T	96
	X-001 Outfall Drainage Ditch, NBN	
	TNX Outfall Delta, Lower Discharge Gully and Swamp, NBN	
	TNX-Area Process Sewer Lines and Tile Fields as Abandoned, NBN	
55	TNX Groundwater, 082G	21
	New TNX Seepage Basin, 901-102G	29
	Old TNX Seepage Basin, 904-76G	
	TNX Burying Ground, 643-5G (Including Spill on 1/12/53 of ½ Ton of Uranyl Nitrate, NBN)	
56	Wetland Area at Dunbarton Bay[d]	71

a OU subunits include RCRA/CERCLA units and RCRA regulated units. Deactivation & Decommissioning facilities are not represented.

b Shaded text identifies the SRS OUs evaluated in this report for the fourth phase of the fifth five-year review (i.e., geosynthetic or stabilization/solidification cover systems).

c H-Area Tank Farm (Waste Tank 16) IROD was issued in August 2016. H-Area Tank Farm (Waste Tank 12) ESD to the IROD was issued in April 2017. A remedy evaluation is premature.

d Revision 1 ROD for the Wetland Area at Dunbarton Bay in Support of Steel Creek Integrator Operable Unit was approved on April 11, 2014 by SCDHEC and April 21, 2014 by USEPA. The ROD has not been issued.

EVALUATION OF CHANGES IN STANDARDS AND TOXICITY

This appendix provides an evaluation of changes in standards and toxicity for chemical and radiological constituents since the last five-year remedy review was initiated in 2012 for the Savannah River Site (SRS) operable units (OUs) evaluated in this report. The purpose of the evaluation is to determine if there are any changes in standards or toxicity values that would call into question the protectiveness of the remedy. No protectiveness issues with respect to changes in standards and toxicity were identified in the previous five-year remedy review report (SRNS 2014).

An evaluation was performed for analytes that were identified as constituents of concern (COCs) for the OUs discussed in Appendix C through Appendix Q. These OUs were grouped in the Geosynthetic or Stabilization/Solidification (S/S) cover systems category if the remedial action included a geosynthetic cover system or if a S/S technology (i.e., in-situ grouting) was selected to deter contaminant migration and provide another layer of protection to prevent intrusion and exposure to contaminated material.

The U.S. Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Non Radiological Constituents (May 2016), USEPA Preliminary Remediation Goals (PRGs) for Radionuclides (November 2014), USEPA Surface Preliminary Remediation Goals (SPRGs) for Radionuclides (September 2014), and USEPA Maximum Contaminant Levels (MCLs) for radiological and chemical constituents were evaluated in this review. These values are identified as 2016 RSLs, 2016 PRGs, 2016 SPRGs, and MCLs in Tables B-1 through B-5 and were compared to the values available in 2012 when the last five-year remedy review for these OUs was initiated. Standards and toxicity values for both the industrial worker and hypothetical residential receptor are provided for comparative purposes for most media.

The comparison tables do not make any distinction between COCs that were the primary drivers for the selected remedial action and other analytes that were simply addressed through the same remedy. Most importantly, the values presented in Tables B-1 through B-5 are not cleanup levels and should not be considered remedial goals unless otherwise noted in the OU-specific remedy reviews. For these reasons, the information in Appendix B is not stand alone, but must be considered in context with the information and selected remedy presented in the OU-specific reviews located in Appendix C through Appendix Q.

Changes to a standard or toxicity factor is unique to each analyte and is often related to revisions in exposure assumptions, reference doses, cancer potency factors, and exposure pathways used to calculate the value. For the reasons explained in the previous paragraph, the impact that more stringent RSLs or PRGs have on protectiveness must be considered with respect to the OU-specific remedy. In most cases, a change in a standard or toxicity value is irrelevant because the analyte(s) may no longer be present or is (are) significantly reduced if the selected remedy also included excavation and offsite disposal. In addition, exposure to contaminants may be controlled by a cover system.

The evaluation for each remedy to determine if exposure assumptions, toxicity data, cleanup levels, and remedial action objectives are still valid is discussed in each OU-specific review located in Appendix C through Appendix Q. The evaluations shown in Tables B-1 through B-5 confirm that there have been no significant changes in standards or toxicity factors that would affect the protectiveness of the remedies evaluated in this report.

DOCUMENTS REVIEWED

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina*, SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

Table B-1. Comparison of Nonradiological Standards in Soil Media

Analyte	2012 RSLs[a]		2016 RSLs[b]		CERCLIS Number(s)[c]
	Residential Soil (mg/kg)	**Industrial Worker Soil (mg/kg)**	**Residential Soil (mg/kg)**	**Industrial Worker Soil (mg/kg)**	
Aluminum	7.7E+04	9.9E+05	7.7E+04	1.1E+06	17
Antimony	3.1E+01	4.1E+02	3.1E+01	4.7E+02	67
Arsenic	3.9E-01	1.6E+00	6.8E-01	3.0E+00	17, 23, 32, 66, 67, 94
Barium	1.5E+04	1.9E+05	1.5E+04	2.2E+05	43, 67
Beryllium	1.6E+02	2.0E+03	1.6E+02	2.3E+03	67
Cadmium	7.0E+01	8.0E+02	7.1E+01	9.8E+02	17, 32, 43
Chromium	2.9E-01	5.6E+00	3.0E-01	6.3E+00	17
Copper	3.1E+03	4.1E+04	3.1E+03	4.7E+04	43
Iron	5.5E+04	7.2E+05	5.5E+04	8.2E+05	67
Lead	4.0E+02	8.0E+02	4.0E+02	8.0E+02	17, 32, 43
Manganese	1.8E+03	2.3E+04	1.8E+03	2.6E+04	43
Mercury	1.0E+01	4.3E+01	1.1E+01	4.6E+01	32, 67, 96
Nickel	1.5E+03	2.0E+04	1.5E+03	2.2E+04	17
Polychlorinated biphenyls (PCBs)					
~Aroclor 1254	2.2E-01	7.4E-01	2.4E-01	9.7E-01	67, 94
~Aroclor 1260	2.2E-01	7.4E-01	2.4E-01	9.9E-01	67, 96
Polyaromatic Hydrocarbons (PAHs)					
~Benzo[a]pyrene	1.5E-02	2.1E-01	1.6E-02	2.9E-01	67
Selenium	3.9E+02	5.1E+03	3.9E+02	5.8E+03	67
Tetrachloroethylene (PCE)	2.2E+01	1.1E+02	2.4E+01	1.0E+02	43, 94
Thallium	7.8E-01	1.0E+01	7.8E-01	1.2E+01	17, 23, 43, 67
Trichloroethylene (TCE)	9.1E-01	6.4E+00	9.4E-01	6.0E+00	94
Uranium	2.3E+02	3.1E+03	2.3E+02	3.5E+03	94
Vanadium	3.9E+02	5.2E+03	3.9E+02	5.8E+03	17, 67
Zinc	2.3E+04	3.1E+05	2.3E+04	3.5E+05	43, 67

a USEPA Nonradiological RSLs, May 2012.
b USEPA Nonradiological RSLs, May 2016.
c OUs and corresponding CERCLIS number(s) are identified in Appendix A, Table A-5.

mg/kg = milligram per kilogram

Table B-2. Comparison of Radiological Standards in Soil Media

Analyte	2012 PRGs[a]		2016 PRGs[b]		CERCLIS Number(s)[c]
	Residential Soil (pCi/g)	Industrial Worker Soil (pCi/g)	Residential Soil (pCi/g)	Industrial Worker Soil (pCi/g)	
Actinium-228	6.79E+02	9.88E+02	7.35E+02	1.1E+03	23, 67, 96
Americium-241	1.89E+00	4.82E+00	2.27E+00	4.7E+00	16, 17, 32, 55, 94
Americium-243(+D)	1.57E-01	2.88E-01	1.67E-01	2.6E-01	94
Antimony-125(+D)	4.72E-01	6.88E-01	4.13E-01[d]	6.0E-01[d]	17, 94
Carbon-14	2.79E+02	1.11E+03	3.17E+02	1.1E+03	32, 55, 60, 94
Cobalt-60	3.90E-02	5.78E-02	3.30E-02	4.8E-02	16, 17, 32, 55, 65, 66, 94
Curium-243	3.33E-01	5.75E-01	3.50E-01	5.4E-01	32, 94
Curium -244	7.25E+00	3.41E+01	8.76E+00	3.3E+01	17, 94
Curium -245	3.95E-01	7.40E-01	3.87E-01	6.2E-01	94
Cesium-137(+D)	6.23E-02	1.03E-01	6.05E-02	9.1E-02	16, 17, 23, 32, 55, 60, 65, 66, 94
Europium-152	4.06E-02	6.43E-02	3.87E-02	5.7E-02	17, 94
Europium-154	4.80E-02	7.35E-02	4.73E-02	7.0E-02	16, 17, 32, 94
Tritium (H-3)	9.34E-01	1.27E+00	2.37E-01	3.0E-01	32, 94
Iodine-129	2.49E+00	9.49E+00	2.75E+00	9.2E+00	32, 94
Potassium-40	1.50E-01	2.65E-01	1.44E-01	2.2E-01	16, 17, 23, 32, 60, 67, 94
Molybdenum-93	1.14E+02	2.99E+02	1.38E+02	3.2E+02	94
Sodium-22	9.04E-02	1.32E-01	7.77E-02	1.1E-01	94
Niobium-94	1.60E-02	2.79E-02	1.60E-02	2.4E-02	94
Niobium-95	7.11E+00	1.03E+01	6.17E+00	9.0E+00	16
Nickel-59	1.08E+03	1.11E+04	7.44E+02	2.1E+03	94
Nickel-63	4.93E+02	4.99E+03	5.72E+02	4.9E+03	60, 94
Neptunium-237(+D)	1.26E-01	2.25E-01	1.33E-01	2.0E-01	32
Lead-212	3.60E+03	5.33E+03	3.40E+03	5.0E+03	67, 96
Promethium-147	2.38E+04	3.46E+04	1.27E+03	1.1E+04	65
Plutonium-238	3.23E+00	1.44E+01	4.28E+00	1.4E+01	17, 23, 32, 94
Plutonium-239	2.82E+00	1.25E+01	3.79E+00	1.2E+01	17, 32, 55, 60, 65, 66, 94
Plutonium-240	2.83E+00	1.27E+01	3.81E+00	1.2E+01	23, 32, 55, 94
Radium-226(+D)	1.27E-02	2.23E-02	1.38E-02	2.1E-02	23, 32, 67
Radium-228(+D)	3.19E-02	4.84E-02	8.82E-02	1.3E-01	16, 60, 67, 94, 96

Table B-2. Comparison of Radiological Standards in Soil Media (continued/end)

Analyte	2012 PRGs[a]		2016 PRGs[b]		CERCLIS Number(s)[c]
	Residential Soil (pCi/g)	Industrial Worker Soil (pCi/g)	Residential Soil (pCi/g)	Industrial Worker Soil (pCi/g)	
Strontium-90	3.71E+00	8.91E+00	4.20E+00	9.0E+00	17, 32, 55, 60, 65, 66, 94
Technetium-99	9.61E+01	7.96E+02	1.13E+02	7.7E+02	32
Thorium-228(+D)	1.54E-01	2.30E-01	2.80E+01[e]	1.1E+02[e]	32, 67, 94, 96
Thorium-234	1.31E+02	2.75E+03	1.22E+03	2.4E+03	67
Uranium-234	4.92E+00	2.91E+01	5.83E+00	2.8E+01	17, 67, 96
Uranium-235(+D)	1.94E-01	3.48E-01	1.94E-01	3.0E-01	17, 32, 67, 96
Uranium-238(+D)	7.25E-01	1.49E+00	7.98E-01	1.4E+00	17, 32, 67, 94, 96

a USEPA Radiological PRGs, August 2010.
b USEPA Radiological PRGs, November 2014.
c OUs and corresponding CERCLIS number(s) are identified in Appendix A, Table A-5.
d PRG shown for Antimony-125 only. PRG for Antimony-125+D is not published in the November 2014 update
e PRG shown for Thorium-228 only. PRG for Thorium-228+D is not published in the November 2014 update.

pCi/g = picoCuries per gram

Table B-3. Comparison of Radiological Standards in Concrete Media

Analyte	2012 SPRGs[a]		2016 SPRGs[b]		CERCLIS Number(s)[c]
	Residential Concrete (pCi/g)	Industrial Worker Concrete (pCi/g)	Residential Concrete (pCi/g)	Industrial Worker Concrete (pCi/g)	
Americium-241	NA	7.76+00	1.38E+00	6.04E+00	48
Americium-242(m)	NA	1.18E+02	4.12E+01	1.79E+02	48
Americium-243(+D)	NA	3.44E-01	6.24E-02	2.72E-01	48
Argon-39	NA	3.8E+02	8.29E+01	3.62E+02	48
Barium-133	NA	3.06E-01	7.07E-02	3.01E-01	48, 94
Bismuth-210(m)	NA	2.16E-01	4.75E-02	2.07E-01	48
Carbon-14	NA	8.83E+03	6.09E+03	2.66E+04	48, 94
Cerium-137	NA	8.26E+04	1.23E+04	5.15E+04	48
Chlorine-36	NA	1.24E+02	3.12E+01	1.36E+02	48
Cobalt-60	NA	6.02E-02	1.66E-02	7.00E-02	48, 94
Curium-243	NA	6.94E-01	1.30E-01	5.60E-01	48
Cesium-137(+D)	NA	1.13E-01	2.77E-02	1.20E-01	48, 94
Europium-152	NA	7.37E-02	1.62E-02	6.95E-02	48, 94
Europium-154	NA	8.58E-02	1.90E-02	8.07E-02	48, 94
Iron-55	NA	2.21E+05	--[d]	--[d]	94
Potassium-40	NA	2.74E-01	7.36E-02	3.22E-01	48, 94
Plutonium-239	NA	1.30E+02	--[e]	--[e]	48
Plutonium-240	NA	1.41E+02	--[e]	--[e]	48
Molybdenum-93	NA	8.47E+02	1.20E+02	5.23E+02	48, 94
Niobium-94	NA	3.00E-02	7.60E-03	3.32E-02	48, 94
Silver-108(m)	NA	3.26E-02	7.41E-03	3.23E-02	48
Nickel-59	NA	1.23E+05	--[d]	--[d]	48, 94
Nickel-63	NA	5.55E+04	--[d]	--[d]	48, 94
Strontium-90(+D)	NA	1.43E+01	1.69E+00	7.29E+00	48, 94
Technetium-99	NA	2.24E+03	--[e]	--[e]	94
Tin-121(m)	NA	2.84E+02	5.04E+01	2.18E+02	48
Uranium-238(+D)	NA	1.90E+00	2.63E-01	1.15E+00	48, 94

[a] Radiological PRGs for concrete, *Radionuclide Preliminary Remediation Goals for Concrete Media* (Engineering Calculation, K-CLC-G-00086, Rev.0). This information was not reported in the previous five-year remedy review report (SRNS 2014) but is provided for historical purposes. NA=2012 residential PRGs for concrete media are not available.

[b] USEPA Radiological SPRGs for concrete, September 2014. SPRGs also represent metal (building components) media.

[c] OUs and corresponding CERCLIS number(s) are identified in Appendix A, Table A-5.

[d] SPRGs for Iron-55, Nickel-59 and Nickel-63 are not published in the September 2014 update.

[e] SPRG website currently being updated; historical data not available at this time for Plutonium-239, Plutonium-240 and Technetium-99.

pCi/g = picoCuries per gram

Table B-4. Radiological Standards in Groundwater Media (MCLs)

Analyte	MCL[a] (µg/L)	CERCLIS Number[b]
Iodine-129	1[c]	16

a USEPA Implementation Guidance for Radionuclides, March 2002. Comparative analysis is not shown for MCLs because standards have not changed since the previous five-year remedy review.

b OUs and corresponding CERCLIS number(s) are identified in Appendix A, Table A-5

c Gross alpha particle activity = 15 pCi/L

Table B-5. Non Radiological Standards in Groundwater Media (MCLs)

Analyte	MCL[a] (µg/L)	CERCLIS Number[b]
Arsenic	10	67
Thallium	2	67

a Current MCL table is provided for reference only. Comparative analysis is not shown because MCLs have not changed since the previous five-year remedy review.

b OUs and corresponding CERCLIS number(s) are identified in Appendix A, Table A-5.

This page is intentionally left blank.

B-AREA OPERABLE UNIT

I. Introduction

This report is the first five-year review for the B-Area Operable Unit (BAOU). The BAOU consists of the Heavy Water Components Test Reactor (770-U) (HWCTR) and the Early Construction and Operational Disposal Sites (ECODS) B-3 and B-5. The review was conducted from August 2016 through November 2016. The selected remedial action for the ECODS B-3 and B-5 subunits was No Further Action (NFA). The selected remedial action for the HWCTR is land use controls (LUCs) with groundwater monitoring. Contaminants have been left in place at the HWCTR at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the BAOU (HWCTR) is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table C-1 lists the chronology of site events for the BAOU.

III. Background

The BAOU is a Resource Conservation Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media of concern is activated metal and concrete associated with the HWCTR facility and soil associated with the ECODS B-3 and B-5 subunits.

Although groundwater is not part of BAOU, the selected remedy includes groundwater monitoring to evaluate the effectiveness of the in situ stabilization/solidification (S/S) remedy.

Physical Characteristics

BAOU is located in the northwest portion of the SRS (Figure C-1). It is located in the Upper Three Runs watershed and is approximately 4.8 km (3 mi) from the nearest property boundary. Depth to groundwater in BAOU is about 30.5 m (100 ft) below ground surface (bgs) near the HWCTR and 15.2 m (50 ft) bgs near the ECODS B-3 and B-5. The HWCTR facility is located on approximately 0.81 hectares (2 acres). The aboveground portions of the facility included a dome shaped containment building, which was 21.3 m (70 ft) in diameter and 19.8-m (65-ft) above grade, and numerous support equipment including piping, tanks, recompressors, shielded transfer fuel coffin, etc. The below-grade containment building extended 16 m (52 ft) below grade and housed the reactor and coolant systems, the spent fuel basin, and the reactor instrumentation. ECODS B-3 and B-5 are located approximately 183 m (600 ft) north of the northeast corner of the SRS Sanitary Landfill (Figure C-2). The construction waste from B Area was buried in these shallow, elongated trenches, and several trenches were also used as burn pits for combustible waste disposal.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the BAOU as being within an industrial area. The future land use is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

Heavy Water Components Test Reactor (HWCTR)

The HWCTR facility was a pressurized heavy water reactor designed to test fuel designs for heavy water power reactors (Figure C-3). The test reactor was not a defense-related facility like the five production reactors at SRS. The HWCTR facility operated from March 1962 until December 1964 when operations were terminated and the facility was placed in a standby condition. All systems that contained heavy water, as well as the spent fuel basin and its circulating system were drained. Low-level residual radioactivity and contamination from operation and maintenance of the reactor and its associated components remained inside the containment building. The radiation levels in most accessible areas of the HWCTR containment building were low (i.e., less than 1 millirem per hour) and the residual radioactivity and contamination from operation and maintenance of the reactor and its associated components remained inside the containment building.

In 2009, the total amount of radioactivity (activated metal and concrete) exceeded the calculated risk thresholds. The majority of the radioactivity in the HWCTR was associated with activated metal in the internal structure of the reactor vessel and associated steam generators. In addition, the facility also contained hazardous substances such as lead, asbestos, and polychlorinated biphenyls associated with the existing equipment or previous operations (e.g., lights, piping, paints, etc.).

A removal action for HWCTR was completed in 2011, which included removal and disposal of the reactor vessel, steam generators, steel containment dome, and all above-grade components of the facility (with the exception of the transfer coffin refueling machine) (SRNS 2011b) (Figure C-3). Following removal of these items, the transfer coffin refueling machine was placed in the reactor facility void space and the below-grade portions of the facility were sealed in place with a grout material to form a stabilized structure. The area was then covered with concrete at the ground surface to prevent infiltration and eliminate direct exposure for future industrial workers to contaminants left in place. Warning signs were installed, ongoing surveillance and maintenance activities were initiated, and LUCs were implemented as part of the removal action. Four groundwater monitoring wells were installed in 2009 to confirm that there was no impact to groundwater from historical releases and to provide a future monitoring network

Figure C-4 provides a current photograph of HWCTR.

ECODS B-3 and B-5

ECODS B-3 and B-5 were two of the twenty-five ECODS identified at SRS that were used to dispose of waste material associated with the construction of SRS facilities. These units were used during the construction of B Area from 1951 to 1955. Prior to construction, the land was primarily used for farming. Human health refined constituents of concern (RCOCs) were found in the surface soils at ECODS B-3 and B-5. In addition, the potential for exposure to asbestos that may have been buried was also identified as a problem that required a removal action response. The Removal Site Evaluation Report/ Engineering Evaluation/Cost Analysis report for ECODS B-3 and B-5 (SRNS 2010) identified the objectives of the removal action and evaluated the alternatives that addressed the potential threats from release of contaminants to the environment.

The removal action for this area included the excavation of approximately 5,620 m^3 (7,350 yd^3) from ECODS B-3, and 918 m^3 (1,200 yd^3) from ECODS B-5 that impacted soil to a depth of 3.7 m (12 ft). The excavations extended to a minimum of 0.6 m (2 ft) beyond the waste (both horizontally and vertically) in each area. Primarily cafeteria waste was identified in the excavated media at both ECODS. All excavated material was transported to the Three Rivers Landfill, which is approved for off-site disposal of CERCLA waste. The affected area was subsequently backfilled with clean fill material to a depth of approximately 3.7 m (12 ft), contoured, graded, and stabilized for establishment of vegetative cover. The filled/contoured/graded area was then seeded for vegetative stabilization. An evaluation of the analytical results of the clean fill material indicated that it met the requirements for an unrestricted (residential) land use scenario. The Removal Action Report (SRNS 2011a) documents the USDOE performance of the Non-Time Critical Removal (NTCR) action. The removal action successfully addressed both the surficial exposure issues as well as the potential for exposure to buried waste in the subsurface.

Initial Response

No initial response actions were taken at BAOU prior to the remedial investigation as part of the standard CERCLA process.

Basis for Taking Action

Heavy Water Components Test Reactor (HWCTR)

Approximately 2,100 curies of radioactivity remained in the HWCTR, which exceeded the industrial worker risk threshold (risk >1E-06) and principal threat source material levels (risk >1E-03) should exposure occur. More than 99 percent of the radioactivity in the facility was contained in the internal structure of the reactor vessel and accompanying steam generators.

Uncertainty associated with the potential for precipitation to infiltrate the above-grade portion of the facility over time and carry residual contamination into the floor drain system or through potential future cracks in the building subfloor over time existed. Contaminant migration analyses showed that the only radionuclide predicted to potentially contaminate groundwater at a level exceeding its maximum contaminant level (MCL) was iodine-129. The 2009 to 2010 sampling results from the groundwater monitoring wells acknowledged that there was no historical impact to groundwater from HWCTR operations or the former underground storage tank location, and specifically, iodine-129 was not detected.

ECODS B-3 and B-5

At ECODs B-3, pesticides (alpha-chlordane, gamma-chlordane, DDD, DDE, DDT, heptachlor, and heptachlor epoxide) were identified as the human health RCOCs for both the future resident and the future industrial worker.

At ECODS B-5, arsenic was identified as a human health RCOC for both the future resident scenario and the future industrial worker scenario in the surface soil interval.

Analyses, including groundwater sampling and modeling, concluded that contaminant migration is not an issue for ECODS B-3 and B-5

IV. Remedial Actions

Remedy Selection

Heavy Water Components Test Reactor (HWCTR)

Per the Record of Decision (ROD) (SRNS 2013), the following remedial action objectives (RAOs) were identified for the HWCTR:

- Eliminate or control all routes of exposure to residual below-grade radioactive or chemical contamination posing human health risks exceeding 1E-06 in media or structures associated with the HWCTR facility; and
- Prevent the potential for migration of residual radionuclides and chemical constituents remaining below grade so that they will not contribute contamination to groundwater above MCLs.

The selected remedial action for the HWCTR portion of the BAOU is LUCs with Groundwater Monitoring. The NTCR action (i.e., implementation of a concrete cover, access control signs) reduced human health risk by eliminating the exposure pathway and minimized the potential of contaminant to migrate to groundwater. The remedial alternative incorporates LUCs from the NTCR action as part of the final remedial action and also provides additional assurance regarding the protection of the groundwater by inclusion of a monitoring program.

ECODS B-3 and B-5

The selected remedy for ECODS B-3 and B-5 is NFA because there is no waste to treat, no institutional or engineering controls, and no applicable or relevant and appropriate requirements after completion of the NTCR action. The ECODS B-3 and B-5 subunit poses no risk to human health and the environment and supports unrestricted land use. Therefore, no RAOs are required and no remedial goals are established for ECODS B-3 and B-5.

Remedy Implementation

The remedial actions implemented for the HWCTR in accordance with the ROD (SRNS 2013) are listed below:

- Implementation of LUCs for 0.8 hectares (2 acres) by installing warning signs, keeping site access/site use controls in place while the property is owned and operated by USDOE, and if the property is ever passed to nonfederal ownership, deed notifications would be provided. The LUCs also include the concrete cover installed during implementation of the NTCR action.
- Although groundwater is not part of the BAOU, periodic groundwater monitoring will be conducted to confirm that there is no future impact to groundwater should an unacceptable degradation of the stabilization materials (i.e., in-situ grout and surface concrete cover) occur. The groundwater monitoring consists of sampling the uppermost aquifer at HWCTR using the existing network of four wells (Figure C-5). Groundwater samples will be collected every five years to support the five-year remedy reviews for the HWCTR facility end-state.

System Operations/Operation and Maintenance

There are no system operational requirements.

The BAOU maintenance activities that have been implemented in accordance with the ROD are as follows:

- Annual site inspections and site maintenance (verify warning signs are intact, verify integrity of the concrete cover, adequate vegetative cover exist, erosion controls are in place and drainage systems are functioning properly); and
- Site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit) have been implemented.

Table C-2 compares the actual O&M costs over the last three years since the remedial action started in Fiscal Year (FY) 2014 to the estimated direct O&M costs from the ROD (SRNS 2013). The estimated O&M cost for FY2014 to FY2016 was $11,500 for annual inspections and maintenance and access controls. The actual O&M cost for FY2014 to FY2016 is $25,052. The actual costs are higher than the estimated costs because routine site maintenance costs were underestimated in the ROD. There has been no major maintenance costs associated with the cover system since the completion of the remedial action.

V. Progress since Last Review

This is the first five-year review. Therefore, there is no previous protectiveness statement.

VI. Five-Year Review Process

The following tasks were performed as part of the five-year review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU and interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment C-1 with the purpose of assessing the protectiveness of the remedy and functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Four groundwater monitoring wells, BMW001D, BMW002D, BMW003D, and BMW004D, were sampled and analyzed in the third quarter of 2016 for the following constituents: gross alpha, nonvolatile beta, iodine-129, tritium, lead, Aroclor 1254, and Aroclor 1260. The 2016 sampling results were compared to the 2010 sampling results (Table C-3). Aroclor 1254, Aroclor 1260, and iodine-129 continue to be non-detect. Lead was detected in all four wells in 2016, but below the MCL (15 µg/L). Gross alpha continues to be detected above the MCL (15 pCi/L) in wells BMW002D, BMW003D, and BMW004D, and nonvolatile beta was detected slightly above the MCL (50 pCi/L) in wells

BMW002D and BMW003D. Tritium was detected in three of four wells (BMW001D, BMW003D, and BMW004D), but at concentrations below its MCL (20 pCi/mL).

The gross alpha results obtained since 2009 correlate with turbidity in the wells, and there is no elevated tritium or iodine-129 in groundwater. Therefore, there were no contaminant migration concerns from review of the groundwater data and no significant changes from 2010 to 2016 that would call into question the effectiveness of the *in situ* S/S and cover system remedy at HWCTR. Prior to the next sampling event, the BMW wells will be redeveloped to reduce the turbidity, followed by filtering of samples and speciation, as needed, for radionuclides.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M Staff Member, on September 20, 2016 at the O&M organization offices. No issues were identified as an outcome of these interviews.

The BAOU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on December 8, 2016. Annual inspections since 2011 have documented the presence of small cracks in the surface of the concrete cover. Although small cracks were observed again in 2016, there is no infiltration of precipitation because the below-grade portions of the facility were grouted and sealed in place forming a stabilized structure. The conditions have not changed to the extent that would compromise the stabilization and containment of the residual waste left in place. Annual monitoring of the cap for crack growth and settlement will continue and repairs performed as needed. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No problems regarding the protection of the remedy for this OU as implemented were identified during the inspection.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The removal and disposal action of the contaminated sediment in ECODS B-3 and B-5 proved to be successful in preventing further leaching of contaminants into the soil. The potential for exposure to asbestos in the subsurface has been eliminated by virtue of the removal action. An evaluation of the analytical results from the clean fill material indicated that ECODS B-3 and B-5 met the requirements for an unrestricted (residential) land use scenario.
- The removal and disposal of the reactor vessel, steam generators, steel containment dome, and all above-grade components of the facility (with the exception of the transfer coffin refueling machine) eliminated exposure of radioactive or chemical contamination posing human health risks exceeding 1E-06 in media or structures associated with the HWCTR facility. These contaminated components were properly disposed of and NFA was necessary for this equipment.
- The removal action of in-situ grouting and stabilization of the HWCTR was effective in eliminating or controlling all routes of exposure to residual below grade radioactive or chemical contamination posing human health risk exceeding 1E-06 in media or structures associated with the HWCTR facility. Annual inspection and maintenance data do not indicate a history of remedy problems or potential remedy failure, which could place protectiveness at risk.

Following completion of the removal actions, the selected remedy for HWCTR of LUCs and groundwater monitoring is effective in preventing exposure to radioactive or chemical contamination posing human health risk exceeding 1E-06 and the potential migration of residual radionuclides and chemicals constituents remaining below grade to groundwater above MCLs. The four BAOU monitoring wells provide additional assurance regarding the effectiveness of the *in situ* S/S remedy. A review of the annual inspection reports, which began in 2011 after completion of the removal action, identified no issues that required corrective action.

The Land Use Control Implementation Plan for BAOU governs LUC implementation, maintenance, monitoring, reporting, and enforcement (SRNS 2014). All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Because the contaminants have been stabilized and exposure to the activated metal and concrete has been mitigated via in-situ grouting and stabilization of HWCTR, changes in standards or to-be-considered guidance would not impact the risks associated with the BAOU.

The USEPA standards and toxicity values have been updated since implementation of the remedy as shown in Appendix B. The changes to the values for COCs at the HWCTR were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that could call into question the protectiveness of the remedy. Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

Elevated gross alpha concentrations were detected in the BMW groundwater wells at the BAOU likely due to turbidity issues. The USDOE recommends redevelopment of the BMW wells prior to the next sampling event to reduce turbidity, followed by filtering of samples and speciation, as needed, for radionuclides. The sampling results from the redeveloped wells will be reported in the Sixth Five-Year Remedy Review Report for SRS OUs with Geosynthetic or S/S Cover Systems.

Table C-4 presents the recommendations for the BAOU.

X. Protectiveness Statement(s)

The remedy is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled with LUCs to prevent exposure to contaminated building components and equipment (i.e., metal and concrete media) remaining below grade in the HWCTR facility. Groundwater monitoring continues to evaluate the effectiveness of the in situ S/S remedy to prevent potential migration of residual contaminants to groundwater. All threats to contaminated building components and equipment (i.e., activated metal and concrete) at the BAOU have been addressed through in situ S/S, concrete cover, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the BAOU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2010. *Removal Site Evaluation Report / Engineering Evaluation / Cost Analysis (RSER/EE/CA) for the Early Construction and Operational Disposal Sites (ECODS) B-3* *and B-5 Operable Unit (OU) (U)*, Revision 1, SRNS-RP-2009-01443, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2011a. *Removal Action Report (RAR) for the Early Construction and Operational Disposal Sites (ECODS) B-3 and B-5 Operable Unit (OU) (U)*, SRNS-RP-2011-00210, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2011b. *Removal Action Report (RAR) for the Heavy Water Components Test Reactor (770-U) (U)*, SRNS-RP-2011-01213, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2013. *Record of Decision Remedial Alternative Selection for the B-Area Operable Unit (U)*, SRNS-RP-2012-00354, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014. *Land Use Control Implementation Plan (LUCIP) for the B-Area Operable Unit*, SRNS-RP-2013-00113, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC

SRNS, 2015. *Corrective Measures Implementation Report (CMIR)/ Remedial Action Completion Report (RACR) for B-Area Operable Unit (U)*, SRNS-RP-2014-00517, Revision 1, Savannah River Nuclear Solutions LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest update, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist B-Area Operable Unit, (U)*, ER-IDS-019-056, Inspection period 2012 through 2016 (annually)

This page is intentionally left blank.

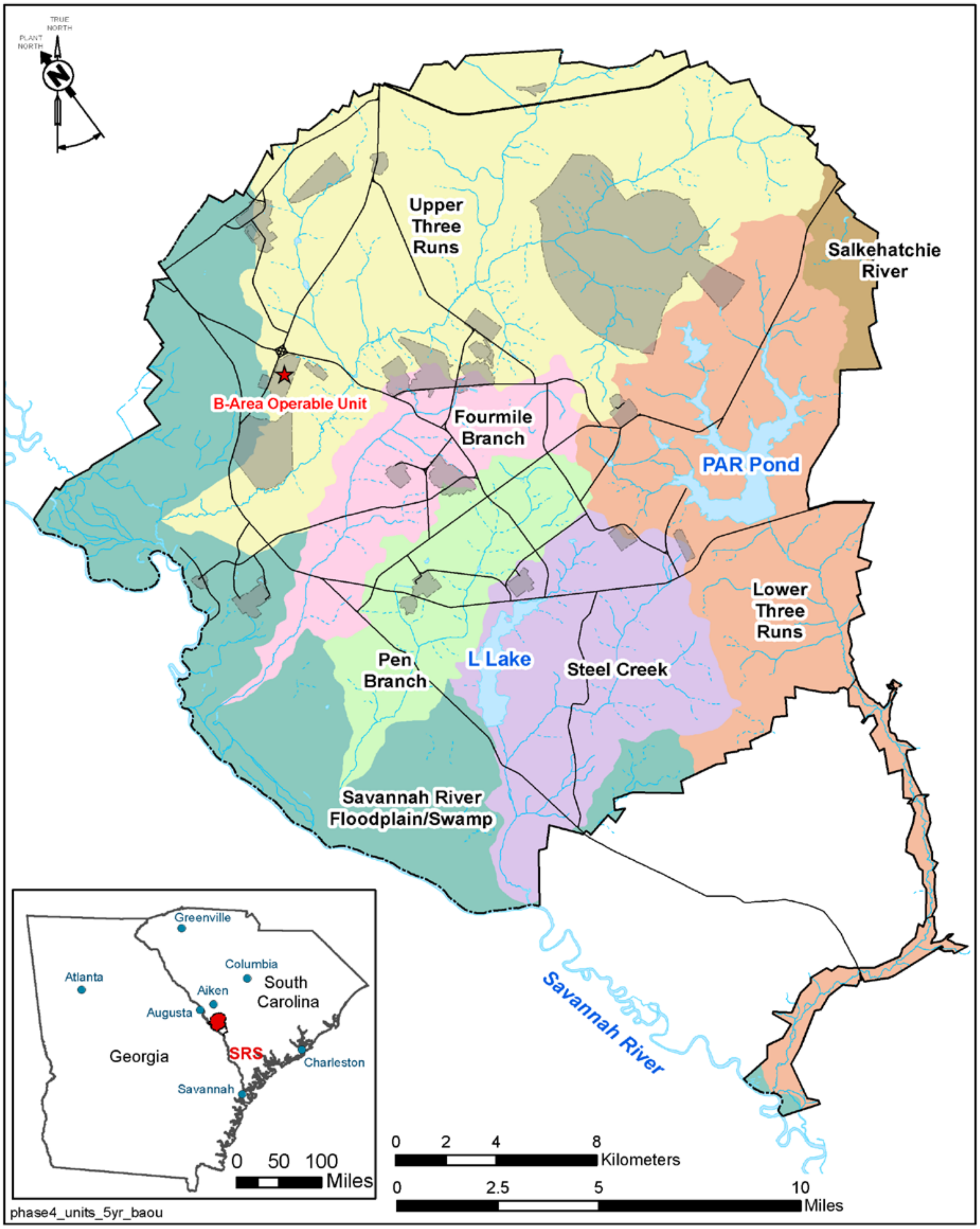


Figure C-1. Location of the BAOU at SRS

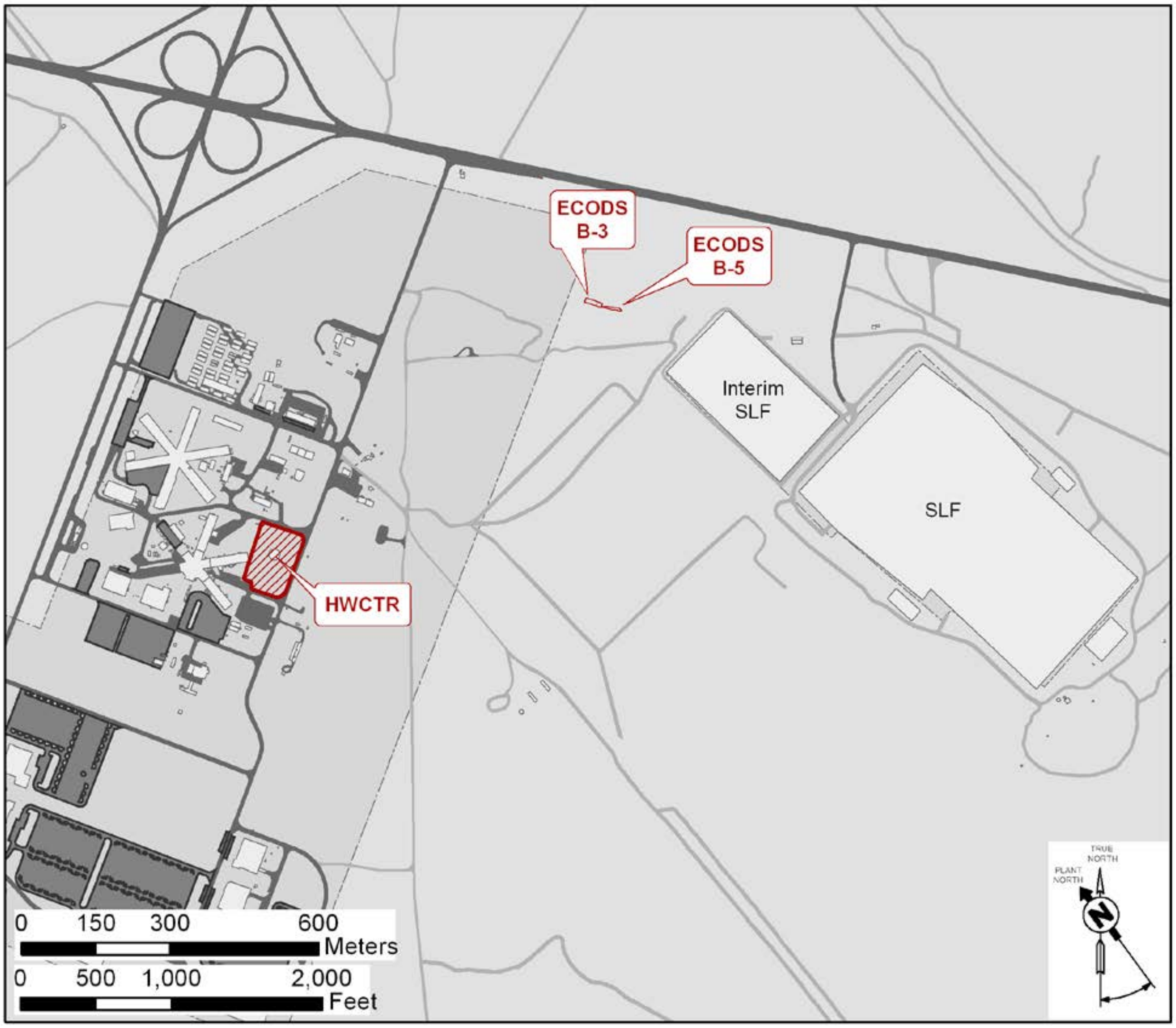


Figure C-2. Location of the BAOU Subunits

Figure C-3. **Photographs of HWCTR Prior to (2009) and During Remediation (2011)**

Figure C-4. Photograph of the Remediated HWCTR (2016)

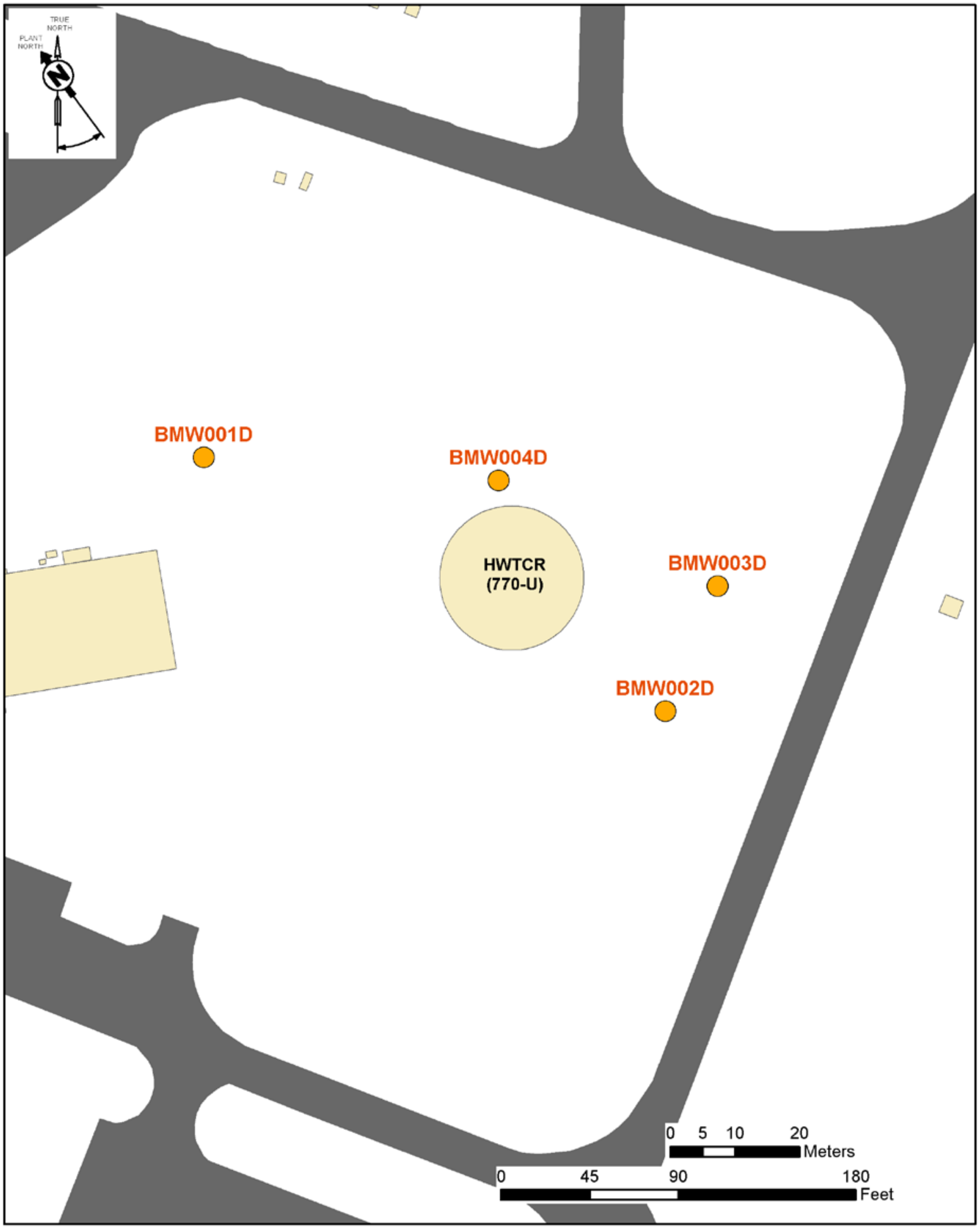


Figure C-5. Location of Groundwater Sampling Wells at HWCTR

This page is intentionally left blank.

Table C-1. Chronology of OU Events

Event	Date
BAOU Field Start	January 11, 2010
HWTCR Removal Action Start	April 14, 2010
ECODS B-3 and B-5 Removal Action Start	July 23, 2010
HWTCR Field Complete	June 27, 2011*
ROD Issuance	April 16, 2013
Remedial Action Start	April 9, 2014
Previous Five-Year Reviews Issuance	None

* Core Team agreed at the completion of the walk down that the HWCTR decommissioning and construction field activities have been completed. Only deficiency noted was with the wording on the access control signs. The wording was corrected and the signs were installed (SRNS 2015).

Table C-2. Comparison of Actual vs. Estimated O&M

	FY2012	FY2013	FY2014	FY2015	FY2016	3-Year Total
Total O&M Actual Costs ($)	N/A	N/A	5,214	5,434	14,404	25,052
Total ROD Estimated Direct O&M Costs ($)	N/A	N/A	500	5,500	5,500	11,500

N/A – cost information is not applicable for FY2012 to FY2013 because the remedial action began in FY2014.

Table C-3. BAOU Groundwater Sampling Results, 2016 Compared to 2010

Contaminant	MCL/PRG	Well	2010 Results	2016 Max Results	Unit
Aroclor 1254	7.8E-03	BMW001D	ND	ND	µg/L
		BMW002D	ND	ND	µg/L
		BMW003D	ND	ND	µg/L
		BMW004D	ND	ND	µg/L
Aroclor 1260	7.8E-03	BMW001D	ND	ND	µg/L
		BMW002D	ND	ND	µg/L
		BMW003D	ND	ND	µg/L
		BMW004D	ND	ND	µg/L
Lead	1.5E+01	BMW001D	ND	1.6E+00	µg/L
		BMW002D	1.9E+01	1.4E+01	µg/L
		BMW003D	5.9E+00	3.4E+00	µg/L
		BMW004D	3.6E+01	8.8E+00	µg/L
Iodine-129	2.3E-01	BMW001D	ND	ND	ρCi/L
		BMW002D	ND	ND	ρCi/L
		BMW003D	ND	ND	ρCi/L
		BMW004D	ND	ND	ρCi/L
Tritium	2.0E+01	BMW001D	5.9E-01	5.7E-01	ρCi/mL
		BMW002D	8.6E-01	6.6E-01	ρCi/mL
		BMW003D	1.1E+00	5.2E-01	ρCi/mL
		BMW004D	1.1E+00	7.4E-01	ρCi/mL
Gross Alpha	1.5E+01	BMW001D	8.5E+00	5.9E+00	ρCi/L
		BMW002D	2.5E+01	1.0E+02	ρCi/L
		BMW003D	1.7E+01	2.2E+02	ρCi/L
		BMW004D	5.3E+01	6.9E+01	ρCi/L
Nonvolatile Beta	5.0E+01	BMW001D	6.5E+00	5.3E+00	ρCi/L
		BMW002D	2.5E+01	5.3E+01	ρCi/L
		BMW003D	1.4E+01	6.1E+01	ρCi/L
		BMW004D	4.4E+01	2.8E+01	ρCi/L

Shading indicates concentration is greater than the MCL/PRG.
ND = non-detect

Table C-4. Recommendations and Follow-up Actions for the B-Area Operable Unit

Issues	Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
					Current	Future
Elevated gross alpha concentrations in groundwater samples are likely related to high turbidity in the BMW wells.	Redevelop the BMW wells in order to decrease turbidity in the wells prior to the next sampling event. Filter samples from redeveloped wells and perform speciation, as needed, for radionuclides. Report results in the Sixth Five Year Remedy Review Report.	USDOE	USEPA/ SCDHEC	Third Quarter of 2021	N	N

This page is intentionally left blank.

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit

I. SITE INFORMATION

Site Name:	**B-Area Operable Unit**	**Date of Inspection:**	**7/27/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #48**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **80°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other In-situ Stabilization and Groundwater Monitoring

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. O&M Staff: Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 09/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. O&M Staff: Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 09/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

III. INTERVIEWS *(Click all that apply)(Continued)*

3. Local Regulatory Authorities and Response Agencies (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

4. Other Interviews *(Optional):* ☐ Report Attached ____________________

____

____

____

IV. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. O&M Documents:

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for B-Area Operable Unit*, ER-IDS-019-056

____

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

IV. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Groundwater monitoring consists of sampling the uppermost aquifer at HWCTR every five years and reporting in the five-year remedy reviews.

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS
☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Candice Freeman (Name) IACD Project Manager (Title) 12/08/2016 (Date) 803-952-7085 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Survey monuments were located and in good condition.

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:__________

B. Other Site Conditions

Remarks:__________

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots): ☐ Location shown on site map ☒ Settlement not evident

Areal extent__________ Depth__________

Remarks:__________

2. Cracks: ☐ Location shown on site map ☐ Cracking not evident

Lengths__________ Widths__________ Depths__________

Remarks: Hairline cracking evident throughout the cover. However, the widths of the cracks are less than 5 millimeters; and therefore, do not require any corrective action.

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________ Depth__________

Remarks:__________

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent__________ Depth__________

Remarks:__________

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☒ No signs of stress

Areal extent__________ Depth__________

Remarks: Vegetation mowed routinely.

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:______________________________________

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent________________ Depth________________

Remarks:______________________________________

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent________________
☐ Ponding ☐ Location shown on site map Areal extent________________
☐ Seeps ☐ Location shown on site map Areal extent________________
☐ Soft subgrade ☐ Location shown on site map Areal extent________________

Remarks:______________________________________

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent________________

Remarks:______________________________________

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident

Areal extent____________ Depth____________

Remarks:________________________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A

☒ Vegetation does not impede flow

Areal extent____________ Type____________

Remarks:________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent____________ Depth____________

Remarks:________________________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A

Remarks:________________________

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

Groundwater monitoring consists of sampling the uppermost aquifer at HWCTR every five years and reporting in the five-year remedy reviews. Four groundwater monitoring wells (BMW001D, BMW002D, BMW003D, and BMW004D) were sampled and analyzed in the third quarter of 2016 for gross alpha, nonvolatile beta, iodine-129, lead, Aroclor 1254, and Aroclor 1260.

X. OTHER REMEDIES

If there are remedied applies at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. In situ Stabilization ☒ Applicable ☐ N/A

In situ stabilization was performed at HWCTR. The remedy is performing as designed.

Attachment C-1. Five-Year Review Site Inspection Checklist – B-Area Operable Unit *(continued)*

XI. OVERALL OBSERVATIONS

Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The removal action included removal and disposal of above grade HWCTR components, in situ S/S of below grade components, and concrete cover of the HWCTR facility and was effective in eliminating the exposure pathway to contaminated building components (i.e., activated metal and concrete). The remedy of LUCs and groundwater monitoring is fully established and functioning as designed.

Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of site inspections and site maintenance (verify no invasive activities have occurred and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining BAOU and the condition of warning signs is good. Consistent with previous annual inspections, small cracks in the concrete cover were observed in 2016. However, the conditions have not changed to the extent that would compromise the stabilization and containment of residual waste left in place. Annual monitoring of the cover for crack growth and settlement will continue and repairs performed as needed.

Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

C-AREA REACTOR SEEPAGE BASINS (904-66G AND 904-68G) OPERABLE UNIT

I. Introduction

This report is the fourth five-year review for the C-Area Reactor Seepage Basins (904-66G and 904-68G) (CRSB) Operable Unit (OU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the CRSB OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the CRSB OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table D-1 lists the chronology of site events for the CRSB OU.

III. Background

The CRSB OU is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The scope of the CRSB OU originally included all three C-Area Reactor Seepage Basins (904-66G, 904-67G, and 904-68G). This report discusses Seepage Basins 1 (904-66G) and 3 (904-68G). Documentation pertaining to remedial actions at Seepage Basin 2 (904-67G) is included with L-Area Reactor Seepage Basin (904-64G) (Appendix L), since both basins were closed similarly without the need for soil stabilization (WSRC 2002).

The media of concern associated with Seepage Basins 1 (904-66G) and 3 (904-68G) is soil. Groundwater is included as part of the C-Area Groundwater OU.

Physical Characteristics

The CRSB OU is located in the central portion of SRS in the western portion of C Area (Figure D-1). The basins were constructed in 1957. Basin 1 (904-66G) was L-shaped with approximate dimensions of 75 x 10.5 m (250 x 35 ft) in the north-south direction, 180 x 35 ft in the east – west direction, and a depth of approximately 2.1 m (7 ft) below ground surface (bgs). Basin 3 (904-68G) was approximately 54 x 27 m (180 x 90 ft) and a depth of 3.6 m (12 ft) bgs. Figure D-2 shows the locations of Basins 1 (904-66G) and -3 (904-68G). These unlined earthen basins were designed to hold contaminated wastewater that was not appropriate for discharge to local streams due to elevated radiological activity (WSRC 1997). Prior to remediation, these basins were open and had not been backfilled to grade.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999a) designates CRSB OU as being within the site industrial support area. The future land use for CRSB OU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The CRSBs were constructed in the late 1950s and were active from 1957 until 1970 and again from 1978 until 1987 (WSRC 1997). From 1970 to 1978, disassembly basin water was mixed with large volumes of heat exchanger cooling water and discharged via the C-Area Discharge Canal to Castor Creek (WSRC 1998). After improvements in the treatment of disassembly basin water (i.e., deionization and filtering), discharge to the seepage basins resumed in 1978. No discharges to the basins have occurred since 1987.

Process purge water from the C-Reactor Disassembly Basin was discharged to the seepage basins to allow a significant portion of the tritium to decay before the water reached Fourmile Branch, eventually flowing to the Savannah River. Radionuclides in the wastewater included tritium, strontium-90, cobalt-60, cesium-137, and other beta-gamma, beta, and alpha emitters from the C-Reactor Disassembly Basin. The exact volume of water disposed in the CRSBs is unknown, but is estimated to be 27 million gallons (Du Pont 1987). Figures D-3 and D-4 present photographs of the CRSB OU before remediation and in the current condition.

Initial Response

A time-critical removal action was performed in 1997 to remove and dispose of radiologically contaminated vegetation from the unit (USDOE 1998). The vegetation was placed in the seepage basins. As the vegetation died, the potential for contamination spreading due to wind and bioturbation increased which warranted the time-critical removal action.

Basis for Taking Action

The potential for human exposure to radiologically contaminated soils in the CRSBs resulting in a future industrial worker risk greater than 1E-06 was the basis for taking action at the CRSBs.

As documented in the Technical Evaluation Report (TER) (WSRC 2000b) and summarized in the Explanation of Significant Difference (ESD) (WSRC 2000a), radiologically contaminated soils in the seepage basin presented a significant potential external exposure risk to future industrial workers. Cesium-137 was identified as the main contributor to the principal threat source material (PTSM) in Basin 1 (904-66G).

No contaminant migration (CM) constituents of concern (COCs) were identified. PTSM was identified in the soils of Basin~~s~~ 1 to a depth below the basin base of 1.8 m (6 ft). Evaluation of Basin 3 identified no PTSM. The groundwater has been identified as a separate OU and is, therefore, considered outside the scope of the CRSB OU remedial action. Groundwater will be investigated as part of the C-Area Groundwater OU.

IV. Remedial Actions

Remedy Selection

The Plug-in Record of Decision (ROD) process was designed to present a common remedy for high-risk radioactively contaminated OUs at SRS with similarities in history of use, contaminants, risk, and location in current industrial areas. For radiologically contaminated soil that represents PTSM, *in situ* stabilization of radiologically contaminated soil that represents PTSM was selected as the common remedy for open reactor seepage basin candidates in the *Plug-in Record of Decision for In Situ Stabilization With Low Permeability Soil Cover for Radiological Contaminants in Soil* approved in October 1999 (WSRC 1999b). A TER (WSRC 2000b) was prepared and verified that cesium-137 was present at high enough levels that the basin soils were considered PTSM and that CRSB OU met the plug-in ROD criteria. PTSM for the plug-in ROD remedy was defined as soil that poses a radiological (or cancer) risk to the future industrial worker equal to or greater than 1E-03.

In lieu of Proposed Plan and ROD documents, an ESD was submitted and was approved in June 2000 (WSRC 2000a). The approved ESD is the document that amends the approved plug-in ROD to include the CRSB OU.

As detailed in the Plug-in ROD (WSRC 1999b), the following generic remedial action objectives were established:

- Prevent human exposure to contaminated basin soils (PTSM) by performing stabilization treatment to the extent practicable and filling the basins. Reduce risks to the future worker from surface soils (0 to 0.3 m [0 to 1 ft]) outside the basin by establishing remedial goals (RGs) for COCs at concentrations equivalent to 1E-06 for carcinogens and a hazard quotient of 1 for noncarcinogens or background (where background levels of COCs exceed 1E-06);
- Prevent the release of COCs in soil to groundwater beneath the unit above maximum contaminant levels (MCLs) or risk-based concentrations (when MCLs are not available). The soil RGs are back-calculated based on these values; and
- Protect the ecological receptors indigenous to the area by preventing or limiting contact with contaminated basin soils and pipelines, and preventing plants and animals from bringing contaminants up towards the surface.

Because the CRSB OU meets the plug-in ROD criteria, the remedy of in situ stabilization with a low permeability membrane cover system was the selected remedy for the CRSB OUs. As described in the ESD, the selected remedy consisted of the following components:

- Consolidation of contaminated soil outside of the basins and around the pipelines into the basins;
- In situ stabilization through grouting to treat PTSM soil in the basin;
- Low permeability soil cover system over the in situ stabilized soil to prevent exposure to radionuclides in the stabilized soil;
- Grouting the pipeline to prevent exposure to borrowing animals; and
- Land use controls (LUCs), including an OU-specific perimeter fence around the basins, to prevent disturbance of the cover system and prohibit residential or agricultural use of the area.

Remedy Implementation

Implementation of the selected remedy included the following:

- Consolidation of contaminated soil outside the basins exceeding PTSM criteria, leachability RGs, or surficial exposure RGs. In accordance with the Unit-Specific Plug-In TER (WSRC 2000b), this action was not performed because the contaminated soil outside the basins did not exceed PTSM criteria, leachability RGs or surficial exposure RGs;
- In situ stabilization by grouting was used to address long-term PTSM soil that posed a risk in excess of 1E-03 for future industrial workers;
- Installation of a 1.8-m (6-ft) minimum thick low permeability soil cover system over the basins to reduce water infiltration and to provide shielding to potential receptors on the surface (WSRC 2003). Although no CM COCs were identified that could impact groundwater in the future (1,000 years), the soil cover system was designed with a 0.6 m (2-ft) minimum thick low permeability soil layer;
- Grouting of process piping to stabilize any potential contamination left inside and prevent access by small animals; and
- Establishment of institutional controls (i.e., LUCs) to include the following:

  - SRS boundary security gates to prevent exposure to intruders;
  - Visible warning signs located at the most probable access points requiring contact of the custodian prior to entry to the OU;
  - Site controls and land use restrictions (i.e., OU-specific perimeter fencing and warning signs) via the Site Use/Site Clearance Program to prevent excavation in the area of the pipeline or cover system and restrict invasive and permanent installation activities at the CRSB OU; and
  - Deed notification/restrictions if the property is ever transferred to non-federal ownership.

System Operations/Operation and Maintenance

There are no system operation requirements. However, the following maintenance activities are ongoing:

- Site inspections for evidence of damage to the cover system due to erosion or intrusion by burrowing animals and to address upkeep of the cover and access control barriers (e.g., the warning signs) are performed annually; and
- Necessary repairs (repair of erosion damage, cover maintenance, OU-specific warning signs and perimeter fence) are performed as required.

Table D-2 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD Amendment (WSRC 2002). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $47,505 for annual inspections and maintenance. The actual O&M cost for FY2012 to FY2016 is $67,454. The actual O&M costs for the CRSB OU are higher than expected because the cost for access controls was not included in the original estimate.

V. Progress since Last Review

The previous protectiveness statement concluded that the remedy of soil stabilization and a low permeability cover system with institutional controls (i.e., LUCs) at the CRSB OU is protective of human health and the environment.

There were no recommendations or follow-up actions from the last five-year review.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU, interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment D-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Review of maintenance inspection reports conducted from FY2012 through FY2016 and a visual inspection of the CRSB OU indicate the structural integrity of the cover system is intact and providing protection to human and ecological receptors. Groundwater associated with the CRSBs will be addressed as part of the C-Area Groundwater OU.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016 at the O&M organization offices. No issues were identified as an outcome of these interviews.

The CRSB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 4, 2016. No issues were identified for the CRSB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 identified signs that needed to be replaced, active ant mounds, and overgrown vegetation. These findings were documented on the field inspection checklist and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The cover system and soil stabilization are effective in preventing human and ecological receptor exposure to contaminated basin soils (PTSM). The cover system maintenance program and LUCs have been effective in maintaining the integrity of the cover system. The annual inspection reports indicate no visible signs of erosion, signs are legible, and administrative controls are in place.

The Land Use Control Implementation Plan for the CRSB OU is located in Appendix A of the Post Construction Report and governs LUC implementation, maintenance, monitoring, reporting, and enforcement (WSRC 2003). All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of final remedy selection are still valid. There have been no changes in physical conditions at the CRSB OU that would affect the protectiveness of the remedy.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the CRSB OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions¶

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the CRSB OU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated media. All threats to contaminated soil at the CRSB OU have been addressed through in situ soil stabilization, implementation of the soil cover, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the CRSB OU for industrial use only, OU-specific perimeter fencing and warning signs, and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

Du Pont, 1987. *Environmental Information Document – Reactor Seepage Basins*, DPST-85-707, E.I. Du Pont Nemours & Co., Savannah River Site, Aiken, SC

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

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 1998. Letter B.T Hennessey to J.L. Crane and K.A. Collingsworth, dated December 17, 1998, *Fiscal Year 1998 Removal Action Report*, OD-99-127, U.S Department of Energy – Savannah River Office, Savannah River Site, Aiken, SC

WSRC, 1997. *Removal Site Evaluation Report for the C-Reactor Seepage Basins (904-066, -067 and -68G) (U)*, WSRC-RP-97-132, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1998. *ASCAD™ RI Work Plan for the C-Reactor Seepage basins (904-66G, 904-67G, and 904-68G) (U)*, WSRC-RP-97-431, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999a. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest update, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 1999b. *Plug-In Record of Decision for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil (U)*, WSRC-RP-98-

4099, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2000a. *Explanation of Significant Difference (ESD) for the Plug-In ROD for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil – C-Area Reactor Seepage Basin (U),* WSRC-RP-2000-4032, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2000b. *Unit-Specific Plug-In Technical Evaluation Report for the C-Reactor Seepage Basins (904-66G, 904-67G, and 904-68G) Operable Unit (U),* WSRC-RP-2000-4008, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002. *Unit-Specific Plug-In Record of Decision Amendment for the C-Area Reactor Seepage Basin (904-67G) and L-Area Reactor Seepage Basin (904-64G) (U),* WSRC-RP-2002-4063, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003. *Post-Construction Report (PCR)/Final Remediation Report (FRR) for the C-Area Reactor Seepage Basin (904-66G, -67G, and -68G) Operable Unit (U),* WSRC-RP-2002-4149, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist C-Reactor Seepage Basins (904-66G, 904-67G, 904-68G) (U),* ER-IDS-019-013, Inspection period 2012 through 2016 (annually)

This page is intentionally left blank.

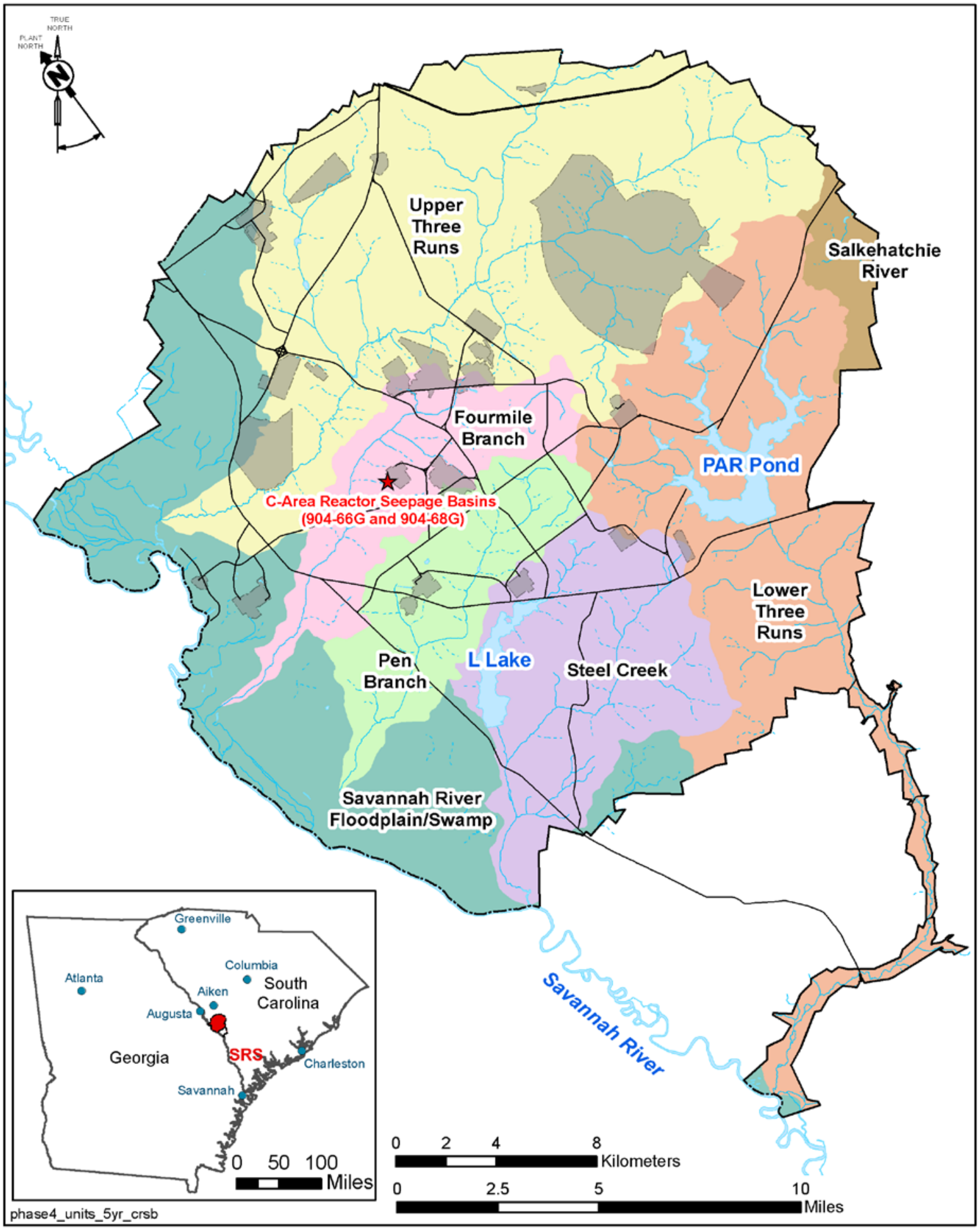


Figure D-1. Location of the C-Area Reactor Seepage Basins OU at SRS

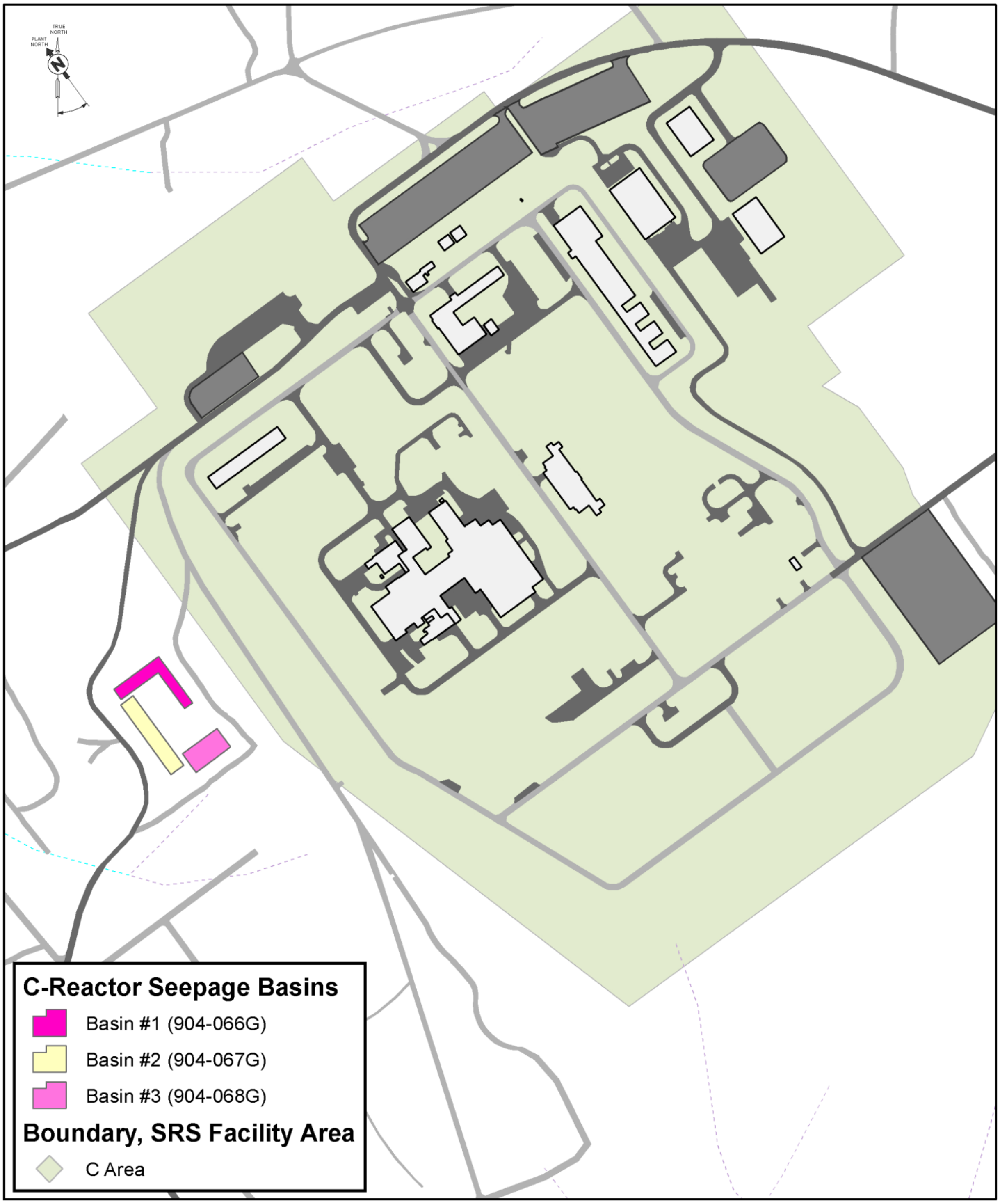


Figure D-2. **Location of the C-Area Reactor Seepage Basins OU in C Area**

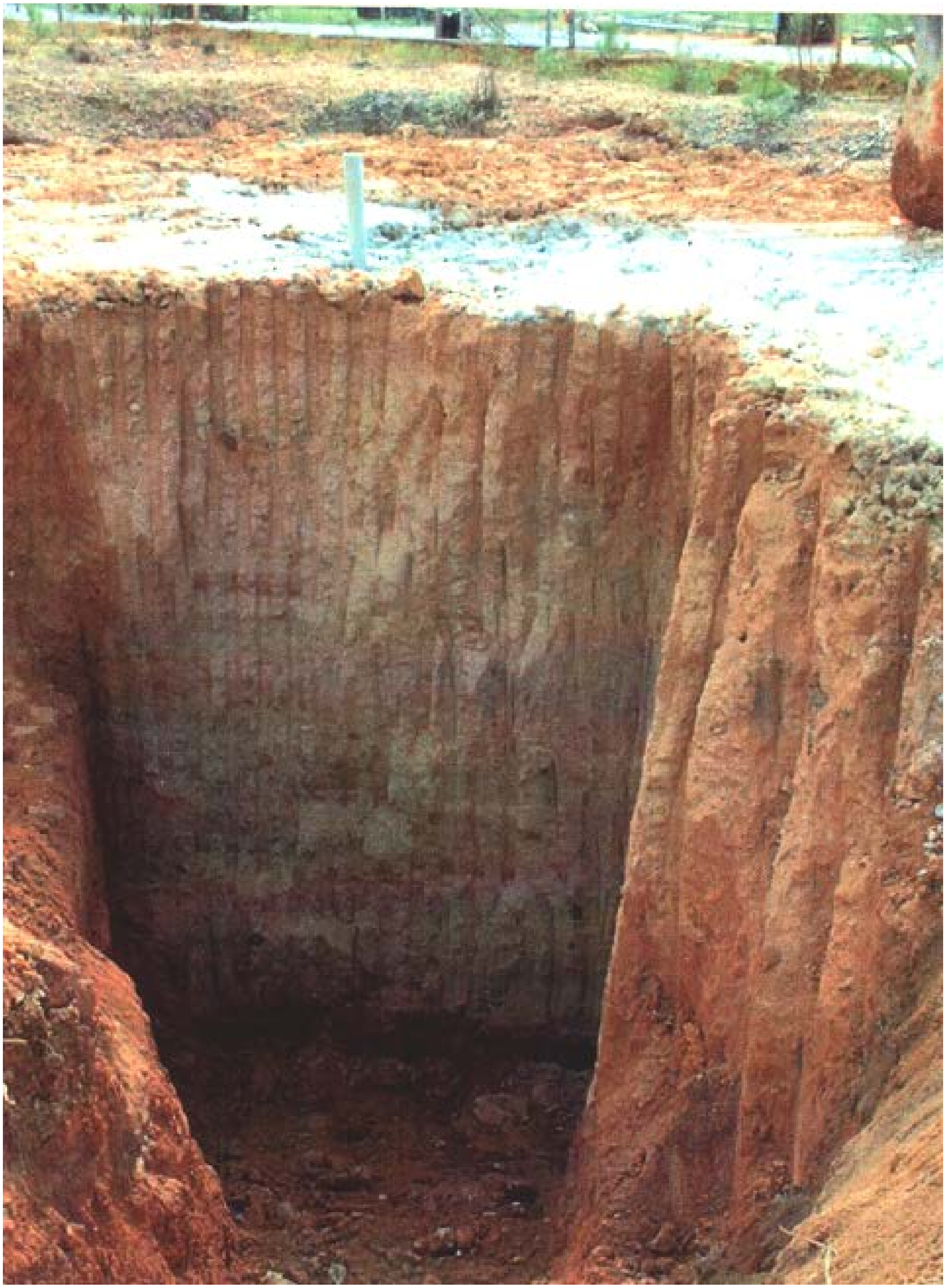


Figure D-3. Photograph of CRSB OU Before Remediation Activities

Figure D-4. Current Photograph of CRSB OU (2016)

Table D-1. Chronology of OU Events

Event	Date
Removal actions (Vegetation)	July 28 to December 9, 1997
Remedial Investigation Field Start/Complete	January 3, 1997 / June 15, 2000
Plug-In ROD Issuance	November 29, 1999
ESD Issuance	October 18, 2000
Remedial Action Start/Complete	February 5, 2001 / June 12, 2002
ROD Amendment	December 5, 2002
Previous Five-Year Reviews Issuance	February 12, 2004 / January 29, 2009 / February 4, 2014

Table D-2. Actual versus Estimated O&M Costs

Project Cost	**FY2012**	**FY2013**	**FY2014**	**FY2015**	**FY2016**	**5-Year Total**
Total Actual O&M Costs ($)	14,162	15,248	11,172	10,500	16,371	67,454
Total Plug-In 2002 ROD Amendment Estimated Direct O&M Costs* ($)	9,501	9,501	9,501	9,501	9,501	47,505

*Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G)

I. SITE INFORMATION

Site Name:	**C-Area Reactor Seepage Basins (904-66G and 904-68G)**	**Date of Inspection:**	**9/6/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #60**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**85°F** **Partly cloudy**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Consolidation, In-situ stabilization via grouting

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1\. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2\. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

1. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

- **Other Interviews** *(Optional):* ☐ Report Attached ____________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for C-Reactor Seepage Basin*, ER-IDS-019-013.

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State
☐ PRP In-House ☐ Contractor for PRP
☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: OU-specific perimeter fencing is required by the remedial action. Perimeter fencing is in good condition.

B. Signs

2. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A

Remarks: Signs are in good condition.

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

V. Access and Institutional Controls *(Continued)*

C. Institutional Controls

A. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office

Contact:	Karen Adams	IACD Federal Project Director	11/04/2016	803-952-7871
	(Name)	(Title)	(Date)	(Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

B. Adequacy: ☒ **ICs are adequate** ☐ **ICs are inadequate** ☐ **N/A**
Remarks: Survey monuments were located and in good condition.

D. General

1. **Vandalism/Trespassing:** ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. **Land use changes onsite:** ☒ N/A
Remarks:

3. **Land use changes offsite:** ☒ N/A
Remarks:

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks: Roads at this site are in good condition.

B. Other Site Conditions

Remarks: Site inspections conducted during FY2012 through FY2016 identified signs that needed to be replaced, active ant mounds, and overgrown vegetation. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent________ Depth________
Remarks:________

2. **Cracks:** ☐ Location shown on site map ☒ Cracking not evident
Lengths________ Widths________ Depths________
Remarks:________

3. **Erosion:** ☐ Location shown on site map ☒ Erosion not evident
Areal extent________ Depth________
Remarks:________

4. **Holes:** ☐ Location shown on site map ☒ Holes not evident
Areal extent________ Depth________
Remarks:________

5. **Vegetative Cover:** ☒ Grass ☒ Cover properly established ☒ No signs of stress
Areal extent________ Depth________
Remarks: Vegetation is mowed routinely.

Attachment D-1. Five-Year Review Site Inspection Checklist – C-Area Reactor Seepage Basins (904-66G and 904-68G) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A
Remarks:____________________

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident
Areal extent__________ Depth__________
Remarks:____________________

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent__________
☐ Ponding ☐ Location shown on site map Areal extent__________
☐ Seeps ☐ Location shown on site map Areal extent__________
☐ Soft subgrade ☐ Location shown on site map Areal extent__________
Remarks:____________________

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent__________
Remarks:____________________

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ **Applicable** ☒ **N/A**

G. Detention/Sedimentation Ponds ☐ **Applicable** ☒ **N/A**

H. Retaining Walls ☐ **Applicable** ☒ **N/A**

I. Perimeter Ditches/Offsite Discharge ☐ **Applicable** ☒ **N/A**

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Consolidation, In situ Stabilization ☒ Applicable ☐ N/A

Consolidation and in situ stabilization were performed at CRSBs OU. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU is institutional controls, contaminated soil consolidation, in situ stabilization with the low-permeability soil cover system and pipeline grouting, to prevent exposure to contaminated media. The remedy is fully established and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

There are no issues. O&M of the low permeability soil cover, current access controls and SRS Site Use and Site Clearance controls are effectively maintaining the long-term protectiveness of the remedy.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

D-AREA EXPANDED OPERABLE UNIT (U)

I. Introduction

This report is the third five-year review for the D-Area Expanded Operable Unit (DEXOU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the DEXOU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the DEXOU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table E-1 lists the chronology of site events for the DEXOU.

III. Background

The DEXOU is a Resource Conservation Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993).

The scope of the DEXOU remedial action includes two surface units: D-Area Rubble Pit (431-2D) (DRP) and 488-D Ash Basin (488-DAB). The 488-DAB is divided into several subunits: 488-DAB (Interior), the 488-D Pooled Basin, the 488-DAB (Exterior), the 488-D Drainage, and the Dead and Stressed Vegetation Area (DSVA). The contaminated media associated with the DEXOU are soils at DRP; and soils, sediment, and surface water at 488-DAB. Groundwater is addressed as part of the D-Area Groundwater OU.

Physical Characteristics

The DEXOU covers approximately 15.3 hectares (37.7 acres) within D Area at SRS in Barnwell County, South Carolina (Figure E-1). The layout of the DEXOU within D-Area is shown on Figure E-2. D Area is situated on a broad and generally flat erosional terrace of low relief adjacent to the floodplain of the Savannah River. The water table is about 7.5 m (25 ft) below groundwater surface throughout D Area. DEXOU lies approximately 900 m (3,000 ft) east of the nearest SRS boundary, the Savannah River.

D-Area Rubble Pit (431-2D)

The DRP is located approximately 300 m (1,000 ft) northwest of the 488-DAB and covers about 4.3 hectares (10.5 acres) (WSRC 1998). The topography is relatively flat with an elevation range of approximately 37.5 to 39.3 m (125 to 131 ft) above mean sea level (msl). The area is heavily vegetated and bounded by a natural drainage (DRP Stream Boundary) both to the east and south of the unit. The DRP Stream Boundary is fed by the D-006 Outfall, which receives stormwater runoff from the northwestern portion of D Area, including storage facilities, parking lots, the northwest side of the D-Area Powerhouse (484-D), and other active and inactive facilities. Surface water runoff from the DRP occurs only during heavy rainfall events. The DRP Stream Boundary flows west into the floodplain of the Savannah River.

488-D Ash Basin

The 488-DAB is an unlined, earthen containment basin located approximately 270 m (900 ft) south of the D-Area Powerhouse (484-D). The 488-DAB is situated adjacent to the floodplain of the Savannah River on a terrace deposit with low relief. The 488-DAB interior subunit is approximately 540 m (1,800 ft) long, 180 m (600 ft) wide and covers 9.3 hectares (22.8 acres) (WSRC 1998). The 488-DAB exterior subunit covers an area of approximately 1.79 hectares (4.4 acres) (WSRC 1998). The basin was constructed above grade and the berms that form the walls of the basin are 5.4 m (18 ft) high. The berms are constructed of man-made fill consisting primarily of sand, silt, and clay. Elevations across the basin range from approximately 36 m (120 ft) msl in the western end to 39 m (130 ft) msl in the eastern end while the bottom is near original grade, approximately 33 to 34.5 m

(110 to 115 ft) msl, which is about 6 m (20 ft) above the elevation of the Savannah River (27.6 m [92 ft] msl).

The bottom of the 488-DAB sits atop a dense, locally continuous, low permeability clay layer, which runs beneath both the 488-DAB and the DSVA. The vertical hydraulic conductivity of the clay layer averages about 1.0E-07 cm/s, which has restricted vertical percolation across the clay layer. As a result, the perched water above the clay layer is elevated with respect to the "regional" water table. The regional water table potentiometric surface is within the clay layer under the basins; consequently, there is little to no unsaturated zone under the water that is mounded above the clay layer.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The Land Use Control Assurance Plan (LUCAP) for the SRS (WSRC 1999) designates the DEXOU as being within an industrial area. The future land use for the DEXOU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

D-Area Rubble Pit (431-2D)

The DRP received waste from 1951 through 1989. About 1.8 hectares (4.4 acres) on the eastern side of the DRP received waste consisting of soil mixed with asphalt, coal, paper, metal, plastic, glass fragments, foam insulation, fiberboard, asbestos, roofing materials, wire, road gravel, and other miscellaneous debris. The estimated volume, assuming an average thickness of 1.8 m (6 ft), is about 38,250 m^3 (50,000 yd^3). The remaining 2.5 hectares (6.1 acres) to the west were covered with ash and coal rejects. Figure E-3 provides a photograph of the DRP prior to remediation activities.

488-D Ash Basin

The 488-DAB was constructed in the early 1950s and used to intercept, stabilize, and provide passive treatment of ash-sluice water before it was discharged to local surface streams. In 1978, ash-sluice water was diverted to the newly constructed 488-1D and

488-2D Ash Basins. From 1978 until the mid-1990s, the 488-DAB received dry ash and coal rejects. In addition to the basin, some areas outside the basin were contaminated by the processes related to the 488-DAB. These areas cover 1.8 hectares (4.4 acres) and include the DSVA, 488-D perimeter soils, and drainage ditch areas. Figure E-3 provides photographs of the 488-DAB and its subunits prior to remediation activities.

Initial Response

A RCRA Facility Investigation (RFI)/Remedial Investigation (RI) Work Plan for the 488-DAB and the D-Area Coal Pile Runoff Basin (489-D) (DCPRB) was issued in 1998 to characterize the waste units (WSRC 1998). Due to the continued operation of the D-Area Powerhouse (484-D), several units that were once part of the DEXOU were removed from the scope of the OU. The DCPRB, D-Area Waste Oil Facility, and D-Area Borrow Pit associated with the planned continued use of the D-Area Powerhouse (484-D) facilities were removed from the original scope in 2001 (WSRC 2001). Two additional units were removed from the DEXOU and placed into other regulatory programs: D-Area Gas State Area was placed in the Underground Storage Tank Program, and D-Area Cinders Disposal Pit was listed as a Site Evaluation Area (WSRC 2004a).

An RFI/RI/Baseline Risk Assessment (BRA) was performed to assess the risks posed by the DEXOU to human health and the environment (WSRC 2003). The assessment included quantitative calculations of human health risks, ecological risks, and the threat posed by future leaching to groundwater.

Basis for Taking Action

The following lists the principal sources of contamination for the DEXOU:

- Elevated metals and polychlorinated biphenyls (PCBs) in DRP soil;
- Coal-related metals and radionuclides associated with coal rejects and ash in and near the 488-DAB; coal rejects containing arsenic and beryllium were identified as principal threat source material (PTSM) based on contaminant mobility;
- Low pH pooled surface water in the 488-D Pooled Basin; and

- Low pH surface water and sediments at the DSVA to the north of the 488-DAB.

The highest metals and PCBs (i.e., Aroclor 1254) contaminant concentrations at the DRP were found in the upper 2.1 m (7 ft) of the pile where debris was present. Approximately 57 m^3 (74 yd^3) of surface soil contained elevated levels of PCBs and 60 m^3 (78 yd^3) of surface soil contained elevated levels of zinc (WSRC 2008). Table E-2 identifies the refined constituents of concern (RCOCs) for DRP soils.

The 488-DAB Interior, consisting mainly of ash and a mixture of ash and coal rejects in the top 1.2 m (4 ft), had elevated levels of arsenic and some coal-related radionuclides. Tables E-3 and E-4 summarize the RCOCs at 488-DAB. Arsenic, selenium, and vanadium were identified as ecological concerns in the surface and subsurface soils. Low pH surface water at the west end of the basin contained metals that posed an unacceptable risk to the ecological receptors and contributed to groundwater contamination.

IV. Remedial Actions

Remedy Selection

Tables E-5 and E-6 present the remedial goals (RGs) at 488-DAB. As stated in the Record of Decision (ROD) (WSRC 2004a), the remedial action objectives (RAOs) for DEXOU are as follows:

D-Area Rubble Pit (431-2D)

- Prevent exposure of industrial workers to surface soils containing unacceptable levels of arsenic and PCBs (i.e., Aroclor 1254);
- Prevent exposure of ecological receptors to elevated levels of metals and PCBs (i.e., Aroclor 1254) in soils; and
- Prevent generation of low pH leachate and beryllium from leaching to groundwater above its maximum contaminant level (MCL).

488-D Ash Basin

- Prevent or minimize contaminants leaching to groundwater above MCLs/RGs;

- Prevent exposure of industrial workers to waste materials, surface soils, and sediments containing unacceptable levels of arsenic and coal-related radionuclides;
- Prevent exposure of ecological receptors to arsenic, selenium, and vanadium present in the basin;
- Prevent or minimize the acidic runoff that results in pooled water at the west end of the basin;
- Prevent exposure of ecological receptors to metals in surface water in the 488-D Pooled Basin, the 488-D Drainage, and the DSVA above ambient water quality criteria;
- Protect ecological receptors from elevated arsenic in sediment in the 488-D Drainage ditch; and
- Prevent exposure of ecological receptors to unacceptable risk due to low pH (due to the presence of coal fines) in the sediment in the DSVA.

As stated in the ROD (WSRC 2004a), the selected remedies for the DEXOU are as follows:

- A removal remedy was selected for DRP to address the low-level threat source material with elevated metals and Aroclor 1254, which consisted of the following activities:
    - Excavating waste materials and soils containing coal rejects to visual extent and verification laterally by arsenic and zinc RGs;
    - Excavating a PCB hot spot followed by verifying that soil concentrations were below the PCB RG;
    - Consolidating excavated soils and waste material from DRP to the 488-DAB;
    - Backfilling with clean fill, grading and vegetating excavated area to minimize erosion;
    - Implementing institutional controls; and
    - Groundwater monitoring to evaluate long-term effectiveness of the remedy in preventing exposure to potential future residents. Groundwater monitoring is conducted under the D-Area Groundwater OU.

- A containment remedy was selected for 488-DAB to address the PTSM in the ash and coal within the basin, which consisted of the following activities:
    - Consolidating the coal rejects and impacted soils and sediment from the 488-DAB exterior subunit within the 488-DAB basin interior;
    - Installing a low permeability geosynthetic cover system at 488-DAB interior subunit;
    - Placing 0.3 m (1 ft) of clean fill over excavated areas with the 488-DAB exterior subunit;
    - Implementing institutional controls; and
    - Groundwater monitoring to evaluate long-term effectiveness of the remedy. Groundwater monitoring is conducted under the D-Area Groundwater OU.
- Institutional controls and monitoring will be performed per the SRS LUCAP (WSRC 1999) and site-specific Land Use Control Implementation Plan.

The following land use control (LUC) objectives for the DEXOU are necessary to ensure protectiveness of the selected remedy:

- Prevent contact, removal or excavation of waste left in place [debris, coal, and coal rejects]; and
- Preclude residential use of the property.

Remedy Implementation

The following actions were conducted for the DRP and 488-DAB source units as final actions (WSRC 2008). Figure E-4 presents photographs of the DEXOU in the current condition.

- The remedial activities for the DRP included:
    - Removing approximately 56.6 m^3 (2,000 ft^3) of PCB-contaminated soil by excavating and transporting to the 488-DAB. The area was sampled for confirmation that PCBs were removed to meet the RG.

  - Consolidated approximately 45,900 m^3 (60,000 yd^3) of soil and coal reject materials containing unacceptable levels of arsenic to visual extent of coal within the DRP and along the adjacent road by excavating and transporting to 488-DAB.
  - Backfilled the DRP to a minimum of 0.09 m (0.3 ft), graded, and vegetated to minimize erosion.

- The remedial activities for the 488-DAB included:
  - Consolidating approximately 38,250 m^3 (50,000 yd^3) of material containing coal rejects at the 488-DAB Exterior Subunit by excavating to a minimum depth of 0.3 m (1 ft) and transporting to 488-DAB. Backfilling, regrading, and seeding all excavated areas. The portion of the DSVA delineated as a wetland (approximately 0.4 hectares [1 acre]) was replaced either through the site wetland bank or reconstruction of a wetland at another location. After excavating and removing waste from 488-DAB exterior, a permanent berm was installed for the new sedimentation basin, and the overflow detention basin was constructed to the north of the sedimentation basin with a 90-cm (36-inch) corrugated drainage pipe leading to the detention basin to drain the stormwater collected in the sedimentation basin from the engineered cover system.
  - Consolidating approximately 84.2 m^3 (110 yd^3) of soil from the bottom and sides of the drainage ditch at the west end of the 488-DAB by excavating to a depth of approximately 0.3 m (1 ft) and transporting to 488-DAB. Removed the section of the overflow drain pipe, which ran between the 488-DAB and the drainage ditch. The remaining section of the pipe, which was within the basin, was sealed with low strength concrete. Backfilled, regraded, and seeded all excavated areas.
  - Managing pooled water on the west side of the basin through evaporation or discharge to the land surface based on pH level. Installed erosion/sediment control measures and temporary berms during construction to minimize soil erosion and direct water away from the pooled water area.

  - Installing a 10-hectare (25-acre) engineered cover system over the entire 488-DAB and consolidated areas. The cover system includes an erosion layer, a protection layer, a drainage layer, and an infiltration layer (geosynthetics). The cover system has a maximum hydraulic conductivity of 4.8E-09 cm/s (WSRC 2008), an expected minimum life of 100 years, and was designed for a 25-year, 24-hour storm event.
  - Establishing a groundwater monitoring network per the requirements of the *Monitoring Work Plan for the D-Area Groundwater Operable Unit* (WSRC 2004b) and abandoning 17 monitoring wells that were no longer needed in the well monitoring network.
- Establishing LUCs for 17.6 hectares (43.27 acres) for the DEXOU to include the following:
  - Warning signs will be posted to alert on-site workers to the presence of hazardous substances and to prevent unauthorized entry and unrestricted uses;
  - Institutional controls (i.e., administrative measures) and use restrictions for on-site workers via the Site Use/Site Clearance Program. Other administrative controls to ensure worker safety include work controls, worker training, and worker briefings of health and safety requirements;
  - SRS access controls to prevent exposure to trespassers, as described in the 2013 RCRA Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary; and
  - In the long-term, if the property is ever transferred to non-federal ownership, the U.S. Government would create a deed for the new property owner in compliance with Section 120(h) of CERCLA that includes notification disclosing former waste management and disposal activities, results from groundwater monitoring, and

remedial actions taken on the site. The deed would also include deed restrictions precluding residential use of the property.

Contamination present in groundwater and the wetland will be addressed as part of the D-Area Groundwater and D-Area Ash Basin Wetlands investigations, respectively.

Systems Operations/Operation and Maintenance

There are no system operational requirements. Groundwater monitoring is being performed to collect groundwater data for evaluating the long-term effectiveness of the remedial action.

The following maintenance activities have been implemented:

- Site inspections will be performed annually to ensure access control barriers (e.g., warning signs) are in place and that the 488-DAB is developing a self-sustaining vegetative cover and/or has not been subject to erosion, subsidence, or intrusion of burrowing animals. Inspections to ensure DRP is developing self-sustaining vegetation; and
- Necessary repairs for erosion control damage will be performed for the geosynthetic cover system, including vegetation, the drainage system and cover slopes. Maintenance (including site inspections, mowing, general housekeeping) and upkeep of access control signs.

Table E-7 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 2004a). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $59,000 for annual inspections and maintenance. The actual O&M cost for FY2012 to FY2016 is $97,122. The actual O&M costs are higher than expected because the cost for LUCs was not included in the ROD estimate.

V. Progress since Last Review

The previous protectiveness statement concluded that the remedy (i.e., excavation and removal of contaminated media, backfilling excavated areas, and implementing institutional controls [i.e., LUCs] to prevent exposure to or ingestion of contaminated soil and sediment) at the DEXOU is protective of human health and the environment.

There were no recommendations or follow-up actions from the last five-year review.

VI. Five-Year Review Process

The following tasks were performed as part of the five-year review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU, interviewed maintenance personnel, and documented the results on the Inspection Checklist provided in Attachment E-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Confirmatory sampling of soils associated with the removal of the PCB contaminated soils was conducted on March 7, 2006. The results of the two samples collected indicated that only Aroclor 1254 was detected and at concentrations well below the RG of 1 mg/kg (0.081 and 0.045 mg/kg).

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016 at the O&M organization offices. No issues were identified as an outcome of these interviews.

The DEXOU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 8, 2016. During this inspection, a few depressions and a bare patch were noticed. These findings were repaired by SRS maintenance. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 28, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 have identified overgrown vegetation, active ant mounds, and hog damage. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

The removal actions for the DRP and 488-DAB exterior subunit, as well as the cover system maintenance program and LUCs for the 488-DAB interior subunit, are effective in preventing exposure of industrial workers and ecological receptors because the actions have broken the pathway to the receptors.

The Land Use Control Implementation Plan for the DEXOU governs LUC implementation, maintenance, monitoring, reporting, and enforcement (WSRC 2005). All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions at the DEXOU that would affect the protectiveness of the remedy.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the DEXOU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues associated with the protectiveness of this OU

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU. Monitoring of the groundwater continues as part of the D-Area Groundwater OU.

X. Protectiveness Statements

The remedy at the DEXOU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by excavation and removal of contaminated media, backfilling excavated areas, and implementing institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated soil and sediment. All threats to contaminated soil and sediment at the DEXOU have been addressed through implementation of physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the DEXOU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1998. *RCRA Facility Investigation/Remedial Investigation Work Plan for the 488-D Ash Basin and D-Area Coal Pile Runoff Basin Operable Unit*, WSRC-RP-97-440, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 2001. *RCRA Facility Investigation/Remedial Investigation Work Plan Addendum for the D-Area Expanded Operable Unit*, WSRC-RP-99-4067, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003. *RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment for the D-Area Expanded Operable Unit (DEXOU) (U)*, WSRC-RP-2001-4162, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004a. *Record of Decision Remedial Alternative Selection for the D-Area Expanded Operable Unit (U)*, WSRC-RP-2004-4007, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004b. *Monitoring Work Plan for the D-Area Groundwater Operable Unit (U)*; WSRC-RP-2003-4150, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005. *Land Use Control Implementation Plan (LUCIP) for the D-Area Expanded Operable Unit (DEXOU) (U)*, WSRC-RP-2004-4065, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008. *Post-Construction Report/Corrective Measures Implementation Report/Remedial Action Completion Report for the D-Area Expanded Operable Unit (U)*, WSRC-RP-2007-4041, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist, D-Area Rubble Pit (431-2D) (U)*, ER-IDS-019-038, Inspection period 2012 through 2016 (annually)

Various - *Inspection Data Sheets – Field Inspection Checklist, D-Area Ash Basin (488-D) (U)*, ER-IDS-019-041, Inspection period 2012 through 2016 (annually)

This page is intentionally left blank.

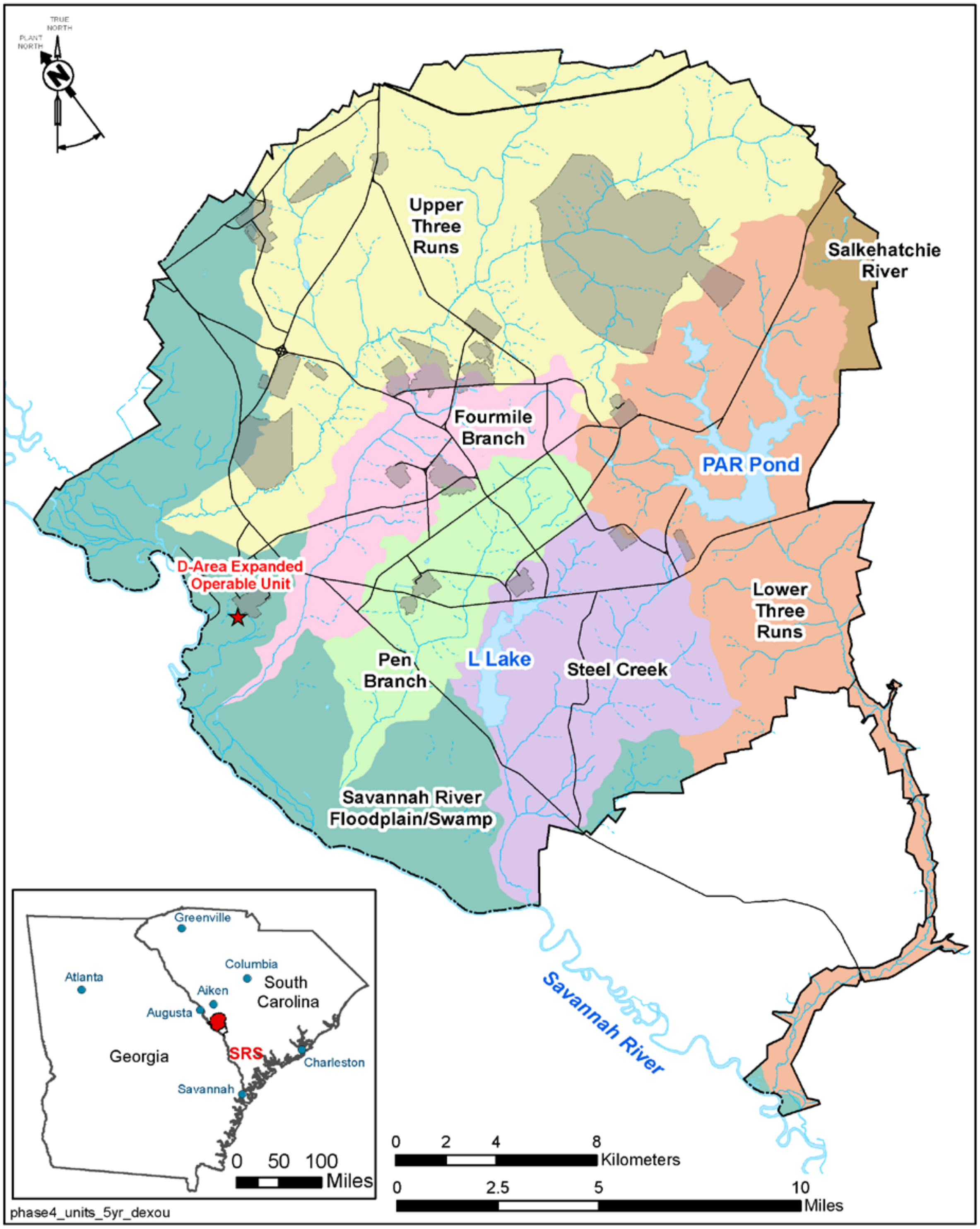


Figure E-1. Location of the DEXOU within the SRS

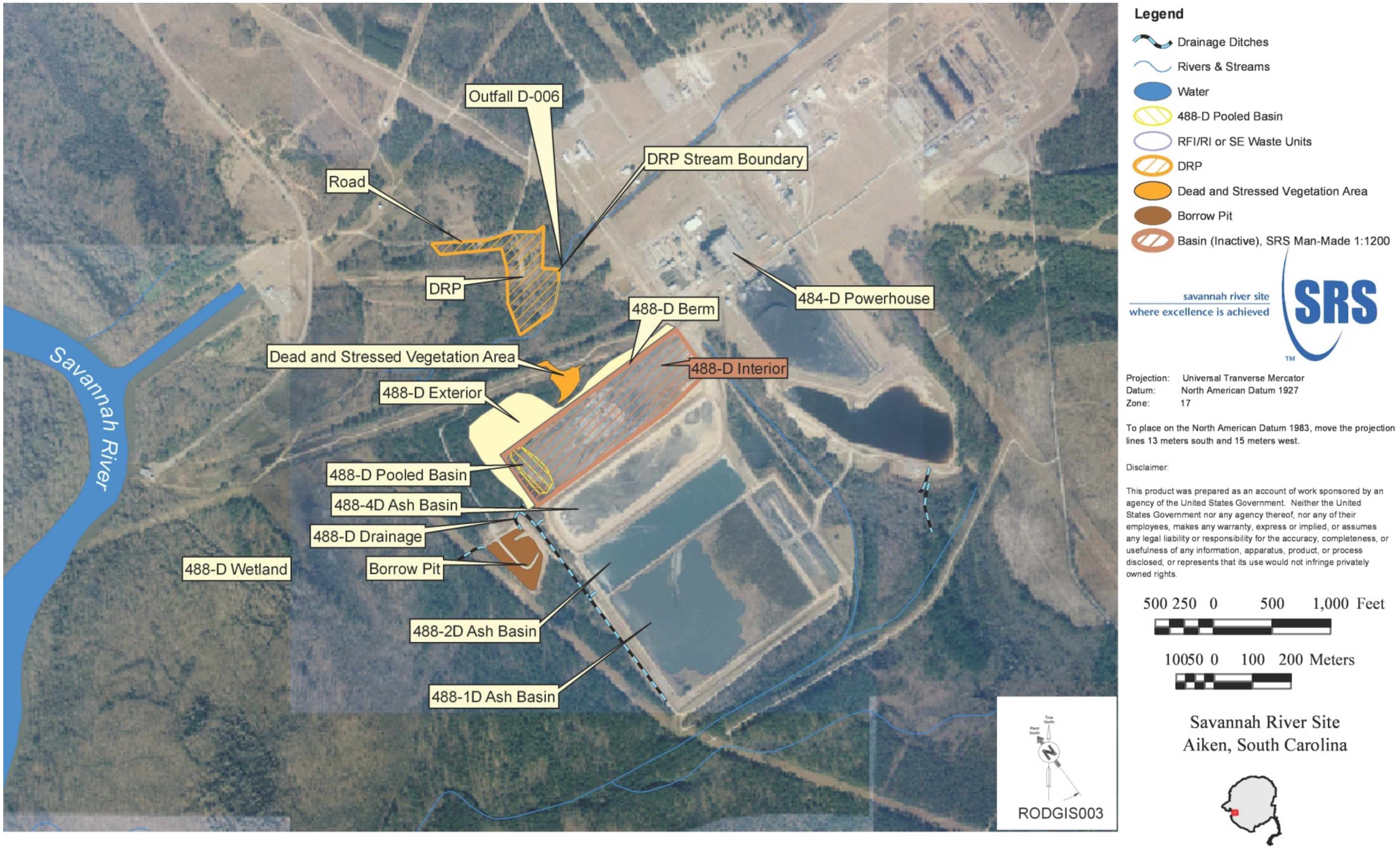
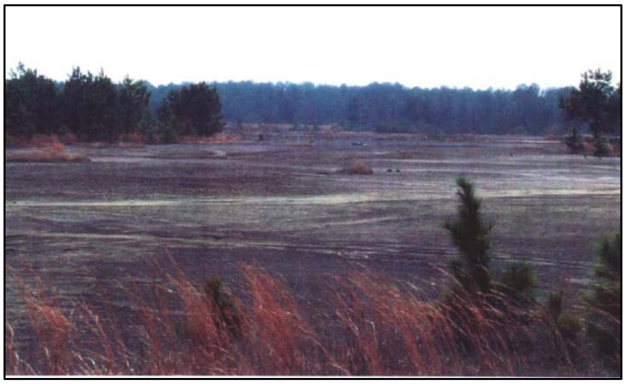


Figure E-2. **Layout ofthe DEXOU within D Area**

DRP



Interior of 488-DAB

Exterior of 488-DAB (North Side)

488-D Pooled Basin and Standpipe

488-DAB Drainage

DSVA (488-DAB Berm in Background)

Figure E-3. Before Photographs of the DEXOU

Figure E-4. Current Photographs of the DEXOU Subunits

Table E-1. Chronology of OU Events

Event	Date
RFI/RI Field Start/Complete (DAB/DCPRB)	September 29, 1998 / March 2, 1999
RFI/RI Field Start / Complete (DEXOU)	February 23, 2001 / December 18, 2003
DEXOU ROD Issuance	December 17, 2004
DEXOU Remedial Action Start / Complete	August 5, 2005 / July 10, 2007
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table E-2. RCOCs for the D-Area Rubble Pit (431-2D)

RCOCs	RCOC Type
Antimony	ECO
Arsenic	HH, ECO
Beryllium	CM
Selenium	ECO
Zinc	ECO
Benzo[a]pyrene	HH-res
Aroclor 1254	ARAR, HH-res, ECO
Aroclor 1260	ARAR, ECO

RCOC Designation:

- ARAR = Applicable or Relevant and Appropriate Requirement
- CM = Contaminant Migration RCOC
- HH = Human Health RCOC
- HH-res = Human Health RCOC for the future resident only
- ECO = Ecological RCOC

Table E-3. RCOCs for 488-DAB (Soil)

RCOC	**488-DAB RCOC Type**	
	(Interior)	**(Exterior)**
Soil		
Arsenic	PTSM, CM, HH, ECO	HH
Barium	CM	
Beryllium	PTSM, CM	
Iron	CM, HH-res	
Mercury	CM	
Selenium	CM, ECO	
Thallium	CM, HH-res	
Vanadium	ECO	
Actinium-228	HH	
Lead-212	HH	
Potassium-40	HH	
Radium-226	CM, HH	
Radium-228	CM, HH	
Thorium-228	HH	
Thorium-234	HH-res	
Uranium-234	CM	
Uranium-235	CM, HH-res	
Uranium-238	CM, HH	

HH – Human Health; HH-res – Human Health residential only
ECO – Ecological
CM – Contaminant Migration
ARAR – Applicable or Relevant and Appropriate Requirements

Table E-4. RCOCs for 488-DAB (Surface Water and Sediment)

RCOC	**RCOC Type** **488-D Pooled Basin**	**488-D Drainage**	**DSVA**
Surface Water			
Aluminum	ARAR, ECO	ARAR, ECO	ARAR, ECO
Arsenic	ARAR, HH-res	ARAR, HH-res	
Beryllium	ARAR, ECO	ARAR, ECO	ECO
Cobalt		ECO	
Copper	ARAR, ECO	ARAR	
Iron	ARAR, ECO	ARAR, ECO	
Thallium	ARAR	ARAR	
pH	ECO	ECO	ECO
Sediment			
Arsenic		HH-res, ECO	HH-res
Actinium-228		HH-res	
Potassium-40		HH-res	HH-res
Radium-226		HH-res	
Radium-228			HH-res
pH			ECO

HH – Human Health; HH-res – Human Health residential only
ECO – Ecological
CM – Contaminant Migration
ARAR – Applicable or Relevant and Appropriate Requirements

Table E-5. RGs for Soils at 488-DAB (Interior) and 488-DAB (Exterior) (WSRC 2004a)

RCOC	488-DAB (Interior) RCOC Type	488-DAB (Exterior) RCOC Type	RG	Units
Arsenic	PTSM, CM, HH, ECO	HH	3.30[1]	mg/kg
Barium	CM		41.8[2]	mg/kg
Beryllium	PTSM, CM		0.332[2]	mg/kg
Iron	CM, HH-res		8,340[2]	mg/kg
Mercury	CM		0.54[2]	mg/kg
Selenium	CM, ECO		0.70[3]	mg/kg
Thallium	CM, HH-res		0.159[2]	mg/kg
Vanadium	ECO		18.8[2]	mg/kg
Actinium-228 Lead-212 Potasisium-40 Radium-226 Radium-228 Thorium-228 Thorium-234 Uranium-234 Uranium-235 Uranium-238	HH HH HH CM, HH CM, HH HH HH-res CM CM, HH-res CM, HH		Visual Extent[4]	NA

1 RG based on human health- future industrial worker risk (1.0E-06)
2 RG based on two times unit-specific background average
3 RG based on ecological risk (LOAEL-based Hazard Quotient=1)
4 Coal-related radionuclides will be addressed through removal of coal rejects (Visual Extent) and verified in the 0-0.3 m (0-1 ft) interval by the arsenic RG.

HH – Human Health; HH-res – Human Health resident only
ECO – Ecological
CM – Contaminant Migration
PTSM – Principal Threat Source Material
N/A – not applicable

Table E-6 RGs for Surface Water and Sediment at 488-D Pooled Basin, 488-D Drainage, and Dead and Stressed Vegetation Area (WSRC 2004a)

RCOC	RCOC Type			RG	Units
	488-D Pooled Basin	488-D Drainage	Dead and Stress Vegetation Area (DSVA)		
Surface Water					
Aluminum	ARAR, ECO	ARAR, ECO	ARAR, ECO	0.0872^1	mg/L
Arsenic	ARAR, HH-res	ARAR, HH-res		0.15^1	mg/L
Beryllium	ARAR, ECO	ARAR, ECO	ECO	0.00053^1	mg/L
Cobalt		ECO			
Copper	ARAR, ECO	ARAR		0.0169^1	mg/L
Iron	ARAR, ECO	ARAR, ECO		0.980^1	mg/L
Thallium	ARAR	ARAR		0.002^2	mg/L
pH	ECO	ECO	ECO	5.8^3	Units
Sediment					
Arsenic		HH-res, ECO	HH-res	3.30^4	mg/kg
Actinium-228		HH-res		Visual Extent^5	NA
Potassium-40		HH-res	HH-res		
Radium-226		HH-res			
Radium-228			HH-res		
pH			ECO	NA^6	Units

1 - RG based on Ambient Water Quality Criteria
2 - RG based on MCL
3 - RG based on the unit-specific average
4 - RG based on the HH-future industrial worker soil (1.3E-06), as the end-state of the DSVA is soil, not sediment
5 - Coal-related radionuclides were addressed through removal of coal rejects (Visual Extent) and verified in the 0-1 foot interval by the arsenic RG
6 - The DSVA will not be restored as a wetland; therefore, the pH RG is not applicable (NA).
HH-res – Human Health residential only
ECO – Ecological
ARAR – Applicable or Relevant and Appropriate Requirements
N/A – not applicable

Table E-7. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	19,567	19,822	17,169	16,777	23,786	97,122
Total ROD Estimated Direct O&M Costs* ($)	23,000	9,000	9,000	9,000	9,000	59,000

*Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D])

I. SITE INFORMATION

Site Name:	**D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D])**	**Date of Inspection:**	**9/08/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #63**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **82°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers
☒ Other Excavation and Consolidation of Contaminated Soil

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) ECACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) ECACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

4. **Other Interviews** *(Optional):* ☐ Report Attached ____________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See Waste Unit Inspection and Maintenance, ER-SOP-019, ER-IDS-019-038 (DRP) and ER-IDS-019-041 (488-D).

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State
☐ PRP In-House ☐ Contractor for PRP
☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Karen Adams (Name) IACD Federal Project Director (Title) 11/08/2016 (Date) 803-952-7871 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☐ Roads adequate ☐ N/A

Remarks: The roads for this OU are in good condition.

B. Other Site Conditions

Remarks: Vegetation is mowed routinely. Construction on 488-4D Ash Landfill and 488-2D Ash Basin has left some rutting on the edges of the cover system. These ruts will be repaired upon completion of irrigation of 488-4D Ash Landfill and 488-2D Ash Basin. Site inspections conducted from FY2012 through FY2016 identified overgrown vegetation, active ant mounds, and hog damage. These findings were addressed soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent________ Depth________

Remarks:________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths________ Widths________ Depths________

Remarks:________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent________ Depth________

Remarks:________

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent________ Depth________

Remarks:________

5. Vegetative Cover: ☐ Grass ☐ Cover properly established ☒ No signs of stress

Areal extent________ Depth________

Remarks:________

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent________________ Depth________________

Remarks:____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent________________
☐ Ponding ☐ Location shown on site map Areal extent________________
☐ Seeps ☐ Location shown on site map Areal extent________________
☐ Soft subgrade ☐ Location shown on site map Areal extent________________

Remarks:____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent________________

Remarks:____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. Outlet Pipes Inspected: ☒ Functioning ☐ N/A

Remarks:____________________

2. Outlet Rock Inspected: ☒ Functioning ☐ N/A

Remarks:____________________

G. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. Siltation:

Areal extent__________ Depth__________ ☐ N/A

☒ Siltation not evident

Remarks:____________________

2. Erosion:

Areal extent__________ Depth__________ ☐ N/A

☒ Erosion not evident

Remarks:____________________

3. Outlet Works: ☒ Functioning ☐ N/A

Remarks:____________________

4. Dam: ☒ Functioning ☐ N/A

Remarks:____________________

H. Retaining Walls ☐ Applicable ☒ N/A

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident

Areal extent__________ Depth__________

Remarks:__________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A

☒ Vegetation does not impede flow

Areal extent__________ Type__________

Remarks:__________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________ Depth__________

Remarks:__________

4. Discharge Structure: ☐ Location shown on site map ☐ N/A

Remarks: In good condition

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Excavation and Consolidation of Contaminated Soil ☒ Applicable ☐ N/A

Excavation and consolidation of contaminated soil were performed at DEXOU. The remedy is performing as designed.

Attachment E-1. Five-Year Review Site Inspection Checklist – D-Area Expanded Operable Unit (D-Area Ash Basin [488-D] and D-Area Rubble Pit [431-2D]) *(continued)*

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The selected remedy for the DEXOU is excavation of waste material from DRP and consolidation within the 488-DAB in conjunction with consolidation of the 488-DAB exposure areas (DSVA, basin exterior, DAB drainage), and application of a low permeability geosynthetic cover system, institutional controls, and monitoring. Institutional controls are in place and being implemented to provide access control and prevent exposure as designed. Selected remedies for the DRP and the 488-D Ash Basin are functioning as intended. There are no issues requiring corrective actions.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the integrity of the cover, which in turn will maintain the effectiveness of the cover to mitigate leaching. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

E-AREA LOW LEVEL WASTE FACILITY (643-26E) OPERABLE UNIT

I. Introduction

This report is the second five-year review for E-Area Low Level Waste Facility (LLWF) (643-26E) (Slit Trench Disposal Units 1 - 5) Operable Unit (OU). This review was conducted from August 2016 through November 2016. Contaminants have been left in place and radiological contaminated waste has been disposed at the E-Area LLWF (Slit Trench Disposal Units 1 – 5) at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the E-Area LLWF (Slit Trench Disposal Units 1 – 5) is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table F-1 lists the chronology of site events for the E-Area LLWF (Slit Trench Disposal Units 1 – 5).

III. Background

The E-Area LLWF was not part of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993) because the U.S. Department of Energy (USDOE) operates and maintains the facility under the authority of the Atomic Energy Act (AEA) and in accordance with USDOE Order 435.1, *Radioactive Waste Management*. However, the U.S. Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and USDOE reached an agreement in 2007 to include the E-Area LLWF as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-regulated unit listed in Appendix C of the FFA. The E-Area LLWF is not identified as a Solid Waste Management Unit under the Resource Conservation and Recovery Act (RCRA). Therefore, an SRS RCRA permit modification was not required.”

Physical Characteristics

The E-Area LLWF OU is located in the central region of the SRS known as the General Separations Area, approximately 9.6 km (6 mi) from the nearest site boundary, as shown in Figure F-1. The E-Area LLWF is comprised of 81 hectares (200 acres), although only 40.5 hectares (100 acres) have been developed for waste disposal. Over the life of the E-Area LLWF, additional disposal units will be constructed as needed.

The E-Area LLWF is located in an area with low to moderate topographic relief and is drained by several perennial streams. The Slit Trench Disposal Units are remote from standing groundwater and conducive to controlled surface water runoff during storm events. The area slopes from an elevation of about 85.9 m (282 ft) in the southernmost corner to an elevation of 74.4 m (244 ft) in the northern most corner. The site is bordered by three streams with several intermittent streams present within the area boundary (Figure F-2). Runoff is to the north toward Upper Three Runs, to the east toward Crouch Branch, and to the west toward an unnamed branch. Crouch Branch and the unnamed branch discharge into Upper Three Runs. Upper Three Runs is approximately 743.1 m (2,438 ft) north of the facility boundary. The nearest perennial stream is approximately 361.8 m (1,187 ft) northeast of the boundary.

The E-Area LLWF is located along a topographic ridge near a groundwater divide. Shallow groundwater beneath the E-Area LLWF flows northerly, toward Upper Three Runs. The average depth from land surface to the water table beneath the Slit Trench Disposal Units is 16.8 m (55 ft) to 19.8 m (65 ft).

The Slit Trench Disposal Units are below-grade earthen disposal units that are used for disposal of USDOE low-level radioactive waste and may be used for disposal of CERCLA regulated low-level radioactive waste.

Five Slit Trench Disposal Units, designated Slit Trench Disposal Units 1 – 5, have been filled to design capacity and have stormwater runoff covers installed. Five other disposal units, designated Slit Trench Disposal Units 6 – 9 and 14, have been sited and waste has been placed within all five of these units. The Slit Trench Disposal Units are identified in

Figure F-3. Each Slit Trench Disposal Unit is approximately 6.1 m (20 ft) deep, 47.9 m (157 ft) wide, and 199.9 m (656 ft) long, and is separated into five individual sections. Each individual section is approximately 6.1 m (20 ft) deep, 6.1 m (20 ft) wide and 199.9 m (656 ft) long (Figure F-4). Approximately 3 m (10 ft) to 4.3 m (14 ft) of undisturbed soil separates each individual disposal section from the next. The excavated soil generated during disposal trench construction is stockpiled for later placement over the disposed waste.

Land and Resource Use

The current land use for the E-Area LLWF is industrial. According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The future land use for the E-Area LLWF is reasonably anticipated to remain industrial with the USDOE maintaining control of the land.

The E-Area LLWF is currently in the operational phase and access is controlled by SRS facility security and administrative controls. Additional land use controls (LUCs) are not part of the interim remedial action. The final Record of Decision (ROD) for the E-Area LLWF is currently scheduled for issuance in March 2063. The Land Use Control Implementation Plan will be deferred until final closure of the entire E-Area LLWF.

There is no current or projected future use of the groundwater or surface water as a drinking water source at the E-Area LLWF. According to the Land Use Control Assurance Plan (WSRC 1999), SRS property is to be owned and institutionally controlled by USDOE.

History of Contamination (Slit Trench Disposal Units Operations)

Radioactive waste disposal operations at the E-Area LLWF began in 1994. The first Slit Trench Disposal Unit received waste in December 1995. The Slit Trench Disposal Units receive low-level radioactively contaminated soil, rubble, wood debris, concrete, equipment, and job control waste (e.g., contaminated protective clothing, plastic sheeting). The waste is disposed of as bulk waste or contained within B-25 boxes, B-12 boxes, 55-gallon drums, Sealand containers and other metal containers. Figure F-5 depicts waste being placed in an open Slit Trench Disposal Unit during active operation.

The Slit Trench Disposal Units have curie inventory limits established in the Performance Assessment (PA), prepared in accordance with USDOE Order 435.1, *Radioactive Waste Management*. When a Slit Trench Disposal Unit reaches the disposal limit established by the PA (either by the sum of fractions of the curie limit to the actual curie inventory or waste volume), the trench is filled with clean soil. There is no single curie limit for a Slit Trench Disposal Unit. The curie limit for each Slit Trench Disposal Unit is specific for each radionuclide and is controlled using a sum-of-fractions technique to ensure each radionuclide remains below the disposal limit established by the PA for that radionuclide. Radionuclide inventory in a Slit Trench Disposal Unit is controlled by waste acceptance criteria and active management of waste receipts to ensure that limits are never exceeded.

Slit Trench Disposal Units 1 – 5 were determined to be operationally closed when the volume or inventory capacity for each disposal unit was reached. The volume capacity for each Slit Trench Disposal Unit will vary from the nominal capacity. Table F-2 provides the date each Slit Trench Disposal Unit was operationally full, the total volume disposed, the total radionuclide inventory, and the sum-of-fractions.

Initial Response

In accordance with USDOE Order 435.1, the E-Area LLWF is designed, operated, and maintained in a manner that is protective of human health and the environment. Closure of the E-Area LLWF under USDOE Order 435.1 will be conducted in three phases: operational closure, interim closure, and final closure. The E-Area LLWF is currently in the operational period and waste disposal is ongoing. With the exception of Slit Trench Disposal Units 1 – 5 and the Naval Reactor Components Disposal Area (643-7E), all other disposal facilities in the E-Area LLWF continue to receive waste.

Operational closure will be conducted at the end of the Slit Trench Disposal Units operation period. Currently, the USDOE is projecting that operational closure for the Slit Trench Disposal Units will begin after completion of operations in the year 2065. Operational closure for the Slit Trench Disposal Units occurs in stages. During disposal activities, trench excavation begins at one end of the trench section and generally proceeds as needed toward the other end of the trench section in order to minimize the time the trench section is open. Waste placement begins at one end of the trench section and proceeds toward the other end. Bulk waste is pushed into the trench section from one end. Containerized waste and large equipment are typically placed in one end of the trench section with a crane. Eventually, containerized waste areas of the trench section are filled in with either bulk waste or clean soil to fill the voids between adjacent containers and the trench section wall. Slit Trench Disposal Units are typically filled to within 1.2 m (4 ft) of the ground surface with waste and backfilled with soil to grade.

Once a section of the Slit Trench Disposal Unit is filled, the clean soil stockpiled during trench section construction is bulldozed in a single lift over that section to produce a minimum 1.2 m (4 ft) thick clean soil layer over the waste (i.e., operational soil cover). The operational soil cover is graded to provide positive drainage off and away from the disposal operation. Subsequent trench sections are filled with waste, covered with an operational soil cover, and graded to promote positive drainage until the entire trench section is filled and covered. The only mechanical compaction that the soil and waste in the trench section receive is from the bulldozer and other heavy equipment moving over the top of a completely backfilled trench. Once a Slit Trench Disposal Unit (i.e., set of five individual sections in the approximately 47.9 m [157 ft] wide by 199.9 m [656 ft] long footprint) has been filled to curie or volume capacity limits and completely covered with a nominal 1.2 m (4 ft) soil cover, it is determined to be operationally closed.

Basis for Taking Action

The E-Area LLWF Slit Trench Disposal Units were approved in 1996 to receive CERCLA waste per the CERCLA Off-Site Rule (OSR), 40 Code of Federal Regulations § 300.440. However, in February 2007, the USEPA sent a Notice of Unacceptability (NOU) to the USDOE making the E-Area Slit Trench Disposal Units unacceptable for the receipt of CERCLA waste. The USEPA’s NOU stated that through reviews and communications, it was determined that tritium had migrated from the Slit Trench Disposal Units into the vadose zone beneath the disposal units. The USDOE, however, determined that the tritium migration was expected and consistent with predictions made by the PA, and no exceedance of the USDOE Order 435.1 performance measures had occurred. In July 2007, representatives from the USDOE, USEPA and SCDHEC met and resolved issues concerning the disposal of CERCLA waste in the Slit Trench Disposal Units. As part of the agreement, the USDOE placed the entire E-Area LLWF on the FFA Appendix C list (satisfying the OSR provision for inclusion in an enforceable agreement). Consequently, the USEPA restored the OSR Acceptability for the Slit Trench Disposal Units, allowing the disposal units to receive CERCLA waste.

In accordance with USDOE Order 435.1, the E-Area LLWF is designed, operated, and maintained in a manner that is protective of human health and the environment. As part of the regulatory agreement for receipt of CERCLA waste, USDOE agreed to evaluate placement of operational stormwater runoff covers over the Slit Trench Disposal Units that have reached operational design capacity as an interim remedial action to further mitigate the tritium migration. Design capacity is determined when the curie limit or volume capacity for each Slit Trench Disposal Unit is reached. The curie limit for a Slit Trench Disposal Unit is specific for each radionuclide and is controlled using a sum-of-fractions technique to ensure each radionuclide remains below the disposal limit established by the PA for that radionuclide. This interim remedial action will increase the protection of human health and the environment by adding additional barriers to water infiltration and will reduce the migration of tritium in the vadose zone. The interim remedial action serves as an enhancement to the current protection measures under USDOE Order 435.1. In addition, the agreement to place the E-Area LLWF in the FFA increases regulatory participation in the final closure decisions for the entire E-Area LLWF. In all other respects, the USDOE will continue to operate the E-Area LLWF under its AEA authority.

IV. Remedial Actions

Remedy Selection

The interim remedial action objective established by the Interim Record of Decision (IROD) (SRNS 2009) and Explanation of Significant Differences (ESD) (SRNS 2010a) is as follows:

- Further reduce stormwater infiltration for Slit Trench Disposal Units 1 – 5 by enhancing stormwater runoff during the E-Area LLWF operational period.

Remedy Implementation

The selected interim remedial action was implemented to meet the interim remedial action objective and included the following activities (SRNS 2012):

- Grading the operational soil cover to promote drainage off the Slit Trench Disposal Units;
- Placing grading fill and structural fill over the graded operational soil cover;
- Placing a low-permeability geosynthetic stormwater runoff cover over the structural fill;
- Installing sand bags on the runoff covers to prevent uplifting from wind;
- Installing and sealing of rubber boots at all cover penetrations (e.g., for lysimeters and neutron probe boreholes) to prevent intrusion of water;
- Installing concrete drainage channels around the perimeter of the covered areas;
- Anchoring the runoff covers to embedded concrete and to the drainage channels;
- Placing riprap where drainage channels open into existing earthen ditches;
- Installing warning barricades, signs, and chains around the covered areas;
- Vegetating disturbed areas outside of the covers, drainage channels, and trenches to prevent erosion; and
- Installing non-slip walkways for operations personnel on the liner for liner protection from pedestrian traffic.

Figure F-6 depicts the stormwater runoff covers for Slit Trench Disposal Units 1 – 5.

System Operations/Operations and Maintenance

There were no operational systems installed as part of the interim remedial action. Therefore, there are no system operational requirements (SRNS 2010b, SRNS 2012).

The following maintenance activities are ongoing:

- Quarterly visual inspections of the runoff covers and drainage systems for damage (i.e., tears, cracks) and ineffective drainage (i.e., standing water),
- Necessary repairs to the runoff covers and drainage system for the duration of the operational period, and
- Inspections of warning barricades, including sign postings and chains around the covered areas, to prevent equipment and vehicular traffic on the cover system.

Table F-4 compares the actual operations and maintenance (O&M) costs over the last five years to the estimated direct O&M costs from the IROD (SRNS 2009). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 is $92,500 for access controls, annual inspections, and annual liner repairs. Actual O&M costs for maintaining the covers are not available. However, there have been no repairs performed on the E-Area LLWF (Slit Trench Disposal Units 1 – 5) stormwater runoff covers during FY2012 toFY2016 and estimated costs are considered fairly accurate estimates for the actual costs. Based on the observed lifting of the covers during wind events and weathering due to sun exposure, it is anticipated that the covers will not be intact for the original project duration of 25 years without substantial repair and rework. The observed subsidence has not compromised the integrity of the covers; however, it is anticipated that with time and additional settlement, rework of the soil beneath the covers will be necessary if positive drainage off the disposal units is to be maintained. As such, the future O&M costs are expected to be significantly higher than originally estimated based on the anticipated condition of the stormwater runoff covers and the soil and material beneath the covers.

V. Progress since Last Review

The previous protectiveness statement concluded that the interim remedy at the E-Area LLWF (Slit Trench Disposal Units 1 – 5) is protective of human health and the environment. The interim remedy enhances the protective measures currently in place and reduces storm water infiltration through the Slit Trench Disposal Units 1 – 5. Because the E-Area LLWF is currently in the operational phase, unit specific LUCs have been deferred until final closure of the entire E-Area LLWF. However, access is controlled by SRS facility security and administrative controls.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed the implementation of the interim remedial action;
- Evaluated the effectiveness of the interim remedial action;
- Inspected the E-Area LLWF (Slit Trench Disposal Units 1 – 5), conducted site interviews, and documented the results on the Inspection Checklist provided in Attachment F-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Based on the FY2015 PA Annual Review (SRNL 2016), operations, disposal activities and vadose zone monitoring results indicate that the conclusions of the PA remain valid with reasonable expectation that the E-Area LLWF will meet the performance objectives delineated in DOE Order 435.1.

Summary of Inspections and Interviews

Interviews were conducted with Don Sink, Solid Waste Management (SWM) Engineering, and Sarita Berry, the SWM Environmental Compliance Authority (ECA), on September 21, 2016 at the SWM Facility. No issues were identified for the E-Area LLWF during these interviews.

The E-Area LLWF was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 22, 2016. No issues were identified for the E-Area LLWF (Slit Trench Disposal Units 1 – 5) during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 22, 2017. No significant problems regarding this OU were identified during the inspection.

Quarterly site inspections conducted during FY2012 and FY2016 noted two depressions in the surface of the E-Area LLWF (Slit Trench Disposal Units 4 and 5) cover that were also noted in the Fourth Five-Year Remedy Review Report (SRNS 2014). Surface depressions at E-Area LLWF are not unexpected, and these subsidence areas are monitored to verify the cover is not compromised. Additionally, the release of the cover anchor strip fasteners has been observed on occasion. The anchor strips remained intact and the fasteners are replaced as needed.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

The stormwater runoff covers (intact though localized subsidence is noted as discussed in Section VIII) are operating as designed to effectively drain stormwater runoff away from the buried trench material significantly reducing infiltration. Based on the FY2015 PA Annual Review (SRNL 2016), vadose zone monitoring indicates that migration of radionuclides remains within the PA predictions and continue to meet the performance objectives.

The E-Area LLWF is currently in the operational phase and access is controlled by SRS facility security and administrative controls. OU-specific LUCs have been deferred until final closure of the entire E-Area LLWF.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

Because of ongoing operations, a CERCLA risk assessment has not been conducted at the E-Area LLWF and is not required to support the interim action. In accordance with USDOE Order 435.1 requirements, the expected migration of radionuclides is evaluated in the PA to ensure protection of groundwater resources. There have been no changes in cleanup levels, standards, or to-be-considered guidance that would alter the conclusions of the PA that call into question the protectiveness of the interim remedy.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Strategy?

The following information should be considered in the overall protectiveness of the strategy:

- The E-Area LLWF PA, as required by USDOE Order 435.1, evaluates the migration of radionuclides and determines the potential impacts to groundwater resources. The E-Area LLWF PA determines acceptable disposal limits for radioactive low-level waste based on key inputs and assumptions associated with the conditions of the waste and disposal facility, including expected releases of radionuclides from the disposal units. The acceptable disposal limits are set at levels that ensure protection of human health and the environment. The annual review of the PA for the E-Area LLWF documents the full assessment of the E-Area LLWF O&M activities. Based on the FY2015 PA (SRNL 2016), vadose zone monitoring indicates that migration of radionuclides is within the PA predictions and is not expected to exceed the drinking water standards beyond a 100-m (328-ft) buffer zone surrounding the disposed waste (USDOE Order 435.1 point of compliance).

- Installation of stormwater runoff covers over the Slit Trench Disposal Units 1 – 5 was not analyzed in the E-Area LLWF 2008 PA (WSRC 2008). Subsequent analysis (SRNS 2011) indicated that use of the stormwater runoff covers over the Slit Trench Disposal Units 1 – 5 would allow significantly (over two orders of magnitude) greater tritium disposal limits for the Slit Trench Disposal Units. Tritium is highly mobile with a relatively short half-life. The increase in the tritium disposal limit is due to the reduction in the anticipated controlled release of tritium from the disposal unit prior to placement of the interim closure cover (i.e., the tritium is held up in the waste zone and decays significantly before the assumed failure of the final cover).
- Since infiltration is significantly reduced with the stormwater runoff covers, long-lived radionuclides, and their daughter products are expected to buildup beneath the cover. This buildup of long-lived radionuclides is expected to result in an increase in the total projected long-term doses to the off-SRS resident; however, the doses are still below the performance objectives of USDOE Order 435.1. The increase in dose is due to the eventual flushing of long-lived parents and their daughters (all held up initially by the stormwater runoff cover, then by the interim and final covers), that get flushed out with the eventual failure of the final cover.

VIII. Issues

The following issues have been identified during this remedy review:

- Maintenance of the stormwater runoff covers continues to be problematic. Since the only mechanical compaction that the placed soil and disposed waste receives is from bulldozer usage and other heavy equipment moving over the top of a completely backfilled trench, significant subsidence as soil settles in and around waste containers is expected during subsequent years after placement of the soil cover. Placing the stormwater runoff covers immediately upon reaching design capacity does not allow for the early settlement to be backfilled. Subsidence beneath the stormwater runoff covers at Slit Trench Disposal Units 4 and 5, and water pooling in these locations was observed and reported in the Fourth Five-Year Remedy Review (SRNS 2014). The

FY2015 inspections determined that these two depressions have not changed in size or depth (see Figures F-7 and F-8). The covers were still intact with no fatigue issues above the depressions. The observed subsidence has not compromised the integrity of the covers, but it is anticipated that substantial rework of the soil beneath the covers will be required if positive drainage off the disposal units is to be maintained. No corrective actions are required at this time.

- During wind events, the covers have been observed to lift substantially, resulting in mechanical stresses to the cover materials. Sandbags are placed as needed on the covers during high winds to mitigate damage. Though the anchor strips are still intact and functioning as designed, the fasteners for the stainless-steel anchor strips come off routinely and are replaced with more durable fasteners. With the additional weathering due to sun exposure, the covers are not expected to meet the original project life of 25 years.
- Subsidence and weathering of the stormwater runoff covers is anticipated to result in significant repairs prior to the end of the design life of the covers. Use of a vegetated soil cover was initially planned since the anticipated subsidence would be readily accessible for maintenance. This cost-effective option was considered in the PA to be adequate for meeting the PA objectives.
- The E-Area LLWF is currently in the operational phase and access is controlled by SRS facility security and administrative controls. OU-specific LUCs have been deferred until final closure of the entire E-Area LLWF. Since the SRS facility security and administrative controls that restrict unauthorized access to the E-Area LLWF were not recognized as part of the interim remedy, the interim remedy was not considered as long-term protective in previous five-year remedy reviews.

IX. Recommendations and Follow-up Actions

The recommendation from the Fourth Five-Year Remedy Review Report (SRNS 2014) identified the need for further discussion with the USEPA and SCDHEC on the installation and maintenance activities for stormwater runoff covers. A meeting and field walkdown was held on December 6, 2013 with the USDOE, USEPA, and SCDHEC to discuss the maintenance issues and a path forward for installation of future stormwater runoff covers. USDOE recommended that the need for stormwater runoff covers be evaluated on an as-needed basis depending on the waste type or curie content. In lieu of a low permeability membrane, USDOE recommended that soil covers and/or vegetative covers that are graded for positive flow or other low permeability materials with less maintenance issues be considered. No new slit trench disposal units have been operationally closed since issuance of the previous five-year remedy review report (SRNS 2014).

Table F-3 presents the recommendations for the E-Area LLWF Slit Trench Disposal Units 1 - 5. The USDOE recommends that discussions continue with the USEPA and SCDHEC on the type of cover system needed for future slit trench disposal units. Additionally, the USDOE recommends revising the FFA Annual Progress Report to include the E-Area LLWF to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls. Further discussion is needed with USEPA and SCDHEC to reach agreement on the revised text and table in the FFA Annual Progress Report.

X. Protectiveness Statement(s)

The interim remedy at the E-Area LLWF (Slit Trench Disposal Units 1 – 5) is currently protective of human health and the environment because access is controlled by SRS facility security and administrative controls.

The interim remedy enhances the current protective measures required by USDOE Order 435.1 and reduces stormwater infiltration through the Slit Trench Disposal Units 1 – 5. Because the E-Area LLWF is in the operational phase, unit specific LUCs have been deferred until final closure of the entire E-Area LLWF. The final ROD for E-Area LLWF is scheduled for issuance in March 2063.

Long-term protectiveness will be achieved by including E-Area LLWF and the SRS facility security and administrative controls that restrict unauthorized access in the FFA Annual

Progress Report. The report is required by the FFA and includes an annual certification by the USDOE Savannah River Site Manager that the listed OUs are in compliance with land use requirements.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNL, 2016. *FY2015 Performance Assessment Annual Review for the E-Area Low-Level Waste Facility*, SRNL-STI-2015-00691, Revision 0, Savannah River National Laboratory, Savannah River Site, Aiken, SC

SRNS, 2009. *Interim Record of Decision Remedial Alternative Selection for the E-Area Low-Level Waste Facility, 643-26E (Slit Trench Disposal Units 1 and 2)*, SRNS-RP-2009-00538, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010a. *Explanation of Significant Differences (ESD) for the Revision 1 Interim Record of Decision Remedial Alternative Selection for the E-Area Low-Level Waste Facility, 643-26E (Slit Trench Disposal Units 1 and 2)*, SRNS-RP-2009-01128, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010b. *Interim Remedial Action Implementation Plan for the E-Area Low-Level Waste Facility, 643-26E (Slit Trench Disposal Units 1 - 5)*, SRNS-RP-2009-01213, Revision 1, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC

SRNS, 2011. *FY 2010 Annual Review - E-Area Low-Level Waste Facility Performance Assessment and Composite Analysis*, SRNS-STI-2011-00024, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2012. *Interim Post-Construction Report (IPCR) for the E-Area Low-Level Waste Facility, 643-26E (Slit Trench Disposal Units 1 – 5),* SRNS-RP-2011-00996, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina,* SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC 2008. *E-Area Low-Level Waste Facility USDOE 435.1 Performance Assessment*, WSRC-STI-2007-00306, Revision 0, Washington Savannah River Company, Savannah River Site, Aiken, SC

Various – SWMF E-Area Inspections – *Quarterly Slit Trench Water Barrier Cover Inspection,* Manual SW15, Procedure SW15.6-INP-SWF-03, Inspection period 2012 through 2016 (quarterly)

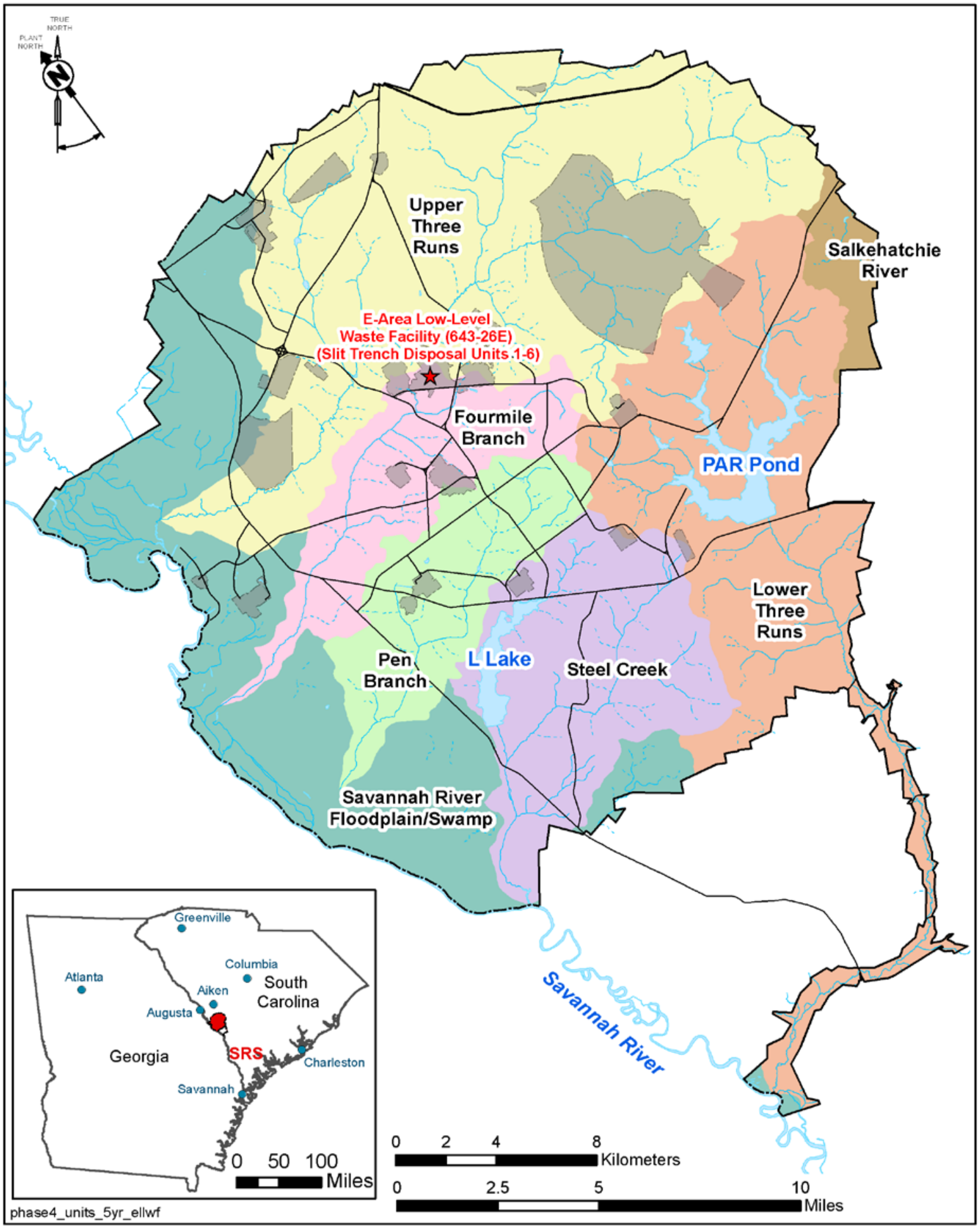


Figure F-1. Location of the E-Area LLWF at SRS

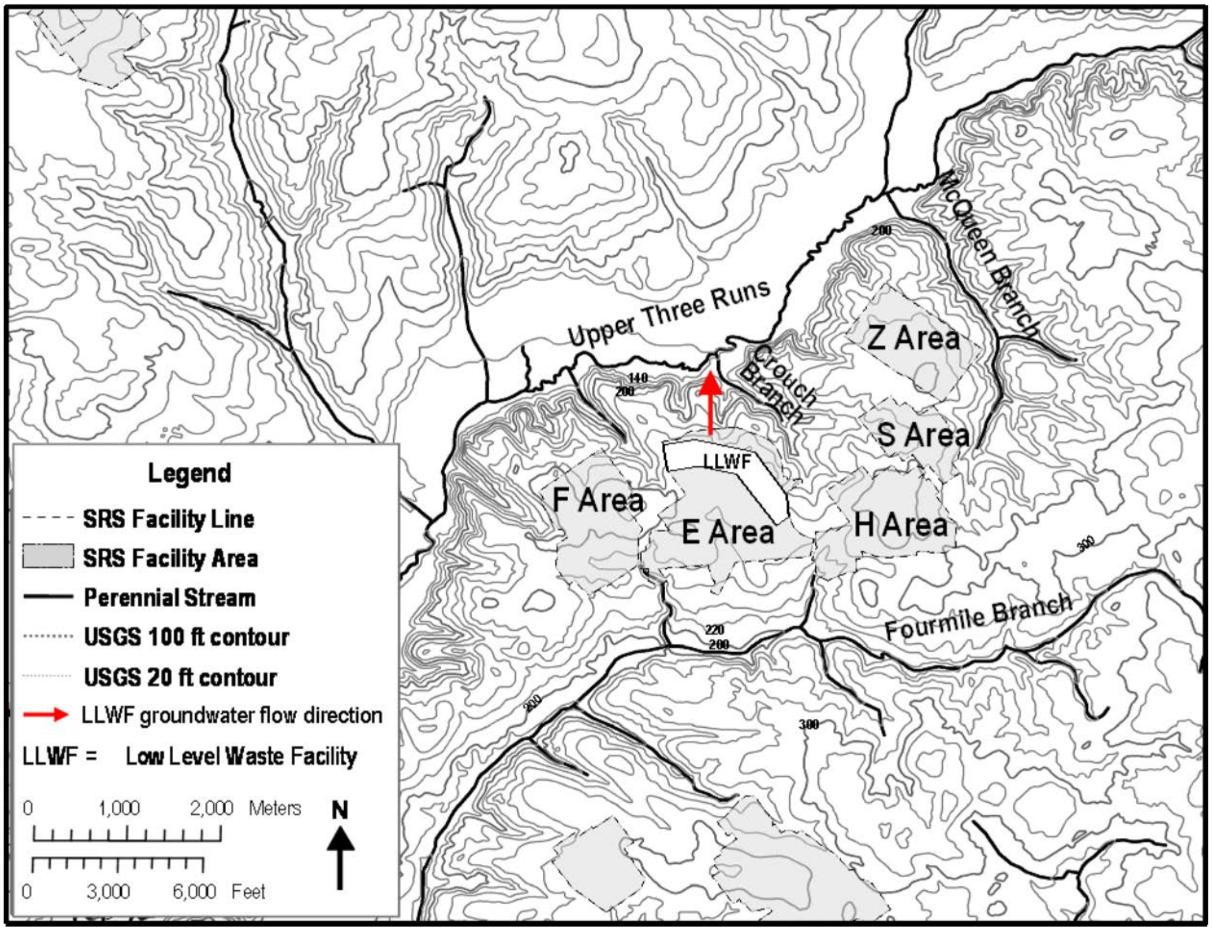


Figure F-2. Upper Three Runs Watershed Stream Locations

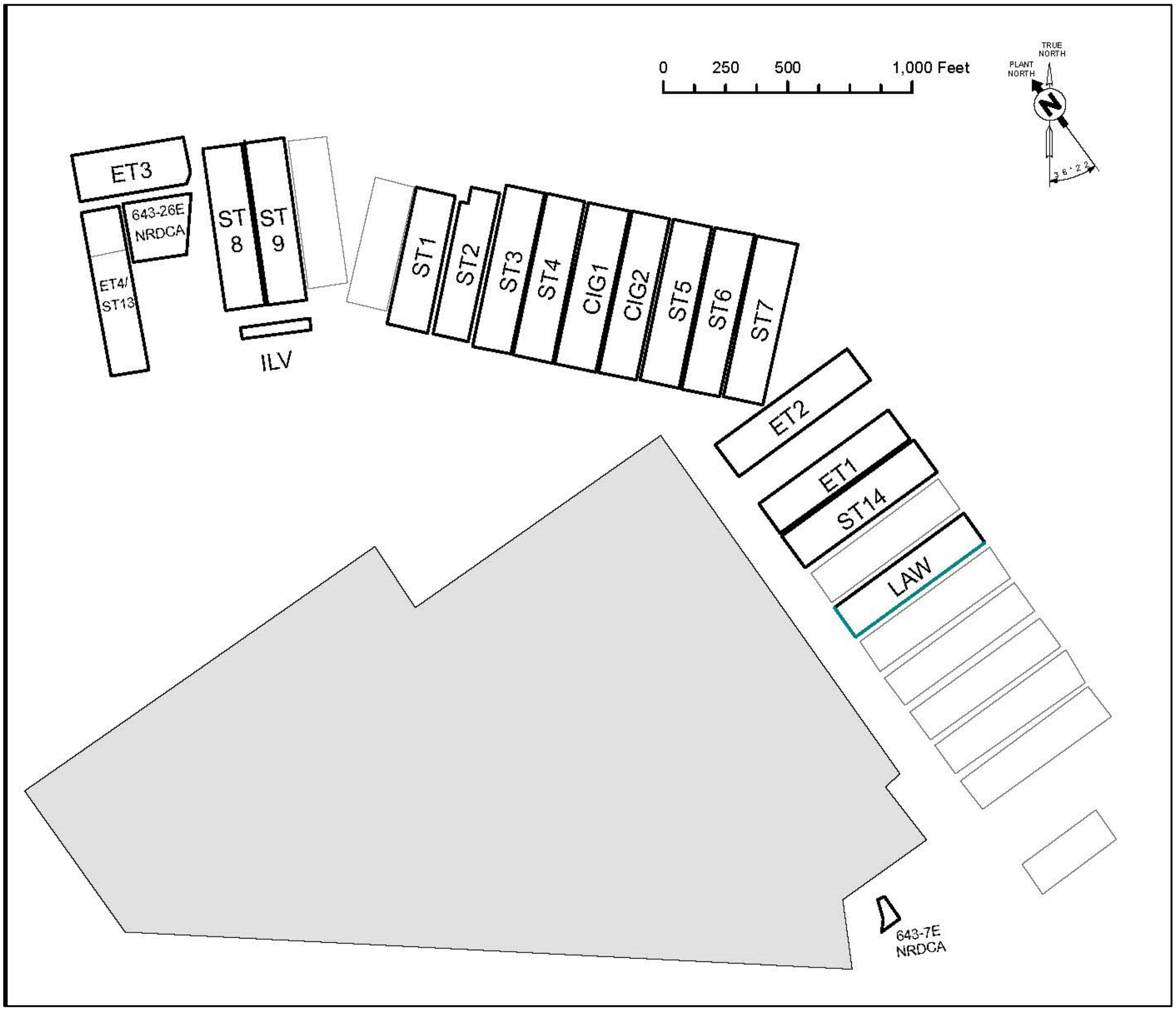
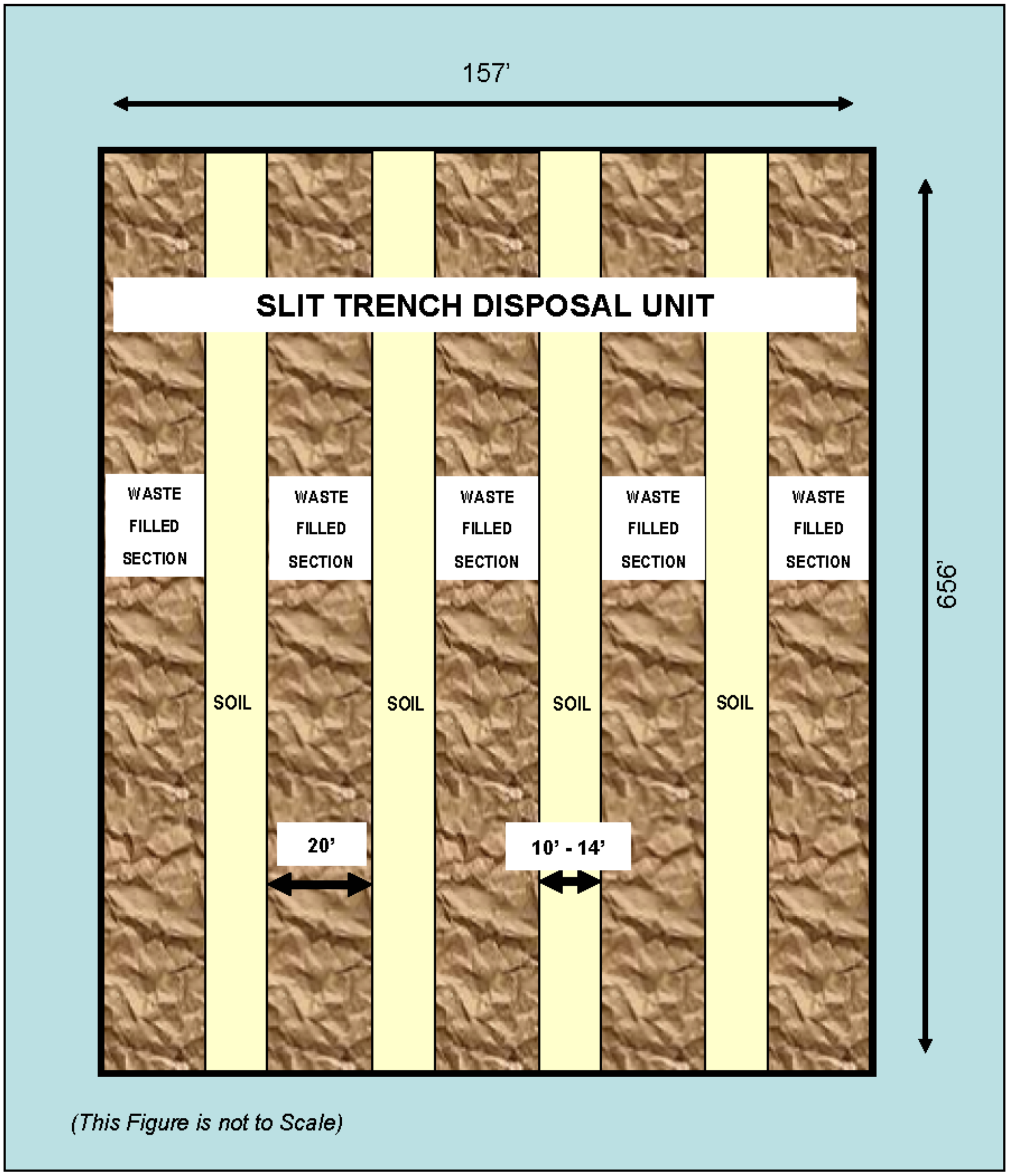


Figure F-3. Layout of the E-Area LLWF



(This Figure is not to Scale)

Figure F-4. **Typical Slit Trench Disposal Unit Layout**

Figure F-5. Slit Trench Disposal Unit Operations (November 2008)

Figure F-6. E-Area LLWF Stormwater Runoff Covers for Slit Trench Disposal Units 1 – 5 (2015)

Figure F-7. **Subsidence of Intact Covers (~3 m [10 ft] diameter) at Slit Trench Disposal Unit 4 (2016)**

Figure F-8. **Subsidence of Intact Covers (~1.5 m [5 ft] diameter) at Slit Trench Disposal Unit 5 (2016)**

This page is intentionally left blank.

Table F-1. Chronology of OU Events

Event	Date
E-Area LLWF added to FFA Appendix C	May 2008
IROD Issuance (Slit Trench Disposal Units 1 and 2)	January 22, 2010
ESD Issuance (added Slit Trench Disposal Units 3 – 5)	April 22, 2010
Interim Remedial Action Start/Complete	May 17, 2010 / March 16, 2011
Previous Five-Year Review Issuance	February 4, 2014

Table F-2. Final Disposal Volumes, Radionuclide Inventory, and Sum of Fractions for E-Area LLWF Slit Trench Disposal Units 1 through 5

Slit Trench Disposal Unit	Date when Operational Full[1]	Final Disposal Volume[2] [m^3 (ft^3)]	Final Radionuclide Inventory[2] (curies)	Sum of Fractions (SOF)[3]
1	9/19/2003	14,264 (503,728)	39.8	0.85
2	8/31/2006	15,560 (549,496)	164	0.87
3	1/6/2010	16,953 (598,690)	125	0.89
4	8/19/2010	19,193 (677,794)	142	0.99
5	10/16/2006	28,125 (993,225)	127,000	0.99

NOTE:

1. Information provided by email correspondence from D. Sink to K. Vangelas on 2012 August 7.
2. Final disposal volumes and radionuclide inventories were obtained from the FY2015 PA Annual Review (SRNL 2016).
3. Limit fractions, i.e., the actual disposed radionuclide content divided by the specific radionuclide PA limit, are maintained for each radionuclide. The SOF is the sum of all the individual fractions. Disposal operations are controlled such that the SOF is below one to ensure compliance with the performance objectives. SOFs were obtained from the FY2015 Annual Review (SRNL 2016).

Table F-3. Recommendations and Follow-up Actions for the E-Area LLWF (Slit Trench Disposal Units 1 – 5)

Issues	Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
					Current	Future
Reevaluation of the installation and maintenance activities (for stormwater runoff covers). The current geosynthetic covers are not expected to meet the original project life of 25 years, and therefore carry anticipated high maintenance and replacement costs.	Further discussion of how these issues impact future covers is needed with USEPA/ SCDHEC.	USDOE	USEPA/ SCDHEC	Not Applicable	N	N
Unit specific LUCs for the E-Area LLWF (Slit Trench Disposal Units 1-5) have been deferred until final closure of the entire E-Area LLWF. SRS facility security and administrative controls that restrict unauthorized access to the E-Area LLWF were not previously recognized as part of the interim remedy. Therefore, the interim remedy was not considered as long-term protective.	Revise the FFA Annual Progress Report to include the E-Area LLWF (Slit Trench Disposal Units 1-5) to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls. Further discussion is needed with USEPA/SCDHEC to reach agreement on the revised text and table in the FFA Annual Progress Report.	USDOE	USEPA/ SCDHEC	September 2018	N	N

Table F-4. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	*	*	*	*	*	*
Total IROD Estimated Direct O&M Costs** ($)	30,500	15,500	15,500	15,500	15,500	92,500

* Actual O&M costs for maintaining the covers are not available.

** Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5)

I. SITE INFORMATION

Site Name:	**E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5)**	**Date of Inspection:**	**9/8/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #86**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny 90°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☐ Access Controls
☐ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers
☐ Other ______________________________

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **Solid Waste Eng:** **Don Sink** (Name) SWM Engineer (Title) 9/21/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.:________________

Problems/Suggestions: ☐ Report Attached Included in text of the Five-Year Remedy Review Report

2. **Solid Waste ECA:** Sarita Berry (Name) SWM ECA (Title) 9/21/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.:________________

Problems/Suggestions: ☐ Report Attached Included in text of the Five-Year Remedy Review Report

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

4. Other Interviews *(Optional):* ☐ Report Attached ____________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See E-Area LLWF Inspection Reports.

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS

☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific remedy review report.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☒ N/A

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:____

B. Other Site Conditions

Remarks: Site inspections conducted quarterly from FY2012 through FY2016 identified two subsidence areas in the surface cover. Developing depressions at E-Area LLWF (Slit Trench Disposal Units 1 – 5) are an expected condition. The subsidence areas are monitored to verify that the cover is still intact. No corrective actions are required at this time.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☐ Settlement not evident

Areal extent__________________ Depth_____________________

Remarks: Subsidence and pooling of water have been observed on the cover (Figures F-7 and F-8) as noted in the previous five-year remedy review. However, the area of concern has not increased in size and the covers are intact. Monitoring of area will continue.

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths_____________________ Widths____________________ Depths_____________________

Remarks: Multiple fasteners for the anchor strips have come off; however, the anchor strips are still intact. Monitoring and replacement of fasteners will continue as needed.

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________________ Depth_____________________

Remarks:____

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent__________________ Depth_____________________

Remarks: ____

5. Vegetative Cover: ☐ Grass ☐ Cover properly established ☐ No signs of stress

Areal extent__________________ Depth_____________________

Remarks: Not applicable; no vegetative cover present.

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:______________________________

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent__________ Depth__________

Remarks:______________________________

8. Wet Areas / Water Damage: ☐ Wet areas/water damage not evident

☒ Wet areas ☐ Location shown on site map Areal extent__________
☒ Ponding ☐ Location shown on site map Areal extent__________
☐ Seeps ☐ Location shown on site map Areal extent__________
☒ Soft subgrade ☐ Location shown on site map Areal extent__________

Remarks: Subsidence and pooling of water have been observed on the cover (Figures F-7 and F-8) as noted in the previous five-year remedy review. However, the area of concern has not increased in size and the covers are intact. Monitoring of area will continue.

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent__________

Remarks: ______________________________

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

D. Cover Penetrations ☒ Applicable ☐ N/A

1. Gas Vents: ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

2. Gas Monitoring Probes:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

3. Monitoring Wells:
☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
Remarks: Monitoring is conducted under the E-Area Monitoring Program and is not part of the interim remedial action. Monitoring data is used to ensure PA performance objectives are not exceeded.

4. Leachate Extraction Wells:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

5. Settlement Monuments: ☐ Located ☐ Routinely Surveyed ☒ N/A
Remarks:

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

G. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. Siltation:
Areal extent________ Depth________ ☐ N/A
☒ Siltation not evident
Remarks: Ponds are functioning as designed.

2. Erosion:
Areal extent________ Depth________ ☐ N/A
☒ Erosion not evident
Remarks:________

3. Outlet Works: ☒ Functioning ☐ N/A
Remarks:________

4. Dam: ☐ Functioning ☒ N/A
Remarks:________

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident
Areal extent________ Depth________
Remarks:________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent________ Type________
Remarks:________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent________ Depth________
Remarks:________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks: Small cracks were observed in the concrete drainage channels on the perimeter of the covers. The cracks were repaired with a concrete epoxy.

Attachment F-1. Five-Year Review Site Inspection Checklist – E-Area Low Level Waste Facility (643-26E) (Slit Trench Disposal Units 1 - 5) *(continued)*

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Soil Vapor Extraction System ☐ Applicable ☒ N/A

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The selected interim remedial action for E-Area LLWF (Slit Trench Disposal Units 1 – 5) is the installation of operational stormwater runoff covers to further reduce stormwater infiltration by enhancing stormwater runoff during the E-Area LLWF operational period. The remedy is currently effective and functioning as designed with the exception of subsidence and pooling of water noted in the OU-specific remedy review report.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures are adequately maintaining the integrity of the E-Area LLWF stormwater runoff covers. The O&M procedures consisting of routine site inspections and site maintenance (cover system) and E-Area LLWF site controls have been implemented. Since covers are intact and functioning as intended, there are no issues requiring corrective actions at this time.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

Mechanical degradation of covers based on observed lifting of covers during wind events and due to settlement of the soil and material beneath the covers is expected to reduce the life of the covers and require unscheduled repairs.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Recommendations provided in the OU-specific review report (Table F-3).

This page is intentionally left blank.

F-AREA RETENTION BASIN (281-3F) OPERABLE UNIT

I. Introduction

This report is the fourth five-year review for the F-Area Retention Basin (281-3F) (FRB) Operable Unit (OU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the FRB OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the FRB OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table G-1 lists the chronology of site events for the FRB OU.

III. Background

The FRB OU is a Resource Conservation Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993).

Physical Characteristics

The FRB OU includes a basin, designated as 281-3F, and two process sewer lines. The OU is located outside and south of the F-Area perimeter fence, approximately 1,019 m (3,397 ft) north of Fourmile Branch (Figures G-1 and G-2). The basin is approximately 60 m (200 ft) long, 38.7 m (129 ft) wide, and 2.1 m (6.9 ft) deep covering an area of approximately 0.24 hectares (0.6 acres). The two process sewer lines (60-cm [24-in] and approximately 165 m [550 ft] long; 90-cm [36-in] and approximately 210 m [700 ft] long) conveyed and discharged water into the north side of the basin.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the FRB OU as being within an industrial area. The future land use for the FRB OU is reasonably anticipated to remain industrial with U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The FRB OU was designed and operated as an unlined temporary storage pond, with a capacity of approximately 4.5 million L (1.2-million gal), for potentially contaminated cooling water from F-Area Canyon Facility and stormwater drainage from the F-Area Tank Farm (FTF). The FRB became operational in 1955 and remained active until 1972. It was closed in December 1978.

Initial Response

After the FRB closure in 1978, soil sampling was performed at the basin and approximately 0.6 m (2 ft) of soil was excavated from the bottom of the basin as a removal action. The basin was backfilled with clean soil and the area was seeded with grass. A total of 969 m^3 (1,267 yd^3) of contaminated soil was removed from the basin and transported to the Old Radioactive Waste Burial Ground (643-E) for permanent disposal.

When the FRB was closed, two sections of the process sewer line that served the basin were abandoned. These included both branches of the pipeline that ran from the FTF and from the F-Area Canyon Facility. The 60-cm (24-in) diameter pipeline that extended from the FTF was sealed off at manhole P37 (805-2F). The 90-cm (36-in) diameter pipeline that extended from the F-Area Canyon Facility was sealed off at manhole P-40. The approximate length of the abandoned portion of the process sewer line located to the north and south of the basin is 345 m (1,150 ft) and is part of this OU.

Basis for Taking Action

Constituents identified as contaminants of concern (COCs) (Table G-2) are present in both the basin and process sewer line areas. Exposures and risks are driven by the COCs in the soils. Carcinogenic risks exist for both the future on-unit worker and hypothetical future on-unit resident in the Basin and Process Sewer Line Areas. The future construction worker is identified as facing a potential carcinogenic risk in the Process Sewer Line Area.

Leaching of strontium-90 from deep soils to the groundwater is estimated to exceed maximum contaminant levels (MCLs) by almost 10-fold in 76 years has been identified as a potential contaminant migration carcinogenic risk to human health in the basin area. The only non-carcinogenic hazard identified for the FRB OU is to the future on-unit resident as a result of potential exposure to metals in soils associated with the basin area. There are no non-carcinogenic hazards associated with the process sewer line area. No ecological risks have been identified with the FRB OU.

IV. Remedial Actions

Remedy Selection

The FRB, surrounding soils, and groundwater were characterized in detail in 1997 (WSRC 1997a, WSRC 1997b). The results showed that the groundwater was not contaminated and, therefore, would not require remediation. The surface soil in the basin area and the process sewer line area was contaminated primarily with cesium-137, radium-226, and potassium-40. The subsurface soil contained strontium-90, which was identified as a contaminant migration COC. The basin deep soil, 1.8 to 4.2 m (6 to 14 ft) deep, is contaminated with high levels of radionuclides and is considered to be principal threat source material (PTSM). No COCs were identified for the groundwater. The final soil COCs for the FRB OU are actinium-228, arsenic, cesium-137, lead-212, plutonium-239/240, potassium-40, radium-226, strontium-90, and thallium. The COCs and associated remedial goals (RGs) are presented in Table G-2.

The remedial action objectives (RAOs) for the FRB OU as listed in the ROD (WSRC 1998) are as follows:

- Reduce risks to human health associated with the COCs through external exposure to radiological constituents by direct contact with the basin area soil, surface water, and sewer line area soil, ingestion of basin area and sewer pipeline area soils and pipeline sediment or produce grown in soils with radiological constituents;
- Prevent or mitigate exposure to highly toxic or highly mobile contaminants that represent PTSM; and

- Prevent or mitigate leaching and migration of strontium-90 to groundwater at levels exceeding its MCL (8.0 ρCi/L).

The selected remedies as described in the ROD (WSRC 1998) are as follows:

- Basin Soils: Institutional Controls, Grouting, a Low Permeability Cover, and Groundwater Monitoring;
- Former Process Sewer Line: Institutional Controls, Pipeline Grouting, Soil Excavation and Disposition in the Basin Soils; and
- Groundwater: No action.

The OU will be physically maintained and institutional controls will remain in place in perpetuity. Short-term institutional controls will include signs posted at the FRB OU indicating the area was used for disposal of waste material and contains buried waste, as well as the SRS Site Use/Site Clearance Programs that prevent excavation of or penetration into the buried waste/contaminated subsurface soils. If the property is transferred to non-Federal ownership, the U.S. Government will take those actions necessary pursuant to Section 120(h) of CERCLA. These actions include a deed notification and a certified survey.

Remedy Implementation

The FRB basin soil remedial actions implemented in accordance with the ROD (WSRC 1998) are listed below:

- Consolidating 32 m^3 (42 yd^3) of hot spot soils by excavating the 1.2 m (4 ft) from the FRB side walls and the hot spots around the process sewer line and transporting the soils to the bottom of the FRB.
- In situ stabilizing of 880 m^3 (1,150 yd^3) of contaminated soil by grouting the FRB deep basin soil approximately 0.6 m (2 ft) above the basin bottom to approximately 1.8 m (6 ft) below the basin bottom or approximately 4.2 m (14 ft) below grade.

- Installing a 0.24-hectare (0.59-acre) low permeability soil cover system with a hydraulic conductivity of 1E-05 cm/s to minimize infiltration of precipitation and to serve as a barrier to shield human and ecological receptors from potential soil contamination. The cover system includes three layers (from bottom to top) - a grading layer of common fill, a 0.6-m (2 ft) thick low permeability soil layer, and a 45-cm (18-in) vegetation layer with the top 15 cm (6 in) being top soil mixed with common fill.
- Establishing land use controls (LUCs) for 0.44 hectares (1.07 acres) (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU).
- Implementing SRS access controls (SRS site security).
- Installing warning signs.

The Process Sewer Line soil remedial actions implemented in accordance with the ROD are described below:

- Grouting pipelines and manholes to prevent access to the contaminants within the pipeline.
- Establishing the same institutional controls as for the basin soil.

Results of groundwater modeling indicated the FRB-associated groundwater posed no risk to human health or the environment. No COCs were identified for the groundwater and no remedial action was required (WSRC 1998).

An Explanation of Significant Differences (ESD) to the ROD (WSRC 2000) was approved to modify the remedy. The ESD was issued on June 13, 2001. The original remedy included an estimate of 229 m^3 (300 yd^3) of contaminated pipeline soils that would require excavation and placement into the basin for stabilization along with the existing basin soils. This estimate was based on the amount of soil that would exceed the established 20 ρCi/g gross alpha and 50 ρCi/g nonvolatile beta screening criteria. During field execution of the selected remedy, it was determined that the estimate of soils exceeding the 20/50 screening criteria was 2,944 m^3 (3,850 yd^3). The basin had insufficient capacity to hold the increased volume of soil. Although this remaining soils exceeds 20/50 screening criteria, it does not represent a PTSM or contaminant migration concern. SRS achieved the 20/50 screening criteria at the basin sidewalls and outlet structure and drainage ditch areas. Due to the limited basin capacity available for soil treatment, a change was proposed for excavation and treatment of soils representing a PTSM while leaving in place pipeline soils that do not represent a PTSM or migration concern.

The ESD modified the 20/50 screening criteria to the following: "The volume of contaminated soil will be determined by comparing the existing sampling data against the acceptance criteria (concentration levels not to exceed 20 ρCi/g alpha and 50 ρCi/g for beta and gamma emitters to a 0.6 m (2 ft) depth while leaving any deeper soils (at depths greater than 0.6 m [2 ft]) that do not represent a PTSM or migration concern)." Analytical data indicated that there are no COCs at concentrations that meet the definition of PTSM at any of these hot spot locations. Soils remaining in the vicinity of the pipeline would be designated as Underground Radioactive Materials Area and would remain under institutional control within the existing nuclear facility. This modification to the original remedy is expected to comply with all RAOs as set forth in the ROD (WSRC 2000) while holding the cost and schedule of the remedy approximately constant.

Figure G-3 presents a current photograph of the OU.

System Operations/Operation and Maintenance

There are no systems operating at the FRB OU.

The FRB OU maintenance activities that have been implemented in accordance with the ROD are as follows:

- Groundwater Monitoring – groundwater sampling data collection is on-going. The monitoring data is evaluated and reported annually to both U.S. Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC). Beginning in 2010, the USDOE, USEPA and SCDHEC agreed that the monitoring data associated with the FRB OU would be included in the annual submittal of the *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)* (SRNS 2013, SRNS 2014b, SRNS 2015).

- Site Inspections – site inspections (semiannual through 2014; annual thereafter beginning in 2015) are performed to verify warning signs, adequate vegetative cover, and erosion controls.

Table G-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 1998). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $35,500 for inspections and maintenance. The actual O&M cost for FY2012 to FY2016 is $49,404. The actual O&M costs are higher than expected because costs for routine site maintenance and preparation of five-year remedy reviews were underestimated in the ROD.

V. Progress since Last Review

The protectiveness statement from the last Five-Year Remedy Review Report concluded that the implementation of in-situ stabilization, low permeability cover system, pipeline grouting, and institutional controls is protective of human health and the environment.

In the fourth five-year remedy review, SRS recommended that the FRB cover inspection frequency be reduced to annual (SRNS 2014a). This reduction would provide adequate monitoring and consistency since the majority of OU covers at SRS are currently inspected annually. On February 6, 2014, the USDOE submitted a letter (USDOE 2014) to USEPA and SCDHEC to reduce inspection frequencies from semiannual to annual for FRB. USEPA and SCDHEC approved the request on March 20, 2014 and March 7, 2014, respectively. Annual inspections for FRB began in 2015.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed documents listed in Section XII. Documents Reviewed;
- Reviewed well monitoring data;

- Confirmed implementation of the remedial action;
- Inspected the OU and documented the results on the Inspection Checklist provided in Attachment G-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance

Data Review

In order to evaluate the potential of exposure to human receptors to soils associated with the basin and abandoned process sewer line and the potential exposure to highly toxic or highly mobile contaminants that represent PTSM (i.e., strontium-90), a review of the Remedial Investigation (RI)/Baseline Risk Assessment (BRA) report (WSRC 1997b), Corrective Measures Implementation Report (CMIR) / Post Construction Report (PCR) / Final Remediation Report (FRR) (WSRC 2001), groundwater data (SRNS 2013, SRNS 2014b, SRNS 2015) and the inspections reports were conducted.

Review of the RI/BRA (WSRC 1997b) and CMIR/PCR/FRR (WSRC 2001) indicates the PTSM contaminated soil remaining in the basin is located below the basin bottoms within the stabilized soil matrix over which a cover was placed; thus, breaking the exposure pathways to receptors and minimizing the potential for exposure to PTSM. The maximum concentration of constituents identified as PTSM were reviewed and corrections made for radioactive decay (Table G-4).

Groundwater data associated with the COCs (WSRC 2001) were reviewed (Table G-5) and indicate that all COC constituents are below MCLs. This provides evidence that the stabilization of contaminants is effectively inhibiting migration of contaminants in the solidified soils beneath the cap. Of the 856 COC analyses records reviewed, 816 records (or 95%) were qualified as definitive level data. Trichloroethylene (TCE) was the contaminant detected at this site, which had no history of discharge to the FRB, and thus is monitored for trigger action as the indicator of contamination from an upgradient source. Review of the TCE data from 1997 through 2016 provides no evidence that concentrations are increasing. Table G-6 provides the concentration ranges for detections of TCE. The well data for TCE was entered into the Monitoring and Remediation Optimization System for trend evaluation. The results of the evaluation indicated a probably decreasing trend in well FRB 1 and a decreasing trend in well FRB 2. The results for well FRB 3 and well FRB 4 were non-detects.

Thus, the selected remedy of in situ stabilization and cover system is effective in preventing human exposure to COCs and preventing or mitigating leaching of PTSM to groundwater at levels that will cause the groundwater to exceed its MCL.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member and Steve Willingham, O&M Staff Member, on September 20, 2016 at the O&M Organization Offices. No issues were identified as an outcome of these interviews.

The FRB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 14, 2016. No issues were identified for the FRB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 22, 2017. No significant problems regarding the FRB OU were identified during the inspection.

Scheduled annual site inspections conducted from 2012 to 2016 identified~~:~~ active ant mounts, overgrown vegetation, broken signage, downed trees, and evidence of hog rooting. These findings were documented on the field inspection checklists and resolved soon after discovery. Additionally, minor damage was identified on the road south of the cap. The road has since been repaired.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

Review of documents, applicable or relevant and appropriate requirements, risk assumptions, and the results of the site inspection indicates that the remedy is functioning as intended by the ROD. Placement and maintenance of a protective low permeability cover over the FRB OU breaks the contaminant migration pathway to the groundwater;

thus, facilitating meeting the RAOs to prevent physical exposure to the contaminants and to mitigate further migration of contaminants to the groundwater.

O&M of the cover system has been effective. Review of the annual inspection reports for the period 2012 through 2016 indicate the in-place remedy is functioning properly. Review of the inspection reports indicates the maintenance is operating effectively and efficiently.

The institutional controls (i.e., LUCs) that are in place include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.); administrative controls that maintain the OU for industrial use only (SRS is a secured government facility with land use restrictions); and warning signs and use restrictions via the SRS Site Use/Site Clearance Program. No activities were observed that would have violated the institutional controls.

The Land Use Control Implementation Plan for the FRB OU is located in Appendix A of the CMIR/PCR/FRR and governs LUC implementation, maintenance, monitoring, reporting, and enforcement (WSRC 2001). All LUC objectives are being met.

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still Valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions at the FRB OU that would affect the protectiveness of the remedy. The remedy of grouting the pipeline and excavating soils with disposition in the basin followed by grouting basin soils with placement of a low permeability cover has eliminated the exposure pathway associated with soils and continues to provide protectiveness to humans by eliminating the exposure pathway.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the FRB OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues for this OU.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the FRB OU is protective of human health and the environment.

All threats posed by soil contamination at the FRB OU have been addressed through in situ stabilization, a low permeability soil cover, pipeline grouting, and institutional controls (i.e., LUCs) to maintain industrial land use. LUCs include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain this site for industrial use only (SRS is a secured government facility with land use restrictions), warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2013. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)*, ERD-EN-2005-0127, FINAL, August 2013, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014a. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina,* SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014b. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U),* ERD-EN-2005-0127, FINAL, August 2014 Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U),* ERD-EN-2005-0127, FINAL, August 2015 Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2014. Letter, B. T. Hennessey (DOE) to S. B. Fulmer (SCDHEC) and R. H. Pope (EPA), *Request to Change the Inspection Frequency for Operable Units Based on the Recommendation in the Fourth Five-Year Remedy Review Report for the Savannah River Site (SRNS-RP-2012-00011, Revision 1.1, November 2013)*, CERCLIS Numbers: 13, 14, 16, 17, 20, 23, 26, 32, 39, and 66, ACP-14-125, dated February 6, 2014, Department of Energy, Savannah River Operations Office, Aiken, SC

WSRC, 1997a. *Groundwater Sampling Report with Residential Risk Assessment for the F-Area Retention Basin (281-3F) (U),* WSRC-RP-96-00905, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1997b. *Remedial Investigation Report with the Baseline Risk Assessment for the F-Area Retention Basin (281-3F) (U)*, WSRC-RP-96-356, Revision 1.2, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 1998. *Record of Decision for the F-Area Retention Basin (281-3F) (U)*, WSRC-RP-97-145, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2000. *Explanation of Significant Difference (ESD) to the Revision 1.1 Record of Decision (ROD) for the F-Area Retention Basin (281-3F) (U)*, WSRC-RP-2000-4079, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 2001. *Corrective Measures Implementation Report/Post-Construction Report/ Final Remediation Report (CMIR/PCR/FRR) for F-Area Retention Basin (FRB) (Building 281-3F) (U)*, WSRC-RP-2001-4049, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

Various - *Inspection Data Sheets – Field Inspection Checklist, F-Area Retention Basin Bldg 381-3F (U)*, ER-IDS-019-009, Inspection period 2012 through 2016 (semiannually through 2014; annually beginning in 2015)

This page is intentionally left blank.

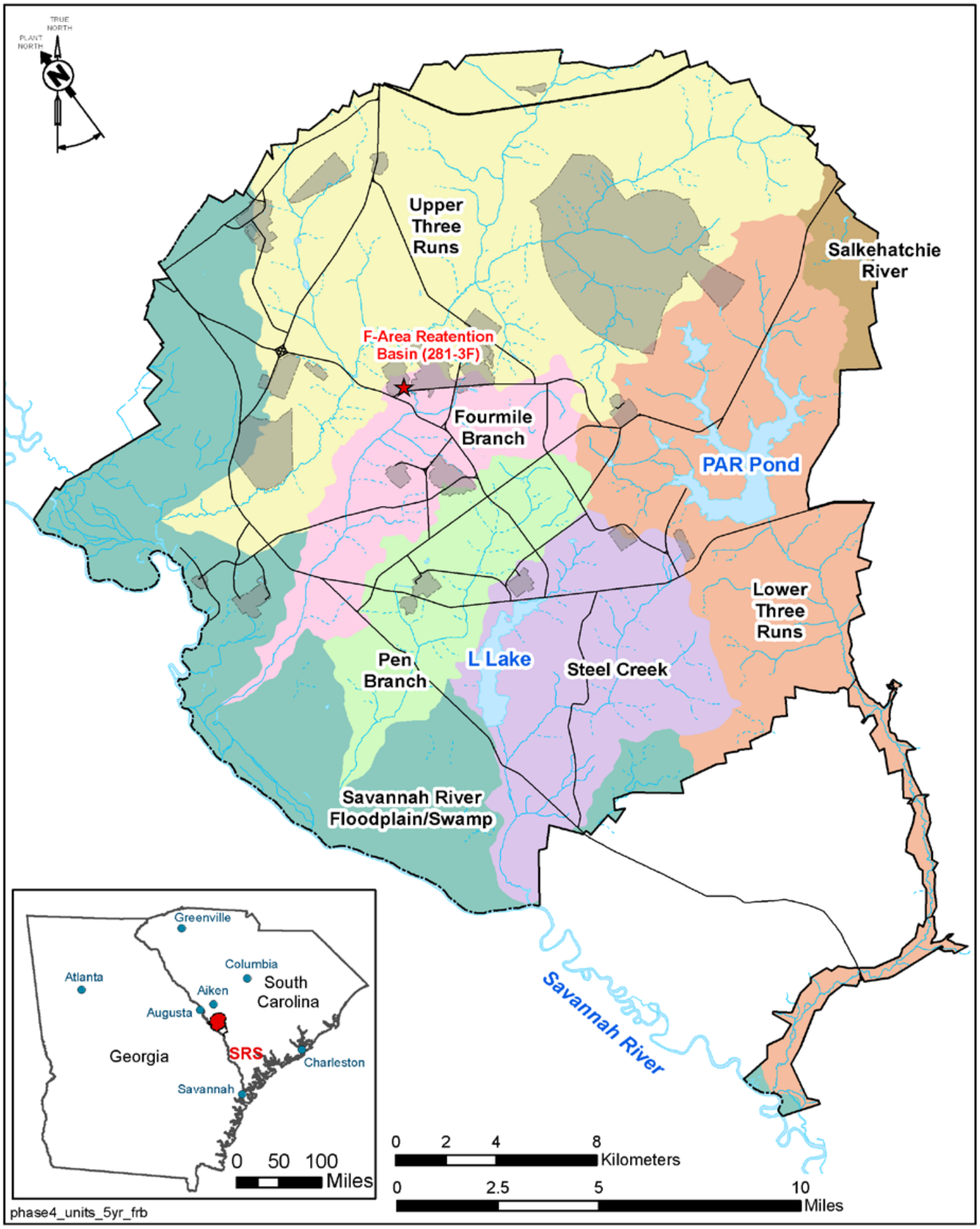


Figure G-1. Location of the F-Area Retention Basin (281-3F) OU at SRS

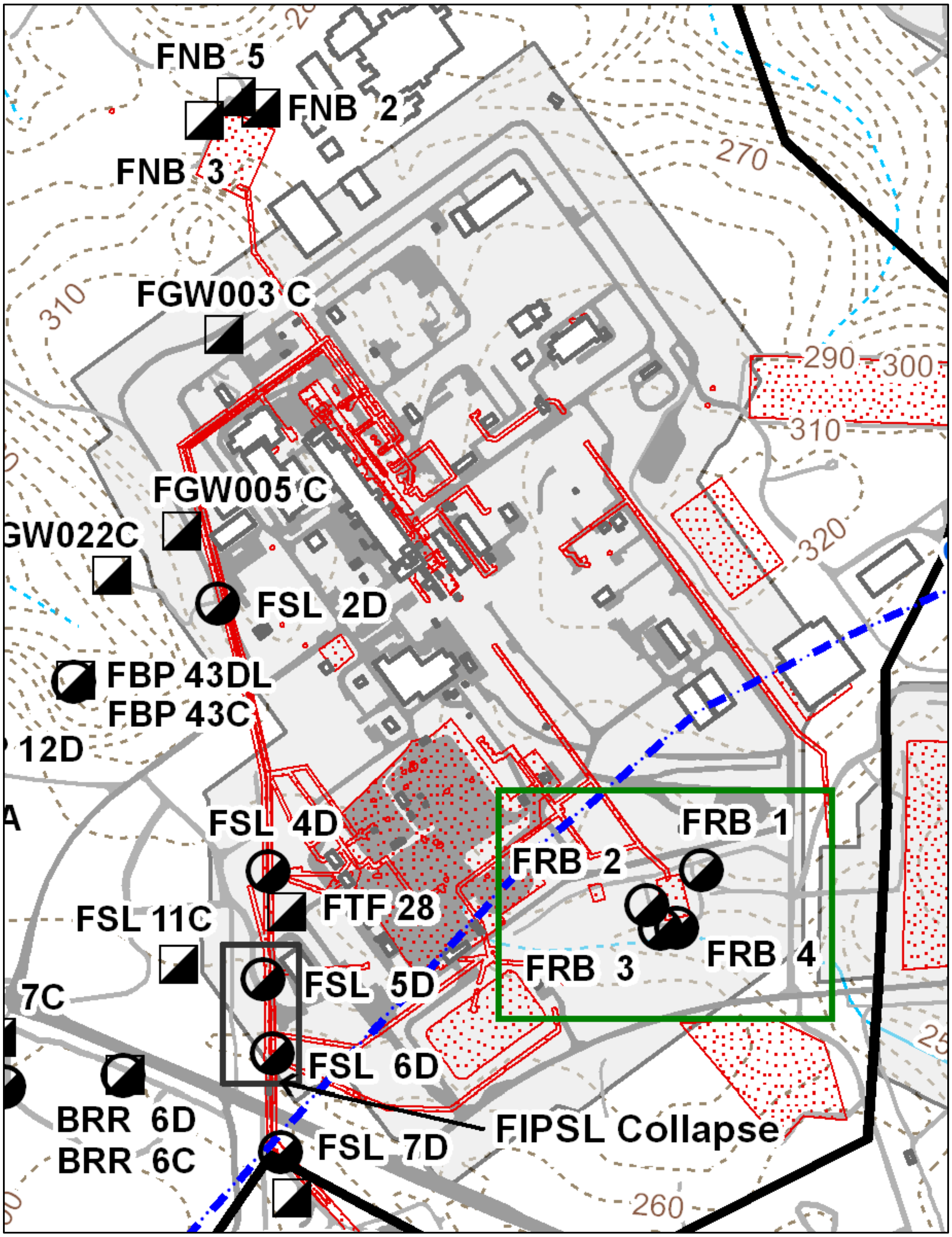


Figure G-2. Location of the F-Area Retention Basin OU within the F-Area at SRS (the basin and monitoring wells are located within the green box)

Figure G-3. Photograph of the F-Area Retention Basin Post-Construction (2016)

This page is intentionally left blank.

Table G-1. Chronology of OU Events

Event	Date
Removal Action (Soil Excavation)	1979
RI Complete	1994 / 1997
ROD Issuance	May 19, 1999
Remedial Action Start/Complete	March 17, 1999 / February 21, 2001
ESD Issuance	June 7, 2001
Previous Five-Year Reviews Issuance	February 12, 2004 / January 29, 2009 / February 4, 2014

Table G-2. Final COCs for FRB OU Soils with RGs

Medium	COC	RG
Former Basin Area		
Surface Soil (0-0.3 m [0-1 ft])	Cesium-137 Potassium-40 Radium-226 Thallium	0.74 ρCi/g 2.53 ρCi/g 0.226 ρCi/g 25.9 mg/kg
Subsurface Soil (0-1.2 m [0-4 ft])	Arsenic Cesium-137 Potassium-40 Radium-226 Plutonium-239/240 Thallium	11.1 mg/kg 0.74 ρCi/g 2.53 ρCi/g 0.226 ρCi/g 69.8 ρCi/g 25.9 mg/kg
Leachability to Groundwater from FRB Soil	Strontium-90	109 ρCi/g
Process Sewer Line Area		
Surface Soil (0-0.3 m [0-1 ft])	Arsenic Actinium-228 Cesium-137 Potassium-40 Radium-226	11.1 mg/kg 0.202 ρCi/g 0.74 ρCi/g 2.53 ρCi/g 0.226 ρCi/g
Subsurface Soil (0-1.2 m [0-4 ft])	Arsenic Actinim-228 Cesium-137 Potassium-40 Radium-226 Strontium-90	11.1 mg/kg 0.202 ρCi/g 0.74 ρCi/g 2.53 ρCi/g 0.226 ρCi/g 233 ρCi/g
Sediment within the Pipeline & Manholes	Arsenic Cesium-137 Plutonium-239/240	63.9 mg/kg 1.1 ρCi/g 26.3 ρCi/g

Table G-3. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	10,560	13,153	7,243	6,436	12,012	49,404
Total ROD Estimated Direct O&M Costs * ($)	9,500	6,500	6,500	6,500	6,500	35,500

*Cost for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Table G-4. PTSM Contamination at Depth for the FRB OU with Maximum Detected Concentrations

Basin Area			Maximum Concentration* (2016)
Medium	Analyte	Maximum Concentration (1995)	
Subsurface Soil at Depth	Cesium-137 Strontium-90 Radium-226	2,200 ρCi/g 1,080 ρCi/g 1.37 ρCi/g	1355.00 ρCi/g 651 ρCi/g 1.36 ρCi/g

*Corrected for radioactive decay

Table G-5. Review of Groundwater Data from Monitoring Wells FRB 1, FRB 2, FRB 3 and FRB 4

			Maximum Concentration			
Analyte	**Units**	**MCL**	**1997 - 2001 [# samples]**	**2002 -2006 [# samples]**	**2007 -2011 [# samples]**	**2012 -2016 [# samples]**
Cesium-137	ρCi/L	200	ND [19]	ND [50]	ND [40]	ND [31]
Radium-226	ρCi/L	14.7	2.44 [19]	3.84 [48]	2.73 [37]	3.30 [33]
Strontium-90	ρCi/L	8.0	ND [21]	ND [44]	ND [36]	ND [33]
TCE	µg/L	5.0	2.4 [25]	1.78 [43]	1.01 [34]	1.06 [31]
Gross alpha	ρCi/L	15	8.53 [37]	8.12 [49]	4.96* [37]	11.1 [33]
Nonvolatile beta	ρCi/L	50	11.02 [37]	7.84 [49]	ND [37]	ND [33]

NOTE: * indicates an estimated value

Table G-6. Concentration Ranges of TCE by Well

	Concentration Range			
Well	**1997 - 2001 (µg/L)**	**2002 - 2006 (µg/L)**	**2007 - 2011 (µg/L)**	**2012 - 2016 (µg/L)**
FRB 1	1.14 – 1.23	0.57 – 1.45	0.88 – 1.01	0.59 – 0.67
FRB 2	1.05 – 2.4	0.56 – 1.78	-	-
FRB 3	1.0 (1 detect)	0.75 – 1.61	-	-
FRB 4	-	0.57 – 1.44	-	1.06 (1 detect)

NOTE: - indicates values were either non-detects or estimated value

This page is intentionally left blank.

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU

I. SITE INFORMATION

Site Name:	**F-Area Retention Basin (231-F) OU**	**Date of Inspection:**	**8/31/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #23**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **95°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Groundwater Monitoring; In Situ Stabilization; Soil excavation and disposal (process sewer line soil).

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______

Contact: ______ (Name) ______ (Title) ______ (Date) ______ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______

Agency: ______

Contact: ______ (Name) ______ (Title) ______ (Date) ______ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______

Agency: ______

Contact: ______ (Name) ______ (Title) ______ (Date) ______ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______

4. **Other Interviews** *(Optional):* ☐ Report Attached ______

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for F-Area Retention Basin*, ER-IDS-019-009 (semiannual through 2014; annual beginning in 2015)

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS
☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☐ Other: Project cost data is summarized in Section IV of this OU-specific review

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs were in good condition.

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Phil Prater (Name) IACD Program Manager (Title) 11/14/2016 (Date) 803-952-9333 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:____________________

B. Other Site Conditions

Remarks: Site inspections performed from FY2012 through FY2016 identified active ant mounts, overgrown vegetation, broken signage, downed trees, and evidence of hog rooting. These findings were resolved by O&M staff soon after discovery. Additionally, minor damage was identified on the road south of the cap. The road has since been repaired.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent__________ Depth__________
Remarks:____________________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths__________ Widths__________ Depths__________
Remarks:____________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________ Depth__________
Remarks:____________________

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent__________ Depth__________
Remarks:____________________

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress
Areal extent__________ Depth__________
Remarks: Vegetation mowed routinely.

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. **Alternative Cover (armored rock, concrete, etc.):** ☒ N/A
Remarks:____

7. **Bulges:** ☐ Location shown on site map ☒ Bulges not evident
Areal extent__________________ Depth______________________
Remarks:____

8. **Wet Areas / Water Damage:** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________________
☐ Ponding ☐ Location shown on site map Areal extent______________________
☐ Seeps ☐ Location shown on site map Areal extent______________________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________________
Remarks:____

9. **Slope Instability:** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent__________________
Remarks:____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Attachment G-1. Five-Year Review Site Inspection Checklist – F-Area Retention Basin (231-F) OU *(continued)*

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Groundwater Monitoring, In Situ Stabilization, Soil Excavation, Disposal ☒ Applicable ☐ N/A

Groundwater monitoring, in situ stabilization, soil excavation, and disposal were performed at FRB OU. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU is in situ stabilization of contaminated soil; low permeability soil cover system; institutional controls; groundwater monitoring, pipeline grouting; and excavation and disposal of contaminated soil. The remedy is fully established and functioning as designed. Groundwater monitoring wells are provided to verify the effectiveness of the in situ stabilization.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (verify no invasive activities have occurred and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the waste unit and the condition of warning signs is good. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

F-AREA TANK FARM OPERABLE UNIT

I. Introduction

This report is the first five-year review for F-Area Tank Farm (FTF) Waste Tanks and Ancillary Structures. This review covers FTF Waste Tanks 5, 6, 17, 18, 19 and 20 and was conducted from August 2016 through November 2016. Following waste removal and grouting of FTF Waste Tanks 5, 6, 17, 18, 19 and 20, stabilized residual material remains in these waste tanks at chemical and/or radiological concentrations that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the interim remedy in place at FTF Waste Tanks 5, 6, 17, 18, 19 and 20 is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table H-1 lists the chronology of site events for the FTF Waste Tanks 5, 6, 17, 18, 19 and 20.

III. Background

The FTF Operable Unit (OU) is listed as a Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulated unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). FTF was constructed to receive waste generated by various SRS production, processing, and laboratory facilities, and treated and stored wastes that were contaminated with heavy metals and high levels of radioactivity. FTF waste storage and removal operations are governed by an Industrial Wastewater Construction Permit (SCDHEC 1993) issued by the South Carolina Department of Health and Environmental Control (SCDHEC) on January 25, 1993 and the FFA. The State of

South Carolina has authority for approval of wastewater treatment facility operational closure under Chapter 61, Article 82 of the SCDHEC Regulations.

Physical Characteristics

The FTF is located at the SRS in Aiken County, South Carolina and was constructed to receive waste generated by various SRS production, processing, and laboratory facilities (Figure H-1). The FTF is a 22-acre site within the General Separations Area (GSA), which encompasses E, F, H, S, J, and Z Areas (Figure H-2). The GSA is located atop a ridge running southwest-northeast that forms the drainage divide between Upper Three Runs to the north and Fourmile Branch to the south.

The FTF consists of 22 liquid waste storage tanks, two evaporator systems, over 13,716 linear m (45,000 linear ft) of transfer pipelines, six diversion boxes, one catch tank, a concentrate transfer system tank and three pump pits. Figure H-3 shows the general layout of FTF. There are three major waste tank types in FTF that range in size from 2,839,059 L (750,000 gal) (Type I tanks) to 4,921,035 L (1.3 million gal) (Type III / IIIA and Type IV tanks) that have varying degrees of secondary containment and intra-tank interferences to waste removal and sampling, such as cooling coils and roof support columns.

FTF Waste Tanks 5 and 6 are Type I waste tanks constructed in the early 1950s and first received waste from F Canyon in 1954. These waste tanks are 23 m (75 ft) in diameter and 7.5 m (24.5 ft) high, with a nominal operating capacity of 2,839,059 L (750,000 gal). The primary tank is made of 1.27-cm (0.5-in) thick carbon steel. The 1.27-cm (0.5-in) thick carbon steel primary tank top and bottom were joined to the walls with non-stress-relieved welded knuckle plates made of the same material. The carbon steel primary tank sits inside a 55.9-cm (22-in) thick reinforced concrete vault with a 0.76-m (2.5-ft) annular space surrounding the primary tank. Lining the bottom of the vault for secondary containment is a 1.5-m (5-ft) high, 1.27-cm (0.5-in) thick carbon steel secondary liner (also referred to as "annulus pan") to collect leakage, if any, from the primary tank. The waste tank tops are approximately 2.75 m (9 ft) below grade. Each Type I waste tank has twelve columns to support the roof. These columns are 1.27-cm (0.5-in) carbon steel pipes filled with concrete and have an outer diameter of 0.6 m (2 ft) and are welded to the top and bottom of the primary tank. Cooling coils in Type I waste tanks are configured in both a horizontal and vertical array, which creates obstacles to waste removal and other activities inside the waste tank. There are approximately 6,954 linear m (22,800 linear ft) of 5.1-cm (2-in) carbon steel pipe cooling coils in a Type I waste tank. Figure H-4 provides a cross-sectional view of a typical Type I waste tank.

Waste Tanks 17, 18, 19 and 20 are Type IV waste tanks constructed in the late 1950s. These waste tanks have a single carbon steel liner with a hemispherical reinforced concrete domed roof. Type IV waste tanks are 25.9 m (85 ft) in diameter and approximately 10.4 m (34 ft) high at the sidewall, with a nominal operating capacity of 4,921,035 L (1.3 million gal). There is no secondary containment structure for Type IV waste tanks. The concrete vault for Type IV waste tanks was built around the primary liner using a technique called “Shotcrete”. The core wall was constructed of 1.9 cm (0.75 in) to 3.8 cm (1.5 in) thick layers of “Shotcrete”. The core wall is 17.8 cm (7 in) thick at the top and 27.9 cm (11 in) at the bottom. Figure H-5 provides a cross-sectional view of a typical FTF Type IV tank.

Land and Resource Use

The current land use for the FTF is industrial. According to the *Savannah River Site Future Use Project Report* (USDOE 1996a), residential uses of the SRS land should be prohibited. The future land use for the FTF is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

The FTF is currently in the operational phase and access is controlled by SRS facility security and administrative controls. Additional land use controls (LUCs) are not part of the interim remedial action. The final Record of Decision (ROD) for the FTF OU is currently schedule for issuance in January 2042. The Land Use Control Implementation Plan (LUCIP) will be deferred until final closure of the entire FTF OU.

There is no current or projected future use of the groundwater or surface water as a drinking water source at the FTF. According to the Land Use Control Assurance Plan (WSRC 1999), SRS property is to be owned and institutionally controlled by USDOE.

History of Contamination

FTF was constructed to receive waste generated by various SRS production, processing, and laboratory facilities. In F Area, plutonium, uranium, and other radionuclides were separated from irradiated fuel and target assemblies using chemical separation processes. Since beginning operations in the early 1950s, FTF has treated and stored the liquid wastes generated from these processes that are contaminated with heavy metals and high levels of radioactivity.

The use of FTF allowed for isolation of these wastes from the environment, SRS workers, and the public. With FTF and its sister facility, H-Area Tank Farm, facilities are in place to pretreat the accumulated sludge and salt solutions (supernate) to enable the management and treatment of these wastes within other SRS facilities (i.e., Defense Waste Processing Facility and Saltstone Production Facility). These treatment facilities convert the sludge and supernate to more stable forms suitable for permanent disposal in a Federal Repository or the Saltstone Disposal Facility, as appropriate.

The USDOE intends to remove from service those waste tanks that do not meet the standards set forth in Appendix B (High Level Radioactive Waste Tank Systems) of the SRS FFA, pursuant to Section 120 of CERCLA and Sections 3008(h) and 6001 of RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 (hereafter jointly referred to as RCRA) and the Atomic Energy Act of 1954. It is recognized that the USDOE cannot practicably remove or decontaminate all structures and equipment. In May 2002, USDOE issued an Environmental Impact Statement (EIS) on waste tank cleaning and stabilization alternatives (USDOE 2002a). Evaluations described in the EIS showed the “Empty, clean and fill waste tank with grout” alternative to be the best approach to minimize human health and safety risks associated with closure of the waste tank (USDOE 2002b).

Initial Response

The State of South Carolina has authority for approval of wastewater treatment facility operational closure under Chapter 61, Article 82 of the SCDHEC Regulations. The *Ronald Reagan National Defense Authorization Act (NDAA) for Fiscal Year 2005*, Section 3116 (a) specifies the criteria for USDOE to use to determine whether residuals remaining in the waste tank systems can be managed as non-high-level waste at a USDOE site in a "covered state" (e.g., South Carolina) where activities are regulated by the state's approved closure plan or permit, authority for the approval or issuance of which is conferred on the State outside of Section 3116. Because the Act was passed in 2005, it did not apply to FTF Waste Tanks 17 and 20 operational closures that occurred in 1997. However, it does apply to the operational closure of FTF Waste Tanks 5, 6, 18 and 19 and future FTF waste tank systems. In response to the Act, USDOE prepared a Section 3116 Basis Document (USDOE 2012a), which was supported by an FTF Performance Assessment (PA) (SRR 2010). Based on the *Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site* (USDOE 2012a) and the environmental protection information provided in the FTF PA, the Secretary of Energy, in consultation with the Nuclear Regulatory Commission, determined that the stabilized residuals, tanks and ancillary structures at closure in the FTF are not high-level radioactive waste and may be disposed of in place at SRS (USDOE 2012b).

Until the FTF waste tanks and ancillary structures are removed from service, they are regulated under the Industrial Wastewater Construction Permit #17,424-IW (SCDHEC 1993), issued to SRS under the South Carolina Pollution Control Act, S. C. Code Ann., Section 48-1-10, et seq., and applicable regulations implementing that Act. Waste tanks and ancillary structures are removed from the conditions of Industrial Wastewater Construction Permit #17,424-IW when operationally closed and removed from service in accordance with an approved General Closure Plan (SRR 2011) and tank-specific Closure Modules.

When all FTF waste tanks and ancillary structures have been removed from service, an appropriate response action will be developed for the FTF OU, which includes the stabilized waste tanks and ancillary structures as well as the surrounding environmental media and groundwater directly below the FTF. Due to the time period from removal of FTF waste tanks and ancillary structures from the Industrial Wastewater Construction Permit #17,424-IW until a final response action is developed for the FTF OU, the SCDHEC, USEPA, and USDOE determined that a CERCLA interim remedial action was needed as the FTF tanks and ancillary structures are removed from service. The CERCLA interim remedial action would serve to detect any conditions of the waste tanks that would compromise stabilization and containment of residual waste and require maintenance actions during the interim period. An Interim Record of Decision (IROD), documenting the interim remedial action, would be issued for the first set of tanks and/or ancillary structures removed from service. An Explanation of Significant Difference (ESD) would then be used to incorporate the interim remedy for additional FTF waste tanks, group of waste tanks, and associated ancillary structures when satisfactorily removed from service in accordance with a SCDHEC approved Closure Module.

Basis for Taking Action

FTF Waste Tanks 17 and 20 were operationally closed (i.e., cleaned and grouted) and removed from service in 1997 in accordance with the approved General Closure Plan (USDOE 1996b, USDOE 1996c) and tank-specific Closure Modules (SRR 1997a, SRR 1997b). No ancillary structures were included in the removal from service of FTF Waste Tanks 17 and 20. The IROD for FTF Waste Tanks 17 and 20 was issued in April 2013 and selected Annual Visible Engineered Barriers Inspection and Maintenance as the interim remedial action (SRR 2012b). The interim remedial action is limited to any maintenance deemed necessary from annual inspections from the time of removal of a waste tank or associated ancillary structure from service until a final ROD is issued for the FTF OU.

FTF Waste Tanks 18 and 19 were operationally closed and removed from service in August 2012 in accordance with the approved General Closure Plan and tank-specific Closure Module (SRR 2011, SRR 2012a). Waste Tanks 5 and 6 were operationally closed and removed from service in December 2013 in accordance with the approved General Closure Plan and tank-specific Closure Module (SRR 2011, SRR 2013b). No ancillary structures were included in the removal from service of FTF Waste Tanks 5, 6, 18 and 19. ESDs for FTF Waste Tanks 18 and 19 (SRR 2013a) and FTF Waste Tanks 5 and 6 (SRR 2014) were issued in September 2013 and September 2014, respectively. The ESDs served to incorporate FTF Waste Tanks 5, 6, 18, and 19 into the interim remedy selected in the IROD for Waste Tanks 17 and 20.

The tanks were isolated from the remaining operating facility and filled with grout. Some equipment installed in the tanks or used in the closure activities (e.g., slurry pumps, transfer jet, thermowells) were filled with grout to the extent practical and entombed in the grout as part of the stabilization process. The tank-specific Closure Modules describe the waste removal, characterization of residuals, associated risk, and stabilization of the waste tanks in more detail.

The IROD does not include the groundwater beneath the FTF or the soils surrounding the waste tanks. An FTF Groundwater Monitoring Plan (SRNS 2011), which describes the monitoring of the groundwater exiting the FTF in accordance with the FTF General Closure Plan (SRR 2011), supports both the operations and operational closure of the FTF waste tanks and includes requirements for reporting the monitoring results. Groundwater and the soils surrounding the tanks will be addressed in the final ROD for the FTF OU.

IV. Remedial Actions

Remedy Selection

The interim remedial action objective (RAO) established by the IROD (SRR 2012b) and ESDs (SRR 2013a, SRR 2014) is as follows:

- Conduct annual visible engineered barriers inspections and maintenance of the waste tanks that have been operationally closed and removed from service.

Remedy Implementation

The selected interim remedial action was implemented to meet the interim RAO and includes the following activities (SRR 2012b):

- Annual inspection of the engineered barriers (i.e., visible grout) for physical integrity;
- Annual visible inspection of the area for excessive water accumulation that may cause premature degradation of the engineered barriers associated with stabilization of the waste tanks; and
- Perform maintenance deemed necessary from the annual inspections from the time of removal of a waste tank or associated ancillary structure from service until a final ROD for the FTF OU is issued.

A current photo of the FTF is provided in Figure H-6.

System Operations/Operations and Maintenance

There were no operational systems installed as part of the interim remedial action. Therefore, there are no system operational requirements.

The following maintenance activities are ongoing:

- Annual visual inspections of the engineered barriers (i.e., visible grout) for physical integrity and ineffective drainage (i.e., excessive water accumulation); and
- Necessary maintenance identified from the annual inspections.

Table H-2 compares the actual operation and maintenance (O&M) costs since annual visible inspections began in Fiscal Year (FY) 2013 to the estimated direct O&M costs from the IROD (SRR 2012b). The estimated O&M cost for FY2013 to FY2016 was $16,000 for visible annual inspections and maintenance. The actual O&M cost for FY2013 to FY2016 is $15,800. The actual costs are as expected.

- As required by the FTF General Closure Plan (SRR 2011), annual visible inspections are conducted to identify unsatisfactory conditions that would lead to loss of integrity or long-term structural strength of the closed waste tanks that would compromise stabilization and containment of residual waste. If evidence of premature degradation is found, appropriate action, including any necessary maintenance or repairs, will be taken.

- Prior to the implementation of the interim remedial action, inspections were conducted in accordance with the respective waste tank closure modules. Annual visible inspections began in FY2013 for Waste Tanks 17, 18, 19, and 20. In FY2014, Waste Tanks 5 and 6 were added to the annual inspections. Annual inspections for FY2013 through FY2016 have been completed. There were no unsatisfactory conditions observed for FTF Waste Tanks 5, 6, 17, 18, 19, and 20 during the FY2013 through FY2016 annual inspections.

V. Progress since Last Review

This is the first review for the FTF Waste Tanks 5, 6, 17, 18, 19, and 20. There is no previous protectiveness statement concerning human health and the environment.

There are no previous recommendations or follow-up actions.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XI. Documents Reviewed;
- Confirmed the implementation of the interim remedial action;
- Evaluated the effectiveness of the interim remedial action; and
- Conducted visual inspection of FTF Waste Tanks 5, 6, 17, 18, 19 and 20, conducted site interviews, and documented the results on the Inspection Checklist provided in Attachment H-1 with the purpose of assessing the protectiveness of the remedy.

Data Review

A review of data is not part of the interim remedy review because the interim action (i.e., visual inspections and maintenance) does not require the cleanup of contaminated media. The PA for the FTF determined that exposure to stabilized residual material in the tanks is unlikely during the interim period (SRR 2010).

Summary of Inspections and Interviews

Interviews were conducted with Mildred Jackson, FTF Environmental Compliance Authority, and Bruce Martin, Waste Disposal Authority, on October 18, 2016, at the F-Area Tank Farm. No issues warranting any corrective actions were identified for the FTF Waste Tanks 5, 6, 17, 18, 19 and 20 during these interviews.

Annual site inspections conducted from FY2013 through FY2016 identified the following for Tanks 17 through 20. Tank 17 had indications of seepage from the southwest riser, minor surface irregularities on top of center riser, coating peeling off riser, surface irregularities on south side of southeast riser and west side of southeast riser, and coating crack on north side of center riser. Tank 18 has a low spot with mud near east riser. Tank 19 has small crack on the south edge of the northwest riser, surface irregularities on the west side of center riser, and north sample riser has indication of surface crack and center riser noted similar surface irregularities on both west and south sides. Tank 20 has surface irregularities and stain on east side of west riser, coating peeling off riser, and west riser on the south side has surface irregularities and surface cracks on top of northwest riser. These conditions are deemed satisfactory, but are being monitored to verify that the conditions do not worsen to an extent that would compromise the stabilization and containment of residual waste in the tanks.

The FTF Waste Tanks 5, 6, 17, 18, 19, and 20 will be inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel at a later date. It is anticipated that no issues will be identified for the FTF Waste Tanks 5, 6, 17, 18, 19, and 20 during this inspection and interview. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRS personnel, on February 22, 2017. No significant problems regarding this FTF Waste Tanks 5, 6, 17, 18, 19, and 20 were identified during the inspection.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The interim remedy is functioning as intended as demonstrated below:

The interim remedy that includes annual inspections of the engineered barriers (i.e., visible grout) for physical integrity and inspection for excessive water accumulation is functioning as intended. Annual inspections serve to detect any conditions of the FTF waste tanks and ancillary structures, which have been operationally closed and removed from service, that would compromise stabilization and containment of residual waste and require maintenance actions during the interim period. Annual inspections began in FY2013 for FTF Waste Tanks 17, 18, 19, and 20 and in FY2014 for FTF Waste Tanks 5 and 6 and have been completed through FY2016.

The FTF OU is currently in the operational phase and access is controlled by SRS facility security and administrative controls. OU-specific LUCs have been deferred until final closure of the entire FTF OU.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The FTF is currently in an operational phase. Because of ongoing operations, a CERCLA risk assessment has not been conducted and is not required to support this interim action. Pursuant to USDOE Order 435.1, a PA was prepared and determined that exposure to stabilized residual material in the waste tanks is unlikely during the interim period (SRR 2010). The potential risk lies in the premature degradation of the engineered barriers, which could increase the likelihood of exposure. Therefore, the interim RAO to conduct annual engineered barriers inspections and maintenance for the waste tanks that have been operationally closed and removed from service is still valid.

Following removal from service of all FTF waste tanks and ancillary structures, an evaluation will be conducted for all media (e.g., soils, structures, equipment) in the FTF OU and additional RAOs, as appropriate, will be established at that time.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Strategy?

No other information has come to light that could call into question the protectiveness of the interim remedy.

VIII. Issues

The following issue has been identified during this remedy review:

- The FTF OU is currently in the operational phase and access is controlled by SRS facility security and administrative controls. OU-specific LUCs have been deferred until final closure of the entire FTF OU. Since the SRS facility security and administrative controls that restrict authorized access to the FTF OU were not recognized as part of the interim remedy, the interim remedy was not considered as long-term protective is previous five-year remedy reviews.

IX. Recommendations and Follow-up Actions

Table H-3 presents the recommendation for the FTF OU. The USDOE recommends revising the FFA Annual Progress Report to include the FTF OU to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls. Further discussion is needed with USEPA and SCDHEC to reach agreement on the revised text and table in the FFA Annual Progress Report.

X. Protectiveness Statement(s)

The interim remedy at the FTF Waste Tanks 5, 6, 17, 18, 19, and 20 is currently protective of human health and the environment because access is controlled by SRS facility security and administrative controls.

Waste tanks and ancillary structures removed from service are cleaned and stabilized with grout to reduce the risk of a leak to the environment and to provide a stable waste form. Currently, annual visible inspections are conducted to ensure that the integrity of the stabilization actions for the closed tanks is protected from significant damage or deterioration during the interim period. The FTF PA (SRR 2010) determined that exposure to stabilized residual material in the waste tanks is unlikely during the interim period from the time the individual waste tanks are removed from service until final closure of the entire FTF OU under a final ROD. The final ROD for the FTF OU is scheduled for issuance in January 2042.

The land use for the FTF is industrial with USDOE maintaining control of the land. The FTF is currently in the operational phase and unit-specific LUCs are not part of the interim action. A LUCIP will be deferred until final closure of the entire FTF OU.

Long-term protectiveness will be achieved by including the FTF OU and the SRS facility security and administrative controls that restrict unauthorized access in the FFA Annual Progress Report. The report is required by the FFA and includes an annual certification by the USDOE Savannah River Site Manager that the listed OUs are in compliance with land use requirements.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SCDHEC, 1993. *Construction Permit #17,424-IW, SRS F/H-Area, Aiken and Barnwell County,* South Carolina Department of Health and Environmental Control, Columbia, SC

SRNS, 2011. *F-Area Tank Farm Groundwater Monitoring Plan*, SRNS-RP-2011-00995, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRR, 1997a. *Industrial Wastewater Closure Module for the High-Level Waste Tank 20 System*, PIT-MISC-0002, Revision 1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 1997b. *Industrial Wastewater Closure Module for the High-Level Waste Tank 17 System*, PIT-MISC-0004, Revision 2, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC.

SRR, 2010. *Performance Assessment for the F-Tank Farm at the Savannah River Site*, SRS-REG-2007-00002, Revision 1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2011. *Industrial Wastewater General Closure Plan for F-Area Waste Tank Systems*, LWO-RIP-2009-00009, Revision 3, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2012a. *Industrial Wastewater Closure Module for the Liquid Waste Tanks 18 and 19,* SRR-CWDA-2010-00003, Revision 2, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2012b. *Interim Record of Decision Remedial Alternative Selection for the F-Area Tank Farm, Waste Tanks 17 and 20,* SRR-CWDA-2012-00111, Revision 1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2013a. *Explanation of Significant Difference (ESD) for Incorporating Tanks 18 and 19 in the Revision 1 Interim Record of Decision Remedial Alternative Selection for the F-Area Tank Farm, Waste Tanks 17 and 20,* SRR-CWDA-2013-00007, Revision 1.1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2013b. *Industrial Wastewater Closure Module for the Liquid Waste Tanks 5F and 6F F-Area Tank Farm, Savannah River Site,* SRR-CWDA-2012-00071, Revision 1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

SRR, 2014. *Explanation of Significant Difference (ESD) for Incorporating Tanks 5 and 6 in the Revision 1 Interim Record of Decision Remedial Alternative Selection for the F-Area Tank Farm, Waste Tanks 17 and 20,* SRR-CWDA-2014-00008, Revision 1, Savannah River Remediation, LLC, Savannah River Site, Aiken, SC

USDOE, 1996a. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 1996b. *Industrial Wastewater Closure Plan for F- and H- Area High Level Waste Tank Systems*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 1996c. *High-Level Waste Tank Closure Program Plan*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2002a. *Savannah River Site High-Level Waste Tank Closure Final Environmental Impact Statement*, May 2002, DOE-EIS-0303, U.S. Department of Energy, Savannah River Operations Office, Aiken, SC

USDOE, 2002b. *Record of Decision for High-Level Waste Tank Closure at the Savannah Site*, August 2002, DOE-EIS-0303-ROD, U.S. Department of Energy, Savannah River Operations Office, Aiken, SC

USDOE, 2012a. *Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site,* DOE/SRS-WD-2012-001, Revision 0, U.S. Department of Energy, Savannah River Operations Office, Aiken, SC.

USDOE, 2012b. *Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site,* DOE-WD-2012-001, U.S. Department of Energy, Savannah River Operations Office, Aiken, SC.

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site,* WSRC-RP-98-4125, Revision 1.1, latest update, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

Various – Inspection Data Sheets – *FTF Annual Closed Waste Tank Inspections,* Inspection periods 2013 through 2016 (annually)

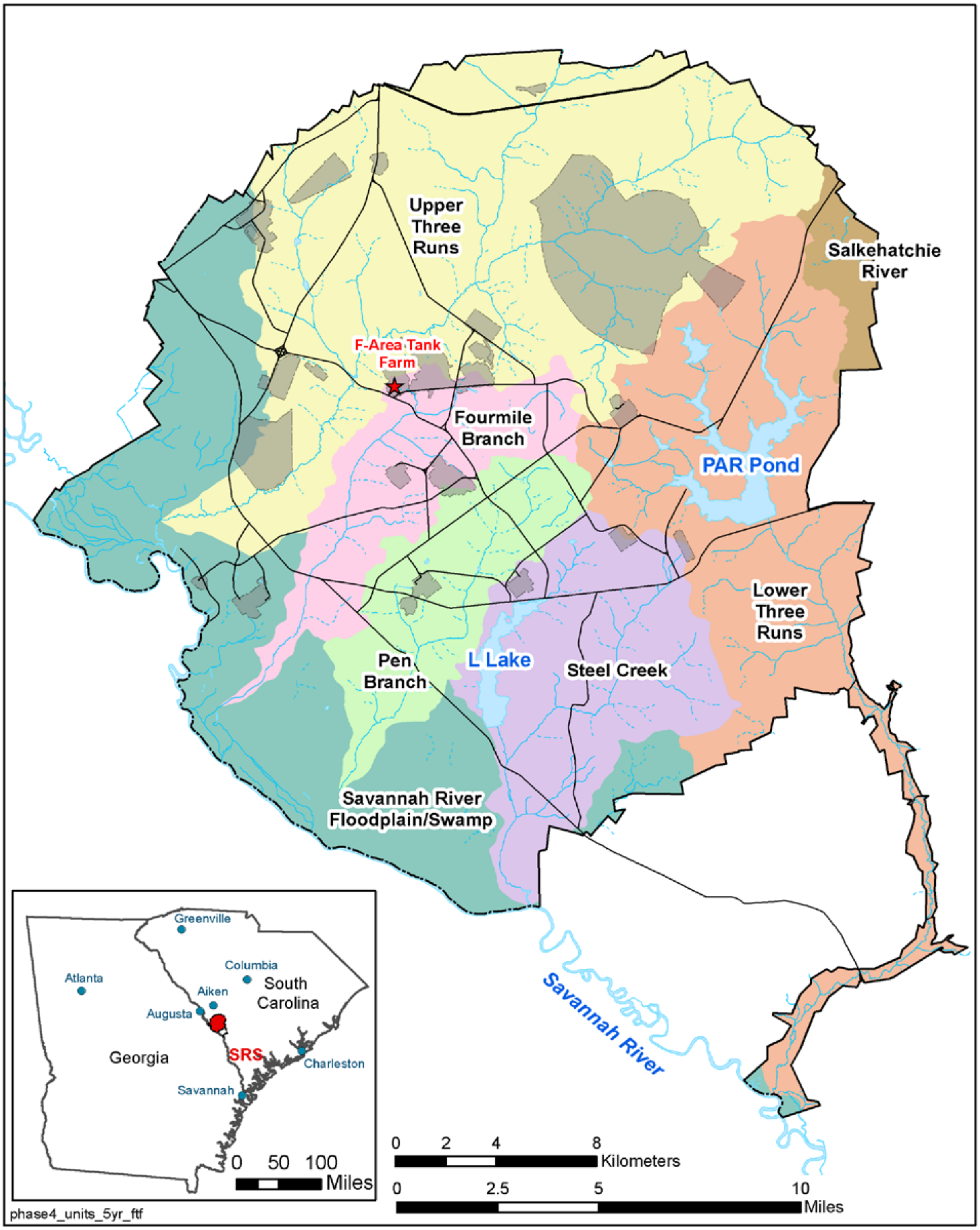


Figure H-1. Location of the F-Area Tank Farm at SRS

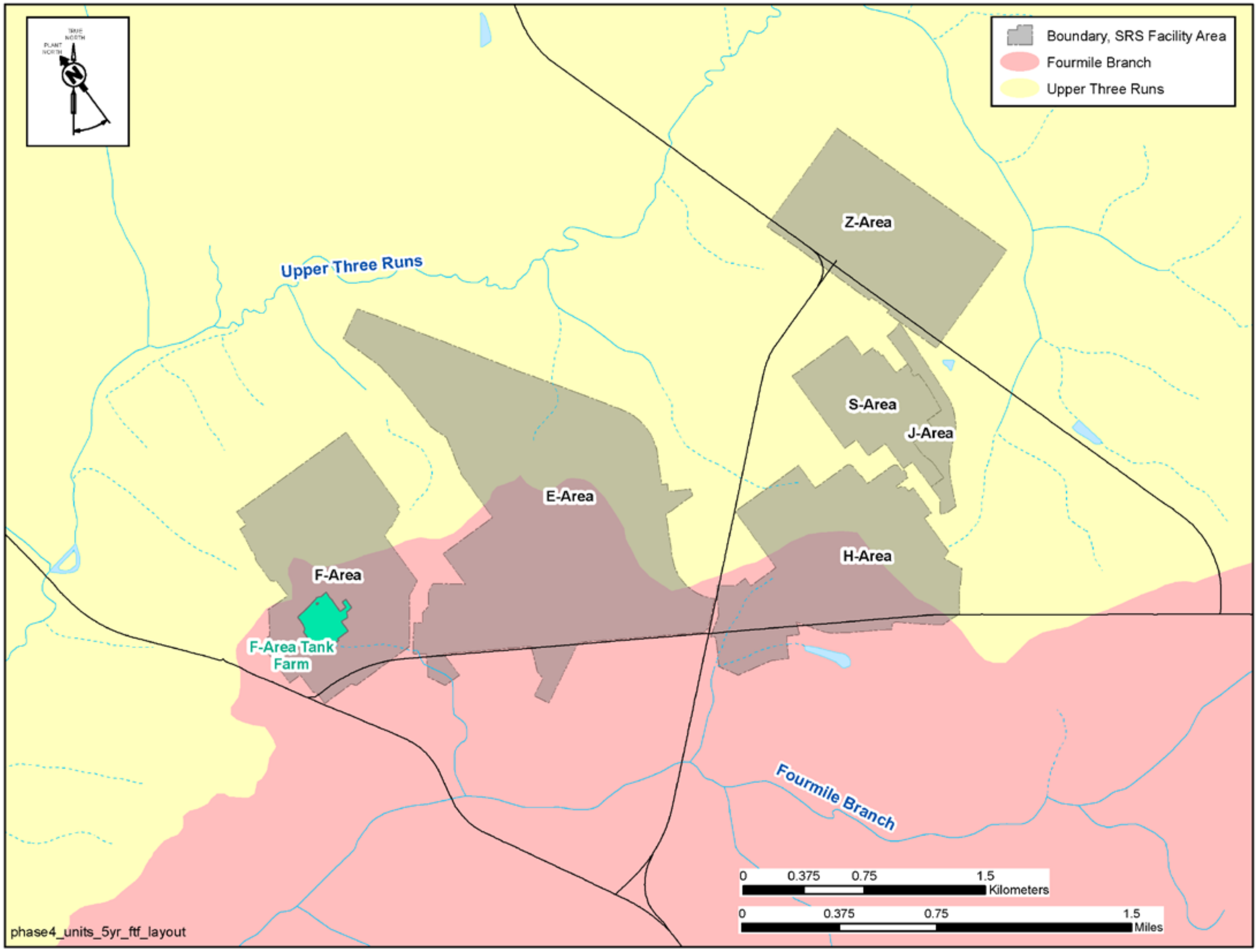


Figure H-2. **Layout of the General Separations Area**

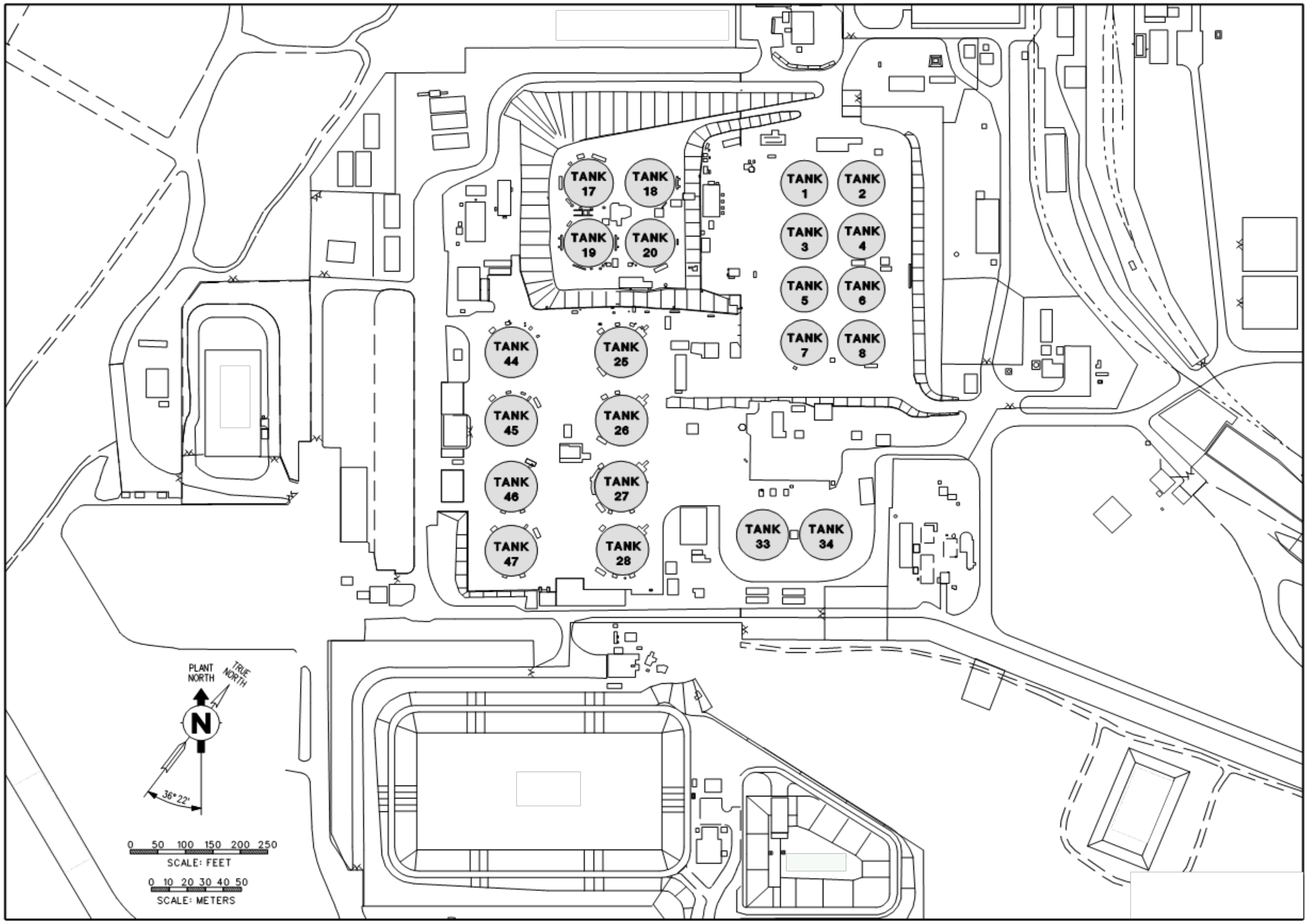


Figure H-3. **Layout of the F-Area Tank Farm**

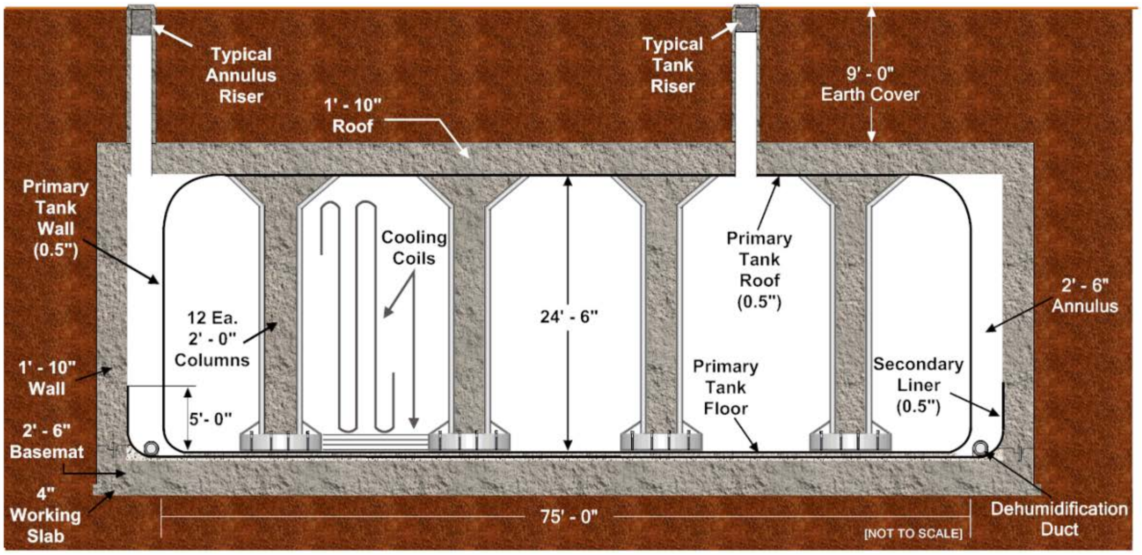


Figure H-4. Cross-Sectional View of Typical Type I Waste Tank

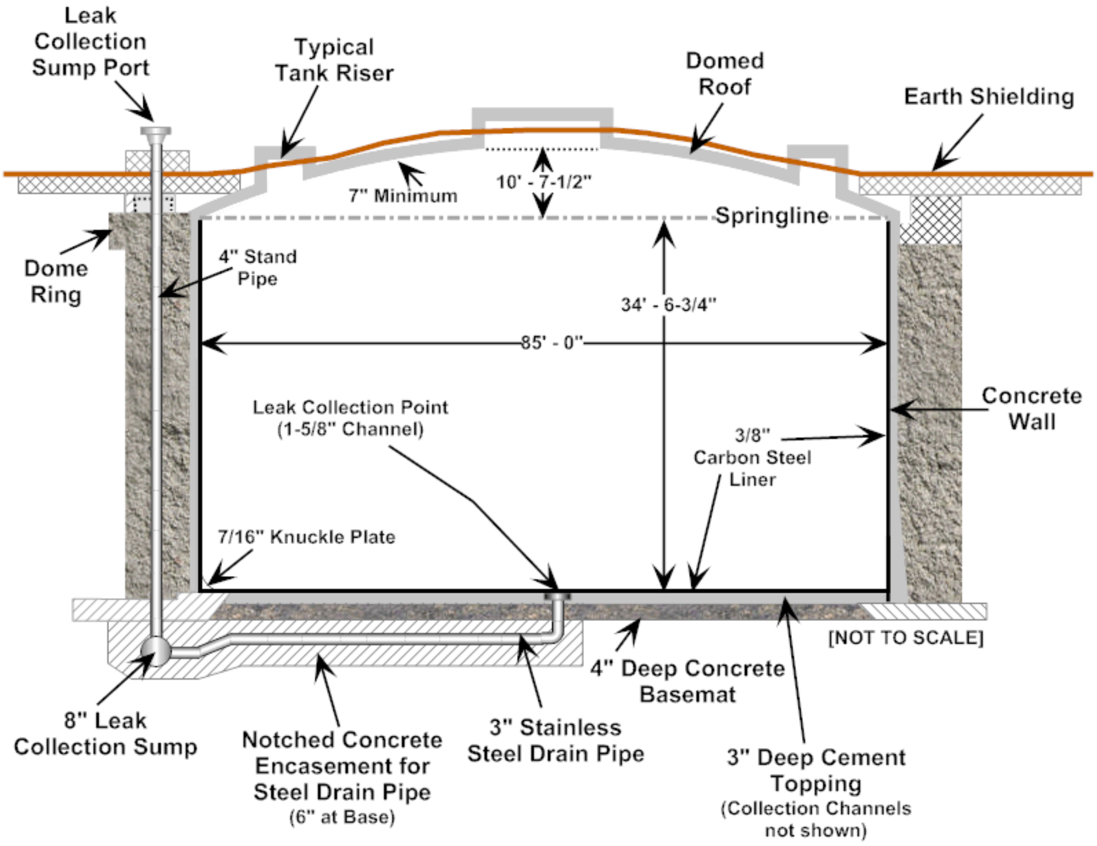


Figure H-5. Cross-Sectional View of Typical FTF Type IV Waste Tank

Figure H-6. **Current Photograph of FTF (2015)**

This page is intentionally left blank.

Table H-1. Chronology of OU Events

Event	Date
IROD Issuance (Waste Tanks 17 and 20)	April 30, 2013
ESD Issuance (added Waste Tanks 18 and 19)	September 23, 2013
ESD Issuance (added Waste Tanks 5 and 6)	September 11, 2014
Interim Remedial Action Start/Complete (Waste Tanks 17, 18, 19, and 20)	March 20, 2014 / Ongoing
Interim Remedial Action Start/Complete (Waste Tanks 5 and 6)	September 17, 2014 / Ongoing
Previous Five-Year Review Issuance	None

Table H-2. Actual versus Estimated O&M Costs

	FY2013	FY2014	FY2015	FY2016	4-Year Total
Total Actual O&M Costs ($)[1]	3,950	3,950	3,950	3,950	15, 800
Total IROD Estimated Direct O&M Costs ($)	4,000	4,000	4,000	4,000	16,000

[1] Prior to implementation of the interim remedial action, inspections were conducted in accordance with the respective waste tank closure modules. Visual annual inspections for the interim remedial action began in FY2013.

Table H-3. Recommendations and Follow-up Actions for the FTF OU

Issues	Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
					Current	Future
Unit specific LUCs for the FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) have been deferred until final closure of the entire FTF OU. SRS facility security and administrative controls that restrict unauthorized access to the FTF OU were not previously recognized as part of the interim remedy. Therefore, the interim remedy was not considered as long-term protective.	Revise the FFA Annual Progress Report to include the FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) to recognize SRS facility security and administrative controls that restrict access as long-term protective. The USDOE Savannah River Site Manager will certify USDOE compliance with these controls. Further discussion is needed with USEPA/SCDHEC to reach agreement on the revised text and table in the FFA Annual Progress Report.	USDOE	USEPA/ SCDHEC	September 2018	N	N

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20)

I. SITE INFORMATION

Site Name:	**FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20)**	**Date of Inspection:**	**10/18/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #23**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **86°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☐ Access Controls
☐ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☐ Other ____________________

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **SRR Staff:** Mildred Jackson (Name) Env. Compliance Authority (Title) 10/18/2016 (Date)

Interviewed: ☒ At Site ☐ At Office ☐ By Phone Phone No.: (803)208-8686

Problems/Suggestions: ☐ Report Attached

2. **SRR Staff:** Bruce Martin (Name) Waste Disposal Authority (Title) 10/18/2016 (Date)

Interviewed: ☒ At Site ☐ At Office ☐ By Phone Phone No.: (803)557-9550

Problems/Suggestions: ☐ Report Attached

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

II. INTERVIEWS *(Click all that apply) (Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ____________ (Date) ____________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

4. Other Interviews *(Optional):* ☐ Report Attached ____________________

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: ____________________

____

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☒ Readily Available ☐ Up to Date ☐ N/A
☐ Contingency Plan/Emergency Response Plan ☒ Readily Available ☐ Up to Date ☐ N/A

Remarks:

3. O&M and OSHA Training Records: ☐ Readily Available ☒ Up to Date ☐ N/A

Remarks:

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRR

☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place

☒ Other: Project cost data is summarized in Section IV of this OU-specific remedy review report.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☒ N/A

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:______________________________

B. Other Site Conditions

Remarks:______________________________

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent__________ Depth__________

Remarks: ______________________________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths__________ Widths__________ Depths__________

Remarks: ______________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________ Depth__________

Remarks:______________________________

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent__________ Depth__________

Remarks: ______________________________

5. Vegetative Cover: ☐ Grass ☒ Cover properly established ☐ No signs of stress

Areal extent__________ Depth__________

Remarks:______________________________

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent________________ Depth___________________

Remarks:____

8. Wet Areas / Water Damage: ☐ Wet areas/water damage not evident

☒ Wet areas ☐ Location shown on site map Areal extent________________
☒ Ponding ☐ Location shown on site map Areal extent________________
☒ Seeps ☐ Location shown on site map Areal extent________________
☒ Soft subgrade ☐ Location shown on site map Areal extent________________

Remarks:____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent________________

Remarks: ____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

D. Cover Penetrations ☒ Applicable ☐ N/A

1. Gas Vents: ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

2. Gas Monitoring Probes:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

3. Monitoring Wells:
☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
Remarks: Groundwater monitoring is not part of the interim remedial action. The FTF Groundwater Monitoring Plan addresses groundwater exiting the FTF in accordance with the FTF General Closure Plan.

4. Leachate Extraction Wells:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:

5. Settlement Monuments: ☐ Located ☐ Routinely Surveyed ☒ N/A
Remarks:

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Attachment H-1. Five-Year Review Site Inspection Checklist – FTF OU (Waste Tanks 5, 6, 7, 17, 18, 19, and 20) *(continued)*

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Soil Vapor Extraction System ☐ Applicable ☒ N/A

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The interim remedy for the FTF Waste Tanks 5, 6, 17, 18, 19, and 20 is Annual Visible Barriers Inspection and Maintenance. The interim remedy is effective and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The selected remedy requires annual inspections and maintenance (as needed). Site inspections indicate that the conditions discussed in Section VI. Five-Year Review Process, Summary of Inspections and Interviews, are satisfactory, but they are being monitored to verify that the conditions do not worsen to an extent that would compromise the stabilization and containment of residual waste in the tanks.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

GENERAL SEPARATIONS AREA CONSOLIDATION UNIT

I. Introduction

This report is the third five-year review for the General Separations Area Consolidation Unit (GSACU) Operable Unit (OU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the GSACU OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the GSACU OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table I-1 lists the chronology of site events for the GSACU OU.

III. Background

The GSACU OU is listed as a Resource Conservation and Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS) (FFA 1993). The media associated with the GSACU OU are soil, sediment, and debris.

Physical Characteristics

The GSACU OU is located in the central portion of SRS, approximately 9.6 km (6 mi) from the nearest SRS boundary (Figure I-1). The GSACU OU consists of four primary subunits (Figure I-2);

- H-Area Retention Basin (281-3H) (HRB) was a single open inactive retention basin 63 m (210 ft) long by 36 m (120 ft) wide by 2.1 m (7 ft) deep and surrounded by a berm (Figure I-3). A process sewer line from the diversion box to HRB and a concrete pipe on the south side of the basin are included in the HRB subunit. The pipe discharged to a concrete spillway along an existing active effluent stream that flows from H Area to Fourmile Branch. The HRB security fence encloses an area of about 0.7 hectares (1.7 acres).

- Warner's Pond (685-23G) is approximately 1.6 hectares (4 acres) in size and is centered in an area that was formerly occupied by a pond approximately 0.4 hectares (1 acre) in size (Figure I-3). Additionally, two sections of inactive process sewer lines that are subject to CERCLA and one section subject to RCRA are also include in the subunit.
- HP-52 Ponds (no building number [NBN]) is a site approximately 0.44 hectares (1.1 acres) in size and is centered in an area that was formerly occupied by two small holding ponds (Figure I-3).
- Old Radioactive Waste Burial Ground (643-E) (ORWBG), including 22 underground storage tanks (Old Solvent Tanks [OSTs] 650-01E through 650-22E) is a 31-hectares (76-acre) earthen trench disposal area for solid radioactive waste produced at SRS, as well as for shipments from other U. S. Department of Energy (USDOE) and Department of Defense facilities (Figure I-4).

Collectively, these subunits are identified as a single OU (Figure I-1) because of their proximity to each other and similar health and environmental threats.

Groundwater is not included as a subunit of the GSACU OU. Groundwater beneath the ORWBG has been contaminated by numerous sources within the Burial Ground Complex (BGC). This groundwater is being evaluated separately under the RCRA Permit Renewal for the Mixed Waste Management Facility (MWMF). Under that permit, institutional controls are required for as long as groundwater remediation is required, which is anticipated to be 170 years. Groundwater beneath the HRB, HP-52 Ponds, and Warner's Pond has been contaminated by numerous sources in H Area. This groundwater is being evaluated by the General Separations Area Eastern Groundwater OU.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the GSACU OU as being within an industrial area. The future land use for the GSACU OU is reasonably anticipated to remain industrial with the USDOE maintaining control of the land.

History of Contamination

H-Area Retention Basin

From 1955 to 1972, HRB received non-hazardous radioactively contaminated wastewater from chemical separations facilities and from the H-Area Tank Farm (HTF). The exact volumes of wastewater received at the basin and discharged from the basin are not known. In 1973, HRB was replaced by a lined basin.

In May 1956, an undetermined volume of material leaked from the discharge gate on the south side of HRB. SRS constructed a temporary holding pond to contain the material. This area is included in the HRB subunit.

Warner's Pond

Warner's Pond was constructed in 1956 as an emergency holding pond to receive contaminated cooling water from the 221-H (H-Canyon) building that flowed into an effluent stream. Contaminated cooling water was discharged to Warner's Pond on three occasions: 1956 (cooling coil leak), 1960 (source not determined), and 1965 (cooling coil leak that released approximately 300 curies [Ci] of activity). Contaminated water from all three events entered the pond via the effluent stream leading from H Area and was diverted or pumped to HRB or to the H-Area Seepage Basins. Warner's Pond was closed in 1966.

Facility records indicate no listed wastes were managed at the RCRA H-Area Inactive Process Sewer Line which operated from 1955 to 1982. Effluent was characterized as hazardous due to mercury and chromium concentrations and low pH. Two spills associated with pipeline breaks that occurred in 1978 adjacent to this subunit have been included in the subunit.

HP-52 Ponds

In 1967, during a transfer of high-level waste at the HTF, some spilled material flowed into a nearby storm sewer and reached the HP-52 outfall. The HP-52 Ponds, two small holding ponds, were constructed to contain the contaminated water. A smaller spill occurred in 1969 when an HTF waste transfer line ruptured and released high-level waste to the storm sewer and outfall.

Old Radioactive Waste Burial Ground

The ORWBG is part of the central disposal area for solid radioactive waste at SRS known as the BGC. Waste was disposed of at the ORWBG from 1952 until 1974, when the site was essentially filled and the majority of waste disposal operations shifted to other facilities in the BGC.

During its operational history, approximately 201,770 m^3 (263,900 yd^3) of radioactive wastes, including radioactively contaminated hazardous substances, were buried within the ORWBG. Most wastes disposed of in the ORWBG were placed in drums, cans, cardboard boxes, plastic bags, and metal containers and then buried in earthen trenches approximately 6 m (20 ft) deep. At the time of burial, approximately 5.1 million Ci of radioactivity was placed in the ORWBG. Much of the short-lived radioactivity has decayed, but a large inventory of radioactive and hazardous substances remains buried at depth in the ORWBG.

The ORWBG consists of four distinct subunits:

- ORWBG - most waste was placed in the ORWBG from 1952 until 1972. Radioactive, hazardous, and mixed waste remain buried in the ORWBG.
- Twenty-two OSTs - emptied in 1977 (by transferring the liquid solvent from the ORWBG to another facility), the OSTs were originally used to store spent plutonium-uranium extraction solvent from 1953 to 1977. Very little residual liquid and sludge remains in the OSTs.
- Mercury Hot Spot – a distinct area containing approximately 20% (0.16 m^3 [5.7 ft^3]) of the total mercury in the ORWBG. Each burial consists of two or three 1-L (0.26 gal) polyethylene bottles filled with elemental mercury, double-bagged, and containerized in 19-L (5-gal) cans.
- Radioactive Hot Spots – multiple and distinct areas containing relatively high concentrations of radionuclides (>60 Ci per 6x6 m [20x20 ft] grid cell). Generally, these consist of tritium, transuranic isotopes, carbon-14, and fission products such as cesium-137 and strontium-90.

Initial Response

Initially, the four OUs were evaluated separately. The RCRA/CERCLA documents for HRB and the ORWBG were completed through the Corrective Measures Study/Feasibility Study stage, and it was determined that there was a preference to remove principal threat source material (PTSM) from HRB and place it at the ORWBG. At this point, PTSM was also identified at Warner's Pond and HP-52 Ponds during pre-work plan characterization work. Given the similar health and environmental threats, similar geologic setting, and proximity of the units, USDOE, South Carolina Department of Health and Environmental Control (SCDHEC), and U.S. Environmental Protection Agency (USEPA) agreed to consolidate HRB, Warner's Pond, HP-52 Ponds, and the ORWBG into a single OU to expedite remedial action. Actions taken at each subunit by SRS to minimize exposure that occurred prior to approval of remedial actions included:

- HRB - in 1996 trees and vegetation were removed. Prior to the final remedial action, the site was primarily covered with grass and small shrubs.
- Warner's Pond - in 1966, the pond was drained, backfilled with clean soil, and paved with asphalt. In 1996 trees and vegetation were removed. Prior to the final remedial action, the site was primarily covered with grass and small shrubs.
- HP-52 Ponds - contaminated soil from the 1967 and 1969 spills containing approximately 1,200 Ci and 0.5 Ci, respectively, of radioactivity was removed and shipped to the ORWBG. The stream banks below the HP-52 outfall were paved with asphalt to minimize contaminant migration (CM) from the soil to the stream and the pond areas were filled with contaminated soil excavated from the stream banks and covered with clean backfill. Stream flow was diverted to redirect flow around the former ponds area and the original effluent ditch was backfilled.
- ORWBG - In 1996, an interim measure/interim action (WSRC 1996) was taken as a source control measure to gain risk reduction before a final action was implemented. In 1998 the interim action of installing an interim soil cover was completed at ORWBG. The soil cover was installed in eight sections, leaving open the OST area and several operating and administrative areas. The purpose of the soil cover was to decrease

stormwater infiltration into the underlying waste, thereby reducing leachate production and contaminant transport to the groundwater. A second interim action (WSRC 2001) was started in 2001 to empty the 22 OSTs to the extent practical, stabilize the residual fluids, and fill the tanks with grout to stabilize them and allow for the placement and subsequent maintenance of a permanent cover. The physical work for this interim action was completed in March 2003.

Basis for Taking Action

PTSM was identified at HRB, Warner's Pond, HP-52 Ponds, and ORWBG. At HRB, Warner's Pond and HP-52 Ponds, PTSM and soil-containing CM contaminants of concern (COCs) was removed to the extent practicable. At the ORWBG, treatment or removal of the PTSM was and is not practical; consequently, engineering controls, including containment, are used to manage the PTSM.

Radionuclides, metals, and volatile organic compounds were identified as COCs for the GSACU OU (WSRC 2002). Two constituents, cesium-137 and strontium-90, were identified as the primary risk drivers. They were used as indicator contaminants for HRB, Warner's Pond, and HP-52 Ponds to guide the remediation and to assess when cleanup goals were met. Remedial goals (RGs) were identified for these two contaminants (Table I-2). No RGs were identified for the ORWBG.

The risks at HRB, Warner's Pond, and HP-52 Ponds are similar in that (1) all three units contain PTSM that presents an unacceptable human health risk to future industrial workers, and (2) cesium-137 is the primary contaminant, both in terms of the principal risk driver and the extent of contamination. Contamination at HRB, Warner's Pond, and HP-52 Ponds poses a threat to current and future industrial workers who may be exposed to it, and HRB and Warner's Pond represent continuing sources of potential groundwater contamination (WSRC 2002).

The ORWBG contains a very large inventory of short- and long-lived radioactive wastes and other hazardous substances. These buried wastes are considered PTSM and would pose an acute risk to human health and the environment if exposure were to occur. In addition, future leaching of contaminants may further affect groundwater quality under the ORWBG (WSRC 2002).

IV. Remedial Actions

Remedy Selection

As stated in the Record of Decision (ROD) (WSRC 2002), the remedial action objectives (RAOs) for the HRB, Warner's Pond, and HP-52 Ponds are as follows:

- Treat and/or remove PTSM by treating and/or removing cesium-137 and strontium-90 at levels above the RGs (Table I-2), to the extent practical;
- Control migration and leaching of strontium-90 that could result in groundwater contamination in excess of maximum contaminant levels beneath each unit by removing soil above the RGs (Table I-2), to the extent practical; and reducing infiltration through any residual contamination above RGs; and
- Protect human and ecological receptors from surface materials containing cesium-137 and strontium-90 above RGs (Table I-2).

As stated in the ROD (WSRC 2002), the RAOs for the ORWBG are as follows:

- Minimize the exposure risk to workers (current and future) and prevent or mitigate inadvertent human intrusion;
- Minimize ecological intrusion in to the buried waste and redistribution/mobilization (erosion) of contaminants from the waste unit to the surrounding areas; and
- Mitigate future leaching of contaminants to groundwater.

As stated in the ROD (WSRC 2002), the selected remedy for the GSACU OU includes the following activities:

- For the HRB, Warner's Pond, and HP-52 Ponds manage standing surface water by solidification and consolidation with the excavated soils and/or by treatment, excavate industrial PTSM materials and soil containing CM COCs above RGs, as well as inactive pipelines that are encountered during excavation activities. Those not accessible are to be grouted in place. The excavated material and soil, as well as any vegetation in contact with PTSM, are to be transferred to areas of the ORWBG that have not been covered by the native soil cover. Following excavation activities, the risk of remnant material will be evaluated. In order to mitigate any residual risk exceeding RGs, the excavations will be backfilled with clean soil. Surface water drainage at Warner's Pond will be restored to a natural state by removing the berms that cause ponding of water. Upon completing construction activities, a post-construction report will be prepared and institutional controls will be implemented.

- For the ORWBG construct a low-permeability geosynthetic cover system (with soil hydraulic conductivity of less than 1E-07 cm/s). This will include the areas where consolidate materials from HRB, Warner's Pond and HP-52 Ponds were placed. Following construction, institutional controls will be implemented. Before institutional controls are terminated, intruder barriers will be installed over the long-lived persistent radioactive hot spots to deter inadvertent human intrusion.

Remedy Implementation

The selected remedy met the RAOs at GSACU OU by implementing the following activities (WSRC 2008):

- Managing standing surface water in the HRB, Warner's Pond, and HP-52 Ponds;
- Consolidating PTSM-contaminated media at the ORWBG by excavating and transporting 12,400 m^3 (16,200 yd^3) from the HRB, 18,800 m^3 (24,600 yd^3) from Warner's Pond, and 7,760 m^3 (10,150 yd^3) from the HP-52 Ponds;
- Installed low permeability geosynthetic covers with a nominal in-place saturated hydraulic conductivity of 1E-07 cm/s or less over the ORWBG (29 hectares [72 acres]), HRB (0.85 hectares [2.1 acres]), and Warner's Pond (1.3 hectares [3.2 acres]) subunits and placed compacted soil backfill over the excavated areas of HP-52 Ponds subunit (0.65 hectares [1.6 acres]).
- Implemented land use controls (LUCs) for 31.7 hectares (78 acres) in ORWBG, 0.9 hectares (2.3 acres) in HRB, 0.7 hectares (1.7 acres) in HP-52 Ponds and

1.6 hectares (4 acres) in Warner's Pond for a total of 34.9 hectares (85.9 acres). LUCs include the following:

- Warning signs at the OU boundaries to alert on-site workers to the presence of hazardous substances and to prevent unauthorized entry and unrestricted uses.
- Site controls and land use restrictions (i.e., OU-specific perimeter fencing and warning signs) via the Site Use/Site Clearance Program to restrict disturbance of the cover system and waste at each unit and to prevent drinking water use of contaminated groundwater. Other administrative controls to ensure worker safety include work controls, worker training, and worker briefings of health and safety requirements.
- SRS access controls to prevent exposure to trespassers, as described in the 2013 RCRA Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary.

Figure I-5 presents current photographs of the GSACU OU.

System Operations / Operation and Maintenance

There are no system operational requirements. The following maintenance activities are being taken to maintain the cover systems as long as the waste remains a threat to human health or environment.

- Site inspections of HRB, HP-52 Ponds, Warner's Pond, and ORWBG for evidence of damage to the cover system due to erosion or intrusion by burrowing animals are being performed annually as a minimum. The inspections also address upkeep of the vegetative cover and access control barriers (e.g., the warning signs, fence).
- Necessary repairs (e.g., replacing eroded or disturbed soil, repairing OU-specific warning signs and perimeter fence, etc.) and vegetation management (e.g., mowing, removal of larger vegetation, etc.) are being performed when required.

Table I-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 2002). The estimated O&M cost for FY2012 to FY2016 was $195,750 for inspections and maintenance. The actual O&M cost for FY2012 to FY2016 is $283,688. The actual O&M costs are higher than expected because costs for routine site maintenance and preparation of five-year remedy reviews were underestimated in the ROD.

V. Progress since Last Review

The previous protectiveness statement concluded that the remedy of excavation of contaminated soil and consolidation under a low permeability geosynthetic cover system with institutional controls (i.e., LUCs) is protective of human health and the environment.

In the fourth five-year remedy review, SRS recommended that the cover inspection frequency for the ORWBG be reduced to annual (SRNS 2014). This reduction would provide adequate monitoring and consistency since the majority of OU covers at SRS are currently inspected annually. On February 6, 2014, the USDOE submitted a letter (USDOE 2014) to USEPA and SCDHEC to reduce inspection frequencies from quarterly to annual for ORWBG. USEPA and SCDHEC approved the request on March 20, 2014 and March 7, 2014, respectively. Annual inspections for the ORWBG began in 2015.

VI. Five-Year Review Process

The following tasks were performed as part of the five-year review:

- Reviewed the documents listed in Section XII, Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU, interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment I-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified for the GSACU OU during these interviews.

The GSACU OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 14, 2016. No issues were identified for the GSACU OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 22, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual inspections conducted from Fiscal Year (FY) 2012 through FY2016 for the HP-52 Pond identified hog damage, active ant mounds, overgrown vegetation, and erosion around the drainage channel on the north and south side. Site inspections (annually) conducted from FY2012 through FY2016 for the HRB identified active ant mounds. Site inspections (quarterly through 2014; annually thereafter) conducted from FY2012 through FY2016 for the ORWBG have identified overgrown vegetation, active ant mounds, burrowing animal trails, tree growing on cover, thinning vegetation on slope, vines growing on fence, and erosion in drainage ditch. Site inspections (annually) conducted from FY2012 through FY2016 for Warner's Pond identified hog damage, active ant mounds, and downed trees near pond. These findings were documented for all these units on the field inspection checklists and were resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The removal of media contaminated at PTSM levels, consolidating residual contaminated materials with the ORWBG and placing a protective soil cover over them has eliminated the exposure pathway for human or ecological receptors and controls migration of strontium-90 from soils to groundwater.

- Annual field inspections of the cover systems are being performed and indicate the integrity of each is intact and no problems have occurred. The most prevalent finding for all subunits is active ant mounds which are addressed on the spot. There also have been sporadic events of minor soil erosion on the side slopes of the cover systems which have been addressed prior to the next inspection.
- Institutional controls (i.e., LUCs) are in place and being implemented to provide access control and prevent exposure as designed. The Land Use Control Implementation Plan for GSACU OU is included as Appendix A of the Corrective Measures Implementation / Remedial Action Implementation Plan and governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (WSRC 2003). All LUC objectives are being met.
- The low permeability cap has significantly reduced the tritium migration from the ORWBG vadose zone to the Southwest Plume of the MWMF. This has resulted in a tritium reduction within the plume of approximately 40%. The low permeability cap appears to have impacted the other plumes associated with the ORWBG (Northwest and Southeast Plumes) to a lesser extent. The groundwater associated with the ORWBG is managed under the MWMF RCRA Permit Renewal.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the GSACU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

There are no recommendations and follow-up actions concerning GSACU OU

X. Protectiveness Statement(s)

The remedy at the GSACU OU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are controlled by the institutional controls (i.e., LUCs), environmental monitoring, site inspections and maintenance. All threats to contaminated media at the GSACU have been addressed through implementation of physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain this site for industrial use only, OU-specific perimeter fencing and warning signs, and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina,* SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2014. Letter, B. T. Hennessey (DOE) to S. B. Fulmer (SCDHEC) and R. H. Pope (EPA), *Request to Change the Inspection Frequency for Operable Units Based on the Recommendation in the Fourth Five-Year Remedy Review Report for the Savannah River Site (SRNS-RP-2012-00011, Revision 1.1, November 2013)*, CERCLIS Numbers: 13, 14, 16, 17, 20, 23, 26, 32, 39, and 66, ACP-14-125, dated February 6, 2014, Department of Energy, Savannah River Operations Office, Aiken, SC

WSRC, 1996. *Interim Record of Decision Remedial Alternative Selection for the Old Radioactive Waste Burial Ground (643-E) (U)*, WSRC-RP-96-102, Rev. 0, March 1996, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 2001. *Interim Record of Decision for the Old Solvent Tanks at the Old Radioactive Waste Burial Ground*, WSRC-RP-2000-4193, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002. *Record of Decision Remedial Alternatives Selection for the General Separations Area Consolidated Unit*, WSRC-RP-2002-4002, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003. *Corrective Measures Implementation/Remedial Action Implementation Plan (CMI/RAIP) for the General Separations Area Consolidation Unit (U)*, WSRC-RP-

2003-4053, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008. *Post-Construction Report (PCR)/Corrective Measures Implementation Report (CMIR)/Remedial Action Completion Report (RACR) for the General Separations Area Consolidated Unit (GSACU) (U)*, WSRC-RP-2006-4067, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

Various – *Inspection Data Sheets - Field Inspection Checklist, H Area Retention Basin (U)*, ER-IDS-019-042, Inspection period 2012 through 2016 (annually)

Various – *Inspection Data Sheets* - F*ield Inspection Checklist, Warner's Pont (U)*, ER-IDS-019-043, Inspection period 2012 through 2016 (annually)

Various – *Inspection Data Sheets - Field Inspection Checklist, HP-52 (U),* ER-IDS-019-044, Inspection period 2012 through 2016 (annually)

Various – *Inspection Data Sheets - Field Inspection Checklist for Old Radioactive Waste Burial Ground Bldg. 643-E (U)*, ER-IDS-019-027, Inspection period 2012 through 2016 (quarterly through 2014; annually beginning in 2015)

This page is intentionally left blank.

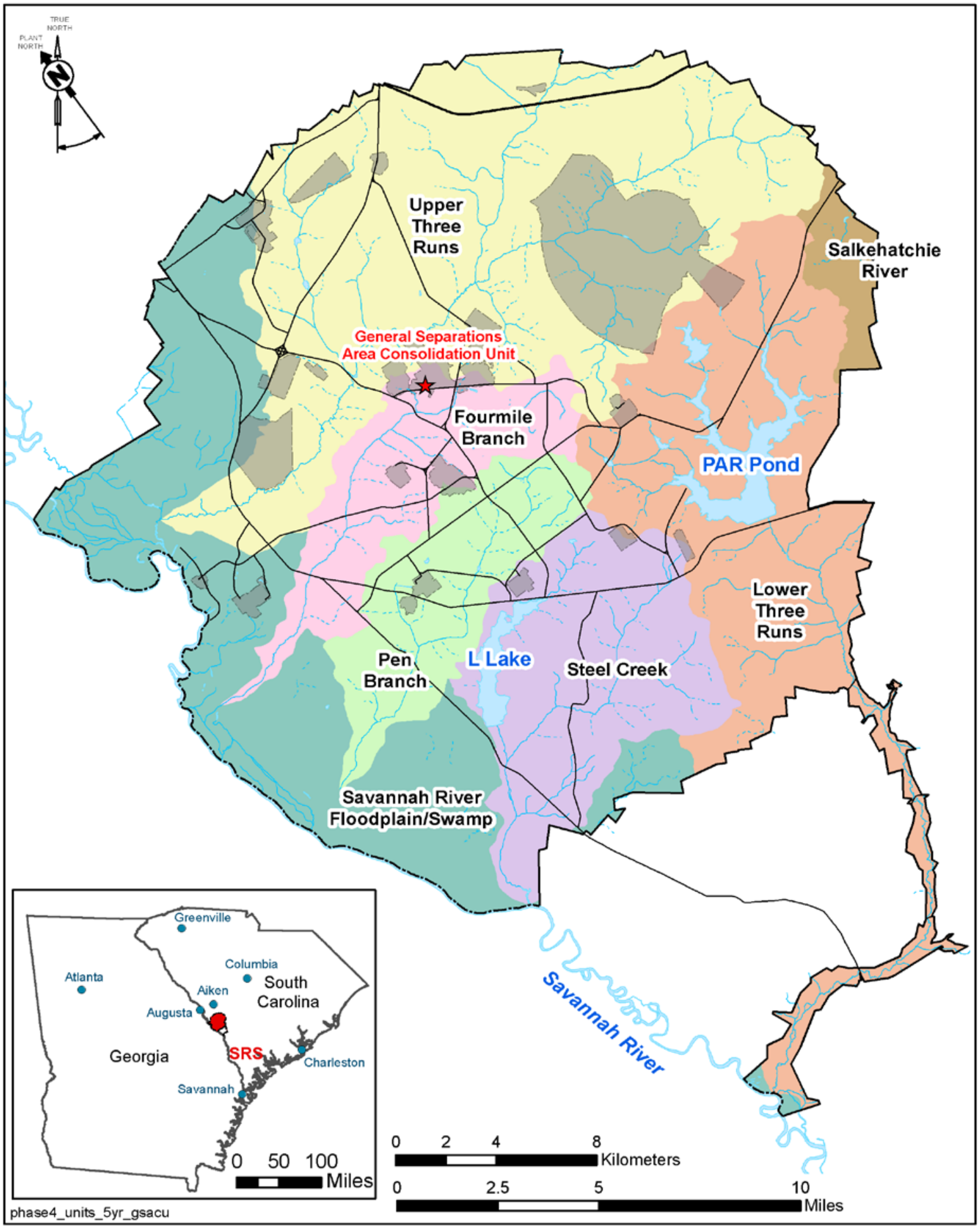


Figure I-1. Location of the General Separations Area Consolidation Unit at SRS

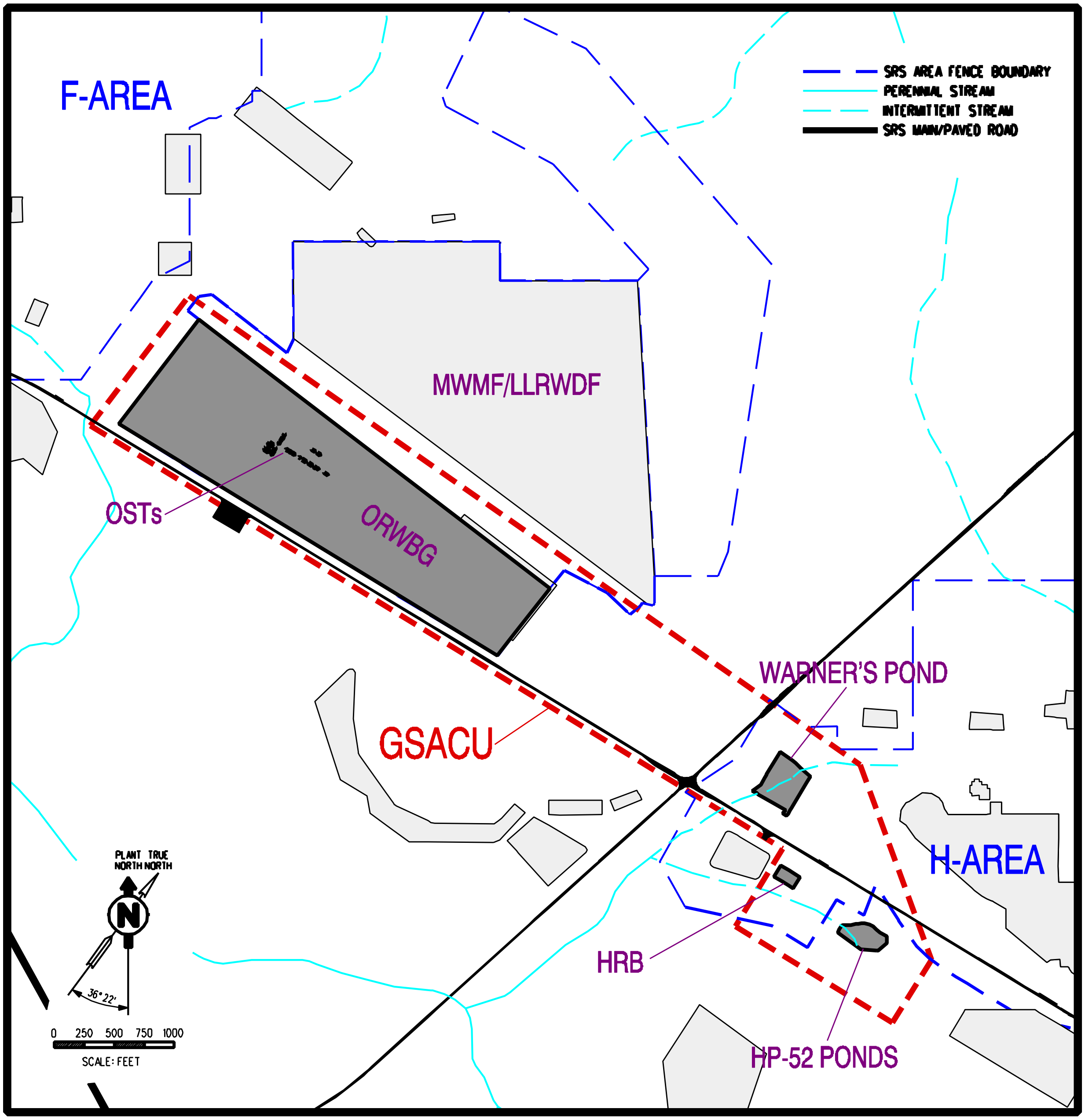


Figure I-2. **General Separations Area Consolidation Unit Four Primary Subunits**

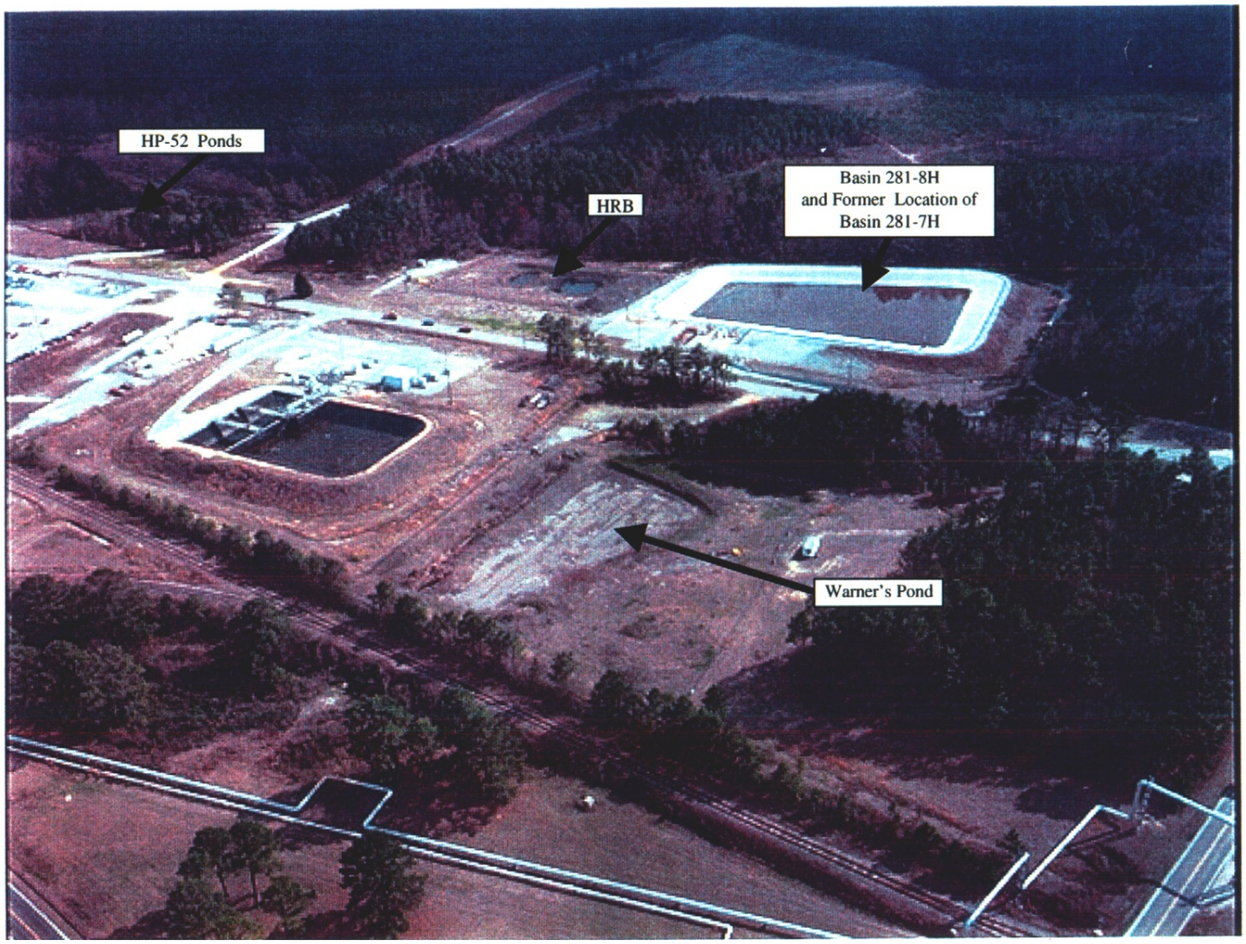


Figure I-3. **Aerial Photograph of the GSACU OU subunits – HRB, Warner's Pond, and HP-52 Ponds – Prior to Remedial Actions (WSRC 2002)**

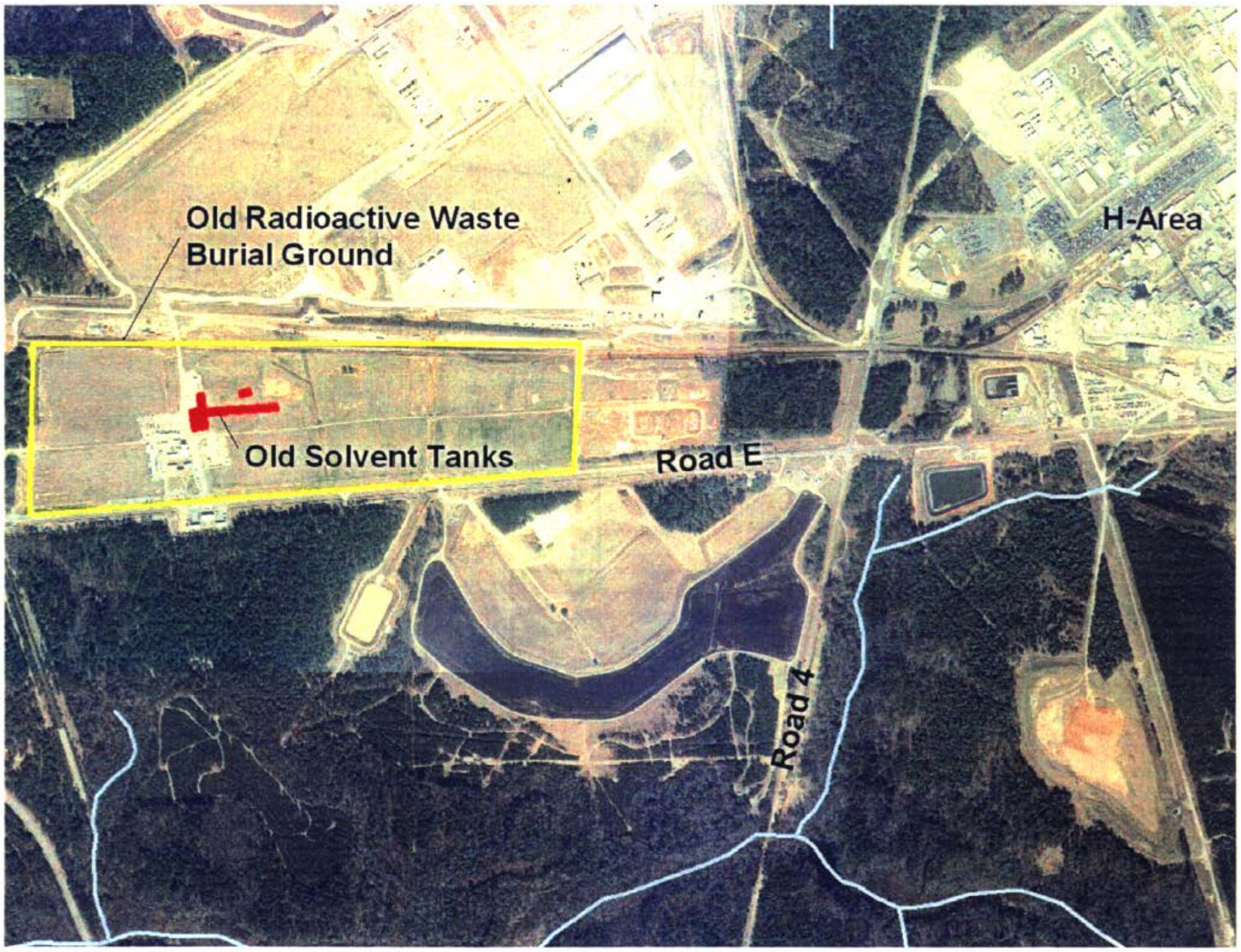


Figure I-4. Aerial Photograph of the ORWBG Prior to Remedial Actions (WSRC 2001)

Figure I-5. Photographs of the GSACU OU Subunits (2016)

This page is intentionally left blank.

Table I-1. Chronology of OU Events

Event	Date
IROD Issuance – ORWBG	July 25, 1996
RCRA Facility Investigation/Remedial Investigation (RFI/RI) Field Start for HRB	October 1, 1997
Interim Remedial Action – ORWBG Start / Complete	July 23, 1996 / May 19, 1998
IROD issuance – OST	September 27, 2001
Interim Remedial Action – OST Start / Complete	September 17, 2001 / March 13, 2003
RFI/RI Field Start for Warner's Pond	July 31, 2002
RFI/RI Field Start for HP-52 Ponds	August 2, 2002
Final ROD issuance - GSACU OU	October 25, 2002
Final Remedial Action – GSACU OU Start / Complete	August 11, 2003 / August 29, 2007
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table I-2. Remedial Goals for the HRB, Warner's Pond, and HP-52 Ponds

COC	Type of COC	RG – Soil (ρCi/g)	RG – Groundwater (ρCi/mL)
Cesium-137	PTSM	104 (all subunits)	N/A
	HH/Eco[1]	0.55 (all subunits)	
Strontium-90	PTSM/CMCOC	1.5/0.65/1.12[2]	8
	HH	57.2 (HRB only)	

1 HH – human health risk, Eco – ecological risk

2 Individual RGs were identified for strontium-90 (PTSM) associated with the HRB basin bottom and sidewalls, the HRB sewer line/discharge area, and the Warner's Pond, respectively. There was no RG identified for strontium-90 for the HP-52 Ponds.

Table I-3. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	46,862	44,697	57,445	59,979	74,705	283,688
Total ROD Estimated Direct O&M Costs * ($)	47,150	37,150	37,150	37,150	37,150	195,750

*Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E)

I. SITE INFORMATION

Site Name:	**General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E)**	**Date of Inspection:**	**9/08/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #32**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **90°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Consolidation, excavation, disposal

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. O&M Staff: Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. O&M Staff: Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

II. INTERVIEWS *(Click all that apply) (Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

4. **Other Interviews** *(Optional):* ☐ Report Attached ______________________

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ *O&M Manual*	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: *Field Inspection Checklist for Old Radioactive Waste Burial Ground*, ER-IDS-019-027 (quarterly through 2014; annual thereafter); *Field Inspection Checklist for Warner's Pond*, ER-IDS-019-043 (annual); *Field Inspection Checklist for HP-52*, ER-IDS-019-044 (annual); and *Field Inspection Checklist for H-Area Retention Basin*, ER-IDS-019-042 (annual)

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A

☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201.HAZWOPER

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A

☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A

☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A

☒ Other Permits ☒ Readily Available ☐ Up to Date ☐ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A

☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State

☐ PRP In-House ☐ Contractor for PRP

☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place

☒ Other: Project cost data is summarized in Section IV of this OU-specific review

Total annual cost by year for review period, if available

From:________ (Date) To:________ (Date) ________ (Total Cost) ☐ Breakdown attached

From:________ (Date) To:________ (Date) ________ (Total Cost) ☐ Breakdown attached

From:________ (Date) To:________ (Date) ________ (Total Cost) ☐ Breakdown attached

From:________ (Date) To:________ (Date) ________ (Total Cost) ☐ Breakdown attached

From:________ (Date) To:________ (Date) ________ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ________

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: OU-specific perimeter fencing is required for the ORWBG. Perimeter fencing is in good condition.

B. Fencing

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A

Remarks: Signs are in good condition.

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Phil Prater (Name) IACD Program Manager (Title) 11/14/2016 (Date) 803-952-9333 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:

B. Other Site Conditions

Remarks: Survey markers were located and in good condition. Vegetation is mowed routinely. Site inspections for the HRB, ORWBG, HP-52 Ponds, and Warner's Pond conducted from FY2012 though FY2016 identified active ant mounds, evidence of hog damage, overgrown vegetation, thinning vegetation on slope, erosion around the drainage channel on the north and south side, and a few downed trees as issues. The findings for all these units were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent______ Depth______

Remarks:

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths______ Widths______ Depths______

Remarks:

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent______ Depth______

Remarks:

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent______ Depth______

Remarks:

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress

Areal extent______ Depth______

Remarks:

Attachment I-1. **Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)***

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:______________________________

____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent__________ Depth__________

Remarks:______________________________

____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent__________

☐ Ponding ☐ Location shown on site map Areal extent__________

☐ Seeps ☐ Location shown on site map Areal extent__________

☐ Soft subgrade ☐ Location shown on site map Areal extent__________

Remarks:______________________________

____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent__________

Remarks:______________________________

____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. Outlet Pipes Inspected: ☐ Functioning ☒ N/A

Remarks:________________________

2. Outlet Rock Inspected: ☐ Functioning ☒ N/A

Remarks:________________________

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident

Areal extent____________ Depth____________

Remarks:________________________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A

☒ Vegetation does not impede flow

Areal extent____________ Type____________

Remarks:________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent____________ Depth____________

Remarks:________________________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A

Remarks:________________________

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Attachment I-1. Five-Year Review Site Inspection Checklist – General Separations Area Consolidation Unit (GSACU) OU including Old Radioactive Waste Burial Ground (643-E) and Old Solvent Tanks (650-1E through 650-22E) *(continued)*

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Consolidation, Excavation, Disposal ☒ Applicable ☐ N/A

Consolidation, excavation, and disposal were performed at GSACU. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for GSACU OU by removing media contaminated at PTSM levels, consolidating residual contaminated materials within the ORWBG under a protective geosynthetic soil cover has met the remedial objectives of preventing physical exposure to contaminants and mitigating migration of contaminants to the groundwater. The cover system is intact; long-term grasses have been fully established. The soil cover is functioning as designed. Drainage channels are functioning adequately.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of site inspections and site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the integrity of the engineered cover, which in turn will maintain the effectiveness of the cover to mitigate leaching. There are no issues requiring corrective action.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

K-AREA REACTOR SEEPAGE BASIN OPERABLE UNIT

I. Introduction

This report is the third five-year review for the K-Area Reactor Seepage Basin (904-65G) (KRSB) Operable Unit (OU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the KRSB OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the KRSB OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table J-1 lists the chronology of site events for the KRSB OU.

III. Background

KRSB OU is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media associated with this OU is soil.

Physical Characteristics

The KRSB OU is located in the south-central portion of the Savannah River Site (SRS) in K Area (Figure J-1). The OU is adjacent to a major electrical transmission line right-of-way and is approximately 120 m (400 ft) west of the K-Reactor Building (105-K). The basin dimensions are approximately 40.5 m x 21 m (135 ft x 70 ft) with an average depth of 2.1 m (7 ft) below ground surface (bgs).

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999a) designates KRSB OU as being within an industrial area. The future land use for KRSB OU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The KRSB was constructed in 1957 to receive low-level radioactive wastewater from disassembly basin purges from K-Reactor Building (105-K). Figure J-2 shows the site layout of the KRSB OU. From 1957 until 1969, the KRSB received low-level radioactive purge water from the K-Area Disassembly Basin via a 180-m (600-ft) long, 7.5-cm (3-in) diameter polyethylene pipe buried approximately 0.6 to 1.2 m (2 to 4 ft) bgs. After the basin was taken out of service, the basin was left open and was not backfilled to grade.

Initial Response

During the primary source investigation at the KRSB in 1996, a break in the pipeline that supplied wastewater to the basin during its operation was detected. Contaminated soil above and below this line break was excavated and disposed. The ends of the pipe where the break was observed were capped. No other initial response actions were taken. The characterization of the basin and pipeline proceeded.

Basis for Taking Action

The potential for human exposure to radiologically contaminated soils in the KRSB resulting in a future industrial worker risk of greater than 1E-06 and the potential for soil contaminants to leach into the groundwater was the basis for taking action at the KRSB.

In 1995, characterization activities were conducted under the *Phase II Remedial Investigation Work Plan for the K-Area Reactor Seepage Basin* (WSRC 1994). A Remedial Investigation (RI) Report and Baseline Risk Assessment (BRA) (WSRC 1998) was prepared and approved in 1998. These studies indicate that the seepage basin, process sewer line, and soil adjacent to the process sewer line present a potential hazard to future industrial workers and residents, and that remediation of the KRSB OU was warranted. Five radionuclides were identified as human health constituents of concern (COCs) in the seepage basin soils: cesium-137, strontium-90, plutonium-239/240, americium-241, and cobalt-60. Carbon-14 and strontium-90 were retained as final contaminant migration (CM) COCs as these contaminants were predicted to leach to groundwater and exceed maximum contaminant levels (MCLs) within 1,000 years. The human health and contaminant migration COCs and remedial goals (RGs) as developed in the RI/BRA for KRSB OU (WSRC 1998) are shown in Table J-2.

Tritium, gross alpha, and total radium were detected in groundwater near the KRSB OU at concentrations above maximum contaminant levels (MCLs) from 1992 to 1996. The groundwater has been identified as a separate OU and is, therefore, considered outside the scope of the KRSB OU remedial action. The groundwater will be investigated as part of the K-Area Groundwater OU.

IV. Remedial Actions

Remedy Selection

The plug-in Record of Decision (ROD) process was designed to present a common remedy for high-risk radioactively contaminated OUs at SRS with similarities in history of use, contaminants, risk, and location within current industrial areas. For radiologically contaminated soil that represents principal threat source material (PTSM), in situ stabilization was selected as the common remedy for open reactor seepage basin candidates in the *Plug-in Record of Decision for In Situ Stabilization With Low Permeability Soil Cover for Radiological Contaminants in Soil* approved in October 1999 (WSRC 1999b). A Technical Evaluation Report (TER) (WSRC 1999d) was prepared and verified that cesium-137 was present at high enough levels that the basin soils were considered PTSM and that KRSB OU met the plug-in ROD criteria. PTSM for the plug-in ROD remedy was defined as soil that poses a radiological (or cancer) risk to the future industrial worker equal to or greater than 1E-03.

In lieu of Proposed Plan and ROD documents, an Explanation of Significant Difference (ESD) document was submitted and was approved in March 2000 (WSRC 2000). The approved ESD is the document that amends the approved plug-in ROD to include the KRSB OU.

As detailed in the Plug-In ROD, the remedial action objectives (RAOs) for the KRSB OU are as follows:

- Prevent human exposure to highly contaminated basin soils (PTSM) by performing stabilization treatment to the extent practicable and filling the basin. Reduce risks to the future worker from surface soils (0 to 0.3 m [0 to 1 ft]) outside the basin by establishing RGs for COCs at concentrations equivalent to 1E-06 for carcinogens and a hazard quotient of 1 for noncarcinogens or background (where background levels of COCs exceed 1E-06).
- Prevent the release of COCs in the soil to groundwater beneath the unit above MCLs or risk-based concentrations (when MCLs are not available). The soil RGs are back-calculated based on these values.
- Protect the ecological receptors indigenous to the area by preventing or limiting contact with contaminated basin soil/pipelines and preventing plants and animals from bringing contaminants up toward the surface.

Because the KRSB OU meets the plug-in ROD criteria, the remedy of in situ stabilization with a low permeability soil cover system was the selected remedy for the KRSB OUs. As described in the ESD, the selected remedy consisted of the following components:

- In situ stabilization through grouting to treat PTSM soil in the basin;
- Low permeability soil cover system over the in situ stabilized soil to reduce infiltration and prevent exposure to radionuclides in the stabilized soil;
- Grouting the pipeline to prevent exposure to borrowing animals; and
- Land use controls (LUCs) to prevent disturbance of the cover system and prohibit residential or agricultural use of the area.

Remedy Implementation

Implementation of the selected remedy included the following:

- Grouted remaining portion of the pipeline from K-Reactor Disassembly Basin to the KRSB where feasible. An obstruction encountered during pipeline grouting, required approximately 12.3 m (41 ft) of process piping to be excavated. The excavated pipe was encapsulated in a grouted waste trench adjacent to the KRSB. This waste trench was encompassed within the footprint of the soil cover system. The excavated areas were backfilled to grade and re-vegetated. Approximately 1.5 m^3 (2 yd^3) of soil from the pipeline excavation was mixed with the KRSB soil prior stabilization activities.
- In situ grouted approximately 446 m^3 (583 yd^3) of PTSM in KSRB basin bottom to a depth of 0.9 m (3 ft).
- Installed a 0.08-hectare (0.20-acre) low permeability soil cover system consisting of three layers (total minimum thickness of 1.8 m [6 ft]) - grading fill, 0.6-m (2-ft) minimum thick low permeability soil and 45-cm (18-in) minimum thick layer consisting of vegetation, common fill, and topsoil. The low-permeability layer was designed to qualitatively meet the 1E-05 cm/s minimum hydraulic conductivity criteria.
- Implemented LUCs for 0.3 hectares (0.74 acres) and posted warning signs at the perimeter of the KRSB OU. LUCs also included physical access controls at the SRS boundaries (fences, guards, security patrols, etc.), site use restrictions via the SRS Site Use/Site Clearance Program, and long-term administrative controls such as deed restrictions to maintain future industrial use only (preventing residential or agricultural use).

Figures J-3 and J-4 present photographs of the KRSB OU before and during remediation and in the current condition.

System Operations/Operation and Maintenance

There are no system operational requirements.

The following maintenance activities are implemented to maintain the soil cover as long as the waste remains a threat to human health or environment:

- Site inspections for evidence of damage to the soil cover due to erosion or intrusion by burrowing animals will be performed annually as a minimum. The inspection also addresses upkeep of the vegetative cover and access control barriers (e.g., warning signs).
- Site maintenance (e.g., replacing eroded or disturbed soil, sign repair, etc.) and vegetation management (e.g., mowing, removal of larger vegetation, etc.) will be performed when required.
- Site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit).

Table J-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 1999b). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $131,060 for inspections and maintenance and access controls. The actual O&M cost for FY2012 to FY2016 is $47,778. The actual O&M costs are lower than expected because no cover repairs were necessary.

V. Progress since Last Review

The previous protectiveness statement from the last five-year review concluded that because the remedial actions at KRSB OU are protective, the site is protective of human health and the environment. This remedy is protective because receptors will not be exposed to contamination above the appropriate remedial goals. Exposure pathways that could result in unacceptable risks to receptors are controlled by the soil stabilization, the low permeability cover system, and the institutional controls. There were no recommendations or follow-up actions from the last five-year review.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU, interviewed maintenance personnel with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls, and documented the results on the Inspection Checklist provided in Attachment J-1; and
- Reviewed changes in standards and to-be-considered guidance.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified as an outcome of these interviews.

The KRSB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 21, 2016. No issues were identified for the KRSB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 identified overgrown vegetation, active ant mounds, and evidence of hog damage. These findings were documented on the field inspection checklists and resolved soon after discovery.

The KRSB plug-in decision document (WSRC 1999c) did not require groundwater monitoring as part of the selected remedy in order to meet the remedial action objectives. Groundwater is not part of the KRSB OU and will be investigated under the K-Area

Groundwater OU. The document included calculations demonstrating that the low-permeability cover would prevent impact to groundwater for at least 1,000 years. As part of the remedy implementation, the four existing wells adjacent to the basin (KRSB-1, KRSB-2, KRSB-3, and KRSB-4A) were abandoned, as documented in the KRSB Post Construction Report (PCR) / Final Remediation Report (FRR) (WSRC 2002).

The K-Area Groundwater OU will be addressed in accordance with the FFA. A core team meeting was held on April 22, 2015 to discuss current groundwater conditions at K-Area and discuss what activities should be undertaken prior to the current FFA field start of 2042. As a result of the meeting, six wells and seven surface water locations are sampled annually for known groundwater contaminants (tritium, tetrachloroethylene, trichloroethylene, and associated degradation products). The data will be reported every five years in a data summary letter. The first letter will be submitted by September 30, 2020.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The soil solidification/stabilization followed by a low permeability soil cover with institutional controls is effective in preventing human exposure and ecological receptors to contaminated media. A review of the PCR/FRR provided evidence that the PTSM associated with the KRSB soil was effectively treated to eliminate potential human exposure to PTSM. In order to prevent human exposure to PTSM, soil and portions of the process sewer line were consolidated in the basin and grouted, and a low permeability cover system was installed over the entire basin. Grouting reduces the mobility (leaching to groundwater and mobilization by burrowing animals) of the PTSM contamination. A low permeability cover system consisting of fill material to bring the basin to grade, 0.6 m (2 ft) of low permeability soil and a 45 cm (18 in) soil/vegetative cover was constructed over the entire basin.

The soil cover system was adequately sloped to reduce infiltration and prevent ponding/subsidence. The combination of the grout and constructed cover system effectively provides a barrier to human exposure to the PTSM.

- The soil solidification/stabilization and installation of a low permeability soil cover are designed to protect the groundwater from future contamination from KRSB OU by immobilizing the CM COCs (strontium-90 and carbon-14) and mitigating infiltration through the contaminated media. Results from the cores collected after grouting are reported in the PCR/FRR and show that the leachability index met the test objective for all tests.
- Review of the cover system annual inspection records indicate that the cap is being maintained and continues to prevent human and ecological exposure to contaminants.
- A review of the PCR/FRR determined that the solidification of the process sewer pipeline from the KRSB to the K-Reactor Disassembly Basin and removal of 12.3 linear m (41 linear ft) of the grouted pipeline was adequate to prevent ecological receptors from coming into contact with internal contamination. External soil contamination was found to be below the 1E-06 risk threshold; therefore, removal of this soil was not warranted. Some soil excavated to gain access to the process sewer pipeline was consolidated within the KRSB. The pipeline was cut into manageable pieces and grouted in a trench within the basin. The cover system over the basin provides an additional barrier to exposure, and annual inspection of this cover system provides verification that ecological receptors are not in contact with the contaminated process sewer line.

The Land Use Control Implementation Plan for the KRSB OU is located in Appendix A of the PCR/FRR and governs LUC implementation, maintenance, monitoring, reporting, and enforcement (WSRC 2002). All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions at the KRSB OU that would affect the protectiveness of the remedy. Because the contaminants have been stabilized and exposure to the contaminated soil has been mitigated via the placement of a low permeability cover, changes in soil standards or to-be-considered guidance would not impact the risks associated with the KRSB OU.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the KRSB OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the KRSB OU is protective of human health and the environment.

All threats associated with exposure to contaminated soil at the KRSB OU have been addressed through soil stabilization, implementation of a low permeability cover system, and LUCs. LUCs include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the KRSB OU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

Because any groundwater contamination potentially associated with the KRSB OU is comingled with contamination from other sources, the groundwater remediation is being addressed as a separate OU. The groundwater plumes associated with the K-Area source units are contained within the SRS boundaries. SRS controls are in place to prevent exposure to or ingestion of contaminated groundwater.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1994. *Phase II Remedial Investigation Work Plan for the K-Area Reactor Seepage Basin,* WSRC-RP-92-16, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1998. *Remedial Investigation Report and Baseline Risk Assessment for the K-Reactor Seepage Basin (904-65G) (U)*, WSRC-RP-96-871, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999a. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 1999b, *Plug-In Record of Decision for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil (U)*, WSRC-RP-98-4099, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999c, *Unit Specific Plug-In Decision Document for K-Area Reactor Seepage Basin Operable Unit (U)*, WSRC-RP-98-4165, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999d, *Unit-Specific Plug-In Technical Evaluation Report for the K-Area Reactor Seepage Basin Operable Unit (U)*, WSRC-RP-99-4205, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2000. *Explanation of Significant Difference (ESD) for the Plug-In ROD In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil- K-Area Reactor Seepage Basin (U)*, WSRC-RP-99-4200, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002. *Post-Construction Report (PCR) / Final Remediation Report (FRR) for the K-Area Reactor Seepage Basin (904-65G) Operable Unit (U)*, WSRC-RP-2002-4030, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist K-Area Reactor Seepage Basin (Bldg 904-65G) (U)*, ER-IDS-019-012, Inspection period 2012 through 2016 (annually)

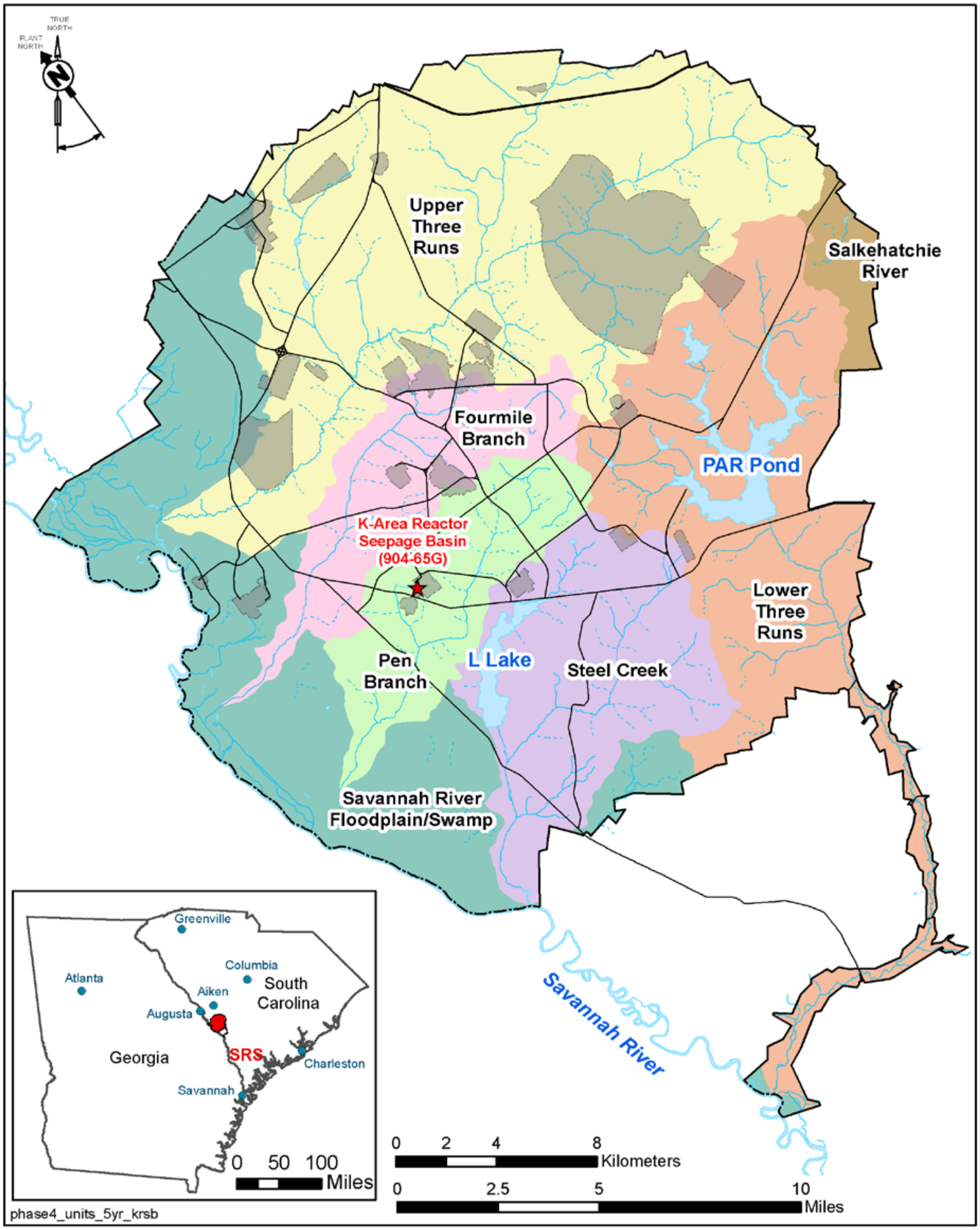


Figure J-1. Location of K-Area Reactor Seepage Basin OU at SRS

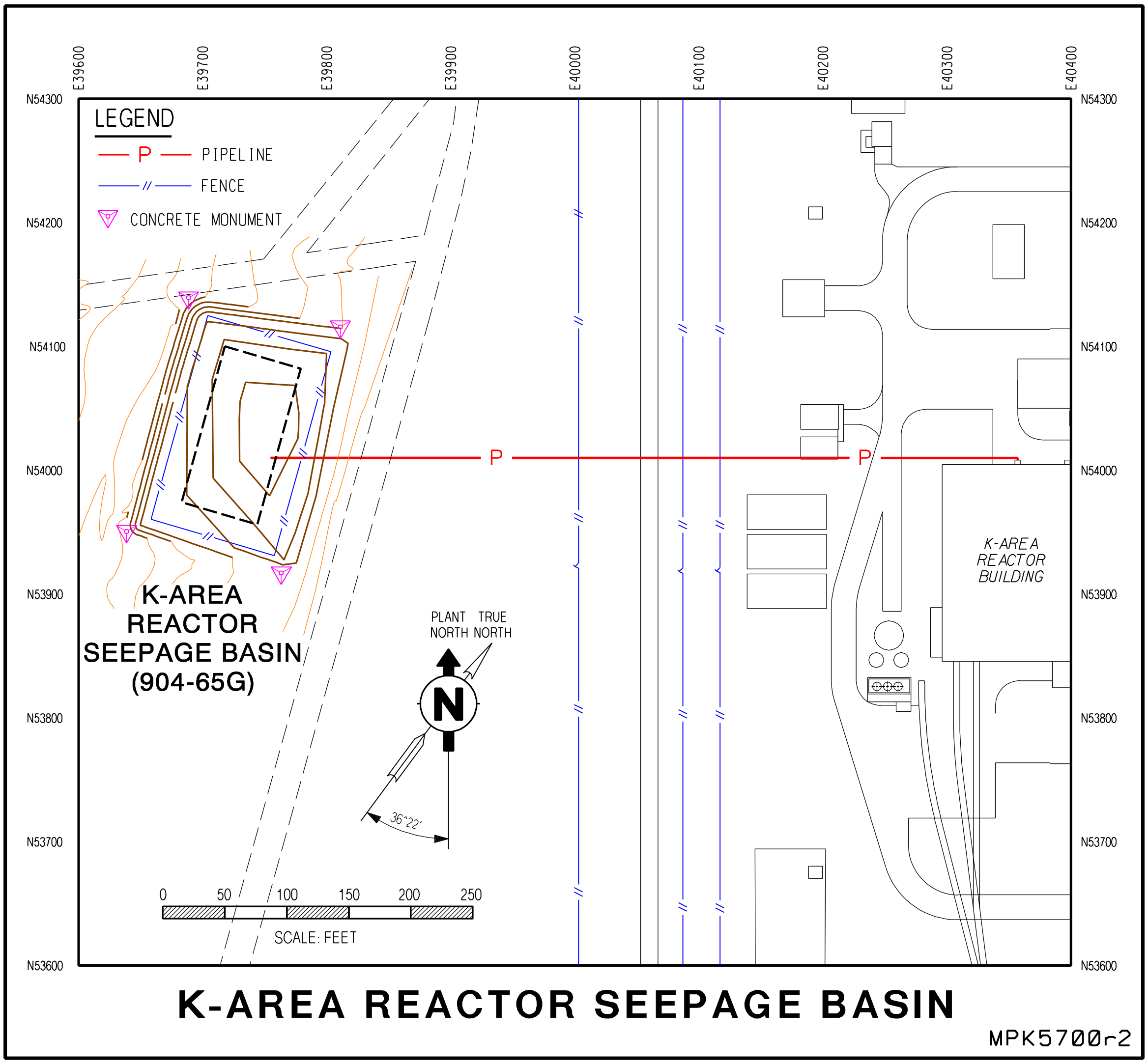


Figure J-2. Site Layout for K-Area Reactor Seepage Basin

Figure J-3. Photographs Before and During Remedial Action

Figure J-4. **Photograph After Remedial Action (2016)**

Table J-1. Chronology of OU Events

Event	Date
RI Start/Complete	July 1995 / May 27, 1998
Plug-in ROD Issuance	November 29, 1999
ESD Issuance	September 16, 2002
Remedial Action Start/Complete	September 29, 2000 / September 3, 2002
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table J-2. COCs and Remedial Goals in KRSB OU Soils

COC	Type of COC	Remedial Goals (ρCi/g)
Americium-241	HH*	6.5
Carbon-14	CM	0.31
Cesium-137	HH	0.105
Cobalt-60	HH	0.0224
Plutonium-239/240	HH	8.25
Strontium-90	HH, CM	28.5 (CM RGO)

HH	Human Health, *Industrial Worker 1.0E-06 Risk (Table 7-7 [WSRC 1998])
CM	Contaminant Migration (Table 7-2 [WSRC 1998])
RGO	Remediation Goal Option

Table J-3. Comparison of Actual vs. Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	10,774	12,138	7,151	6,299	11,415	47,778
Total ROD Estimated Direct O&M Costs*($)	26,212	26,212	26,212	26,212	26,212	131,060

*Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit

I. SITE INFORMATION

Site Name:	**K-Area Reactor Seepage Basin (904-65G) Operable Unit**	**Date of Inspection:**	**9/08/2016**
Location and Region	**SRS, USEPA Region 4**	**CERCLIS #**	**#55**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**Sunny** **77°F**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other In-Situ Stabilization via grouting and low permeability soil cover

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______________________

Contact: ____________ ____________ ____________ ____________
(Name) (Title) (Date) (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

Agency: ______________________

Contact: ____________ ____________ ____________ ____________
(Name) (Title) (Date) (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

Agency: ______________________

Contact: ____________ ____________ ____________ ____________
(Name) (Title) (Date) (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

4. **Other Interviews** *(Optional):* ☐ Report Attached ______________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for K-Reactor Seepage Basin*, ER-IDS-019-012.

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Contingency Plan/Emergency Response Plan	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Effluent Discharge	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Waste Disposal; POTW	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Other Permits	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Water (Effluent)	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State
☐ PRP In-House ☐ Contractor for PRP
☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☐ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Brian Hennessey (Name) FFA Program Manager (Title) 11/21/2016 (Date) 803-952-8365 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:____________________

B. Other Site Conditions

Remarks: Site inspections conducted from FY2012 through FY2016 identified overgrown vegetation, active ant mounds, and evidence of hog damage. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent__________ Depth__________

Remarks:____________________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths__________ Widths__________ Depths__________

Remarks:____________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________ Depth__________

Remarks:____________________

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent__________ Depth__________

Remarks:____________________

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress

Areal extent__________ Depth__________

Remarks: Vegetation is mowed routinely.

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A
Remarks:______________________________
____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident
Areal extent__________ Depth__________
Remarks:______________________________
____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent__________
☐ Ponding ☐ Location shown on site map Areal extent__________
☐ Seeps ☐ Location shown on site map Areal extent__________
☐ Soft subgrade ☐ Location shown on site map Areal extent__________
Remarks:______________________________
____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent__________
Remarks:______________________________
____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Attachment J-1. Five-Year Review Site Inspection Checklist – K-Area Reactor Seepage Basin (904-65G) Operable Unit *(continued)*

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. In situ Stabilization via Grouting ☒ Applicable ☐ N/A

In situ stabilization via grouting was performed at the KRSB OU. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU is institutional controls, contaminated soil consolidation, in situ stabilization treatment, with a low-permeability soil cover system. The remedy is fully established and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

There are no issues. O&M of the low permeability soil cover, current access controls and SRS Site Use and Site Clearance controls are effectively maintaining the long-term protectiveness of the remedy

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

L-AREA OIL AND CHEMICAL BASIN (904-83G) AND L-AREA ACID/CAUSTIC BASIN (904-79G) OPERABLE UNIT

I. Introduction

This report is the fourth five-year review for the L-Area Oil and Chemical Basin (904-83G) (LAOCB) and L-Area Acid/Caustic Basin (904-79G) (LAACB) Operable Unit (OU). The review was conducted from August 2016 through November 2016. The selected remedial action for the LAACB was No Action because soil contamination was below levels requiring remedial action. However, contaminants have been left in place at the LAOCB at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the LAOCB is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table K-1 lists the chronology of site events for the LAOCB and LAACB OU.

III. Background

The LAOCB and LAACB OU is a Resource Conservation Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media of concern is LAOCB subsurface soils.

The groundwater beneath the LAOCB and LAACB OU is addressed by the L-Area Southern Groundwater (LASG) OU.

Physical Characteristics

LAOCB and LAACB are located within the SRS, approximately 90 m (300 ft) south of the L-Area Reactor perimeter fence and 375 m (1,250 ft) north of L Lake (Figure K-1). The water table is approximately 7.5 m (25 ft) below ground surface in the area of the LAOCB. LAOCB was constructed in 1961 as an unlined seepage basin and measured approximately

54.6 m (182 ft) long by 32.4 m (108 ft) wide at the berm, with an average depth of 3.6 m (12 ft) and covering an area of 0.2 hectares (0.5 acres). The LAACB was constructed in 1954 and measured 15 m by 15 m (50 ft by 50 ft) with an average depth of 2.1 m (7 ft) and covering an area of 0.023 hectares (0.057 acres).

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the LAOCB and LAACB OU as being within an industrial area. The future land use is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

LAOCB started operations in 1961 and remained active until 1979. The basin received wastewater from L-Area Hot Shop (717-G) (LAHS) through a 15-cm (6-in) pipeline and a 5-cm (2-in) pipeline, approximately 135 m (450 ft) long. Wastewater from other areas of SRS was transported in drums and tanker trucks and was disposed of in the basin via a bermed concrete drainage pad located outside and upgradient at the north side of the basin. Liquid wastes, consisting of small volumes of slightly radioactive oil and chemical wastewater, were sent to the LAOCB from throughout SRS, but came primarily from the reactor areas. The LAHS discharged decontamination wastewater containing radionuclides, detergents, and spent degreasing solvents through the pipeline to the basin.

LAACB started operations in 1954 and remained active until 1968. This basin received wastewater from the L-Area water treatment plant facility via a pipeline (vitrified clay) and received waste from the reactor and separations areas consisting of dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion exchange units in the water purification processes in the center of the SRS.

Initial Response

No initial response actions were taken at LAOCB or LAACB prior to the remedial investigation as part of the standard CERCLA process.

Basis for Taking Action

The potential for human exposure to radiologically contaminated soils in the LAOCB OU resulting in a future industrial worker risk of greater than 1E-06 is the basis for taking action at the LAOCB. LAOCB soils, which were contaminated with radionuclides (primarily cobalt-60 and cesium-137) to a depth of less than 0.6 m (2 ft), posed the greatest risk at the OU. The vegetation within the LAOCB security fence was contaminated with radionuclides from the basin. Four monitoring wells were potentially a conduit for the migration of contaminants of concern (COCs) to the water table aquifer. Relatively high levels of radioactive contamination were detected on the internal surface of the LAOCB pipelines, but not in the soils surrounding the LAOCB pipelines. Table K-2 provides a list of the COCs for the LAOCB soil and associated pipelines.

The LASG OU, a comprehensive groundwater OU, was created because of uncertainty associated with the nature and extent of the known and suspected groundwater plumes in the vicinity of the LAOCB and LAACB OU, LAHS, and L-Area Reactor Seepage Basin. Groundwater beneath this OU is being addressed holistically as part of the LASG OU.

IV. Remedial Actions

Remedy Selection

LAACB is a No Action site because soil contamination was below levels requiring remedial action.

The following remedial action objectives (RAOs) were identified for the LAOCB OU:

- Reduce risks to human health and the environment associated with:
    - External exposure to radiological constituents;

  - Inhalation of radiological constituents;
  - Ingestion of soil or produce grown in soil with radiological constituents;
- Prevent or mitigate the leaching and migration of COCs to unit groundwater; and
- Achieve remedial goals (RGs) established for unit soils.

The selected remedial actions for LAOCB were as follows:

- In-situ stabilization and disposal of the LAOCB pipeline in the LAOCB;
- In-situ stabilization and capping the LAOCB; and
- Institutional controls (i.e., land use controls).

The selected remedial action for the LAACB, LAACB pipeline and the LAACB effluent drainage ditch soil was No Action because soil contamination was below levels requiring remedial action.

Remedy Implementation

The LAOCB soil remedial actions implemented in accordance with the Record of Decision (ROD) (WSRC 1997) are listed below:

- Removal of fencing and other physical obstructions surrounding the LAOCB area. Consolidation of 150 m^3 (200 yd^3) of contaminated debris and soils by excavating the LAOCB sidewalls, the LAOCB pipelines (the internal contamination was immobilized by grouting), and contaminated soils, vegetation and debris, and placing at the bottom of the LAOCB. Backfilling of the pipeline trenches was performed after confirmation of the absence of radiological contamination.
- A demonstration of the shearing injector soil stabilization technique and process was performed in two small areas of the LAACB. The area was backfilled with clean soil and vegetated. No remedial action was required for the LAACB; however, the selected remedial action included backfilling and grading similar to acid/caustic basins in other SRS areas. In accordance with the ROD, no post ROD documentation or reviews were required for this action.

- In situ stabilization by grouting of 1,660 m^3 (2,170 yd^3) of LAOCB basin soil and consolidated material from the surface to approximately 0.6 m (2 ft) below the basin bottom.
- Installation of a 0.18-hectare (0.45-acre) low permeability soil cover system designed with a hydraulic conductivity of 1E-05 cm/s to minimize infiltration of precipitation and serve as a barrier to shield human and ecological receptors from potential contamination from the soil. The cover system includes three layers (from bottom to top) – clean fill, a 0.6-m (2-ft) thick low permeability soil layer, and a 45-cm (18-in) topsoil/vegetation layer.
- Implementation of Land Use Controls (LUCs) for 0.54 hectares (1.32 acres) by installing warning signs, keeping site access/site use controls in place while the property is owned and operated by USDOE, and if the property is ever passed to nonfederal ownership, deed notifications would be provided.
- Abandonment of four existing monitoring wells and clearing of vegetation, fencing, and other physical obstructions within the immediate vicinity of the LAOCB.

Figures K-2 and K-3 present photographs of the LAOCB OU before remediation and in the current condition.

System Operations/Operation and Maintenance

There are no system operational requirements.

The LAOCB OU maintenance activities that have been implemented in accordance with the ROD are as follows:

- Site inspections and site maintenance (verify warning signs are intact, adequate vegetative cover exist, erosion controls are in place and drainage systems are functioning properly); and
- Site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit) have been implemented.

Table K-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 1997). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $149,900 for inspections, maintenance, and access controls. The actual O&M cost for FY2012 to FY2016 is $52,501. The actual costs are less than the estimated costs because the estimated cost for five-year remedy reviews were significantly overestimated in the ROD.

V. Progress since Last Review

The previous protectiveness statement concluded that the implementation of in-situ stabilization, low permeability cover system, pipeline grouting, and institutional controls (i.e., LUCs) is protective of human health and the environment for potential exposures to the soil.

In the fourth five-year remedy review, SRS recommended that the cover inspection frequency for the LAOCB be reduced to annual (SRNS 2014). This reduction would provide adequate monitoring and consistency since the majority of OU covers at SRS are currently inspected annually. On February 6, 2014, the USDOE submitted a letter (USDOE 2014) to USEPA and SCDHEC to reduce inspection frequencies from semiannual to annual for LAOCB. USEPA and SCDHEC approved the request on March 20, 2014 and March 7, 2014, respectively. Annual inspections for LAOCB began in 2015.

VI. Five-Year Review Process

The following tasks were performed as part of the five-year review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed implementation of the remedial action;
- Inspected the OU and interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment K-1 with the purpose of assessing the protectiveness of the remedy and functionality of the access controls; and

- Reviewed changes in standards and to-be-considered guidance.

Data Review

Two groundwater monitoring wells, LCO 2DL (upgradient of LAOCB) and LCO 6DL (downgradient of LAOCB) (Figure K-4), were sampled and analyzed in the third quarter of 2016 for the following constituents detected in LAOCB soils: carbon-14, cobalt-60, strontium-90, tritium, non-volatile beta, and gross-alpha. The sampling was initiated based on the recommendations and follow-up actions for the LASG OU during the fourth five-year remedy review. All results for both wells were either non-detect or below U.S. Environmental Protection Agency (USEPA) preliminary remediation goals (PRGs)/ maximum contaminant levels (MCLs), and are consistent with historical levels. The 2016 results are listed in Table K-4. These results indicate that the well abandonment and soil stabilization in LAOCB are preventing the migration and leaching of COCs to the groundwater.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M Staff Member, on September 20, 2016 at the O&M organization offices. No issues were identified during this interview.

The LAOCB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 21, 2016. No issues were identified for the LAOCB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No problems regarding the remedy of this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 active ant mounds, missing OU signs, and hog damage. These findings were documented on the field inspections checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The selected remedy of In-Situ Stabilization and Capping of the LAOCB soil and In-Situ Stabilization and Disposal of the LAOCB pipeline are effective in preventing exposure of human and ecological receptors to radiological constituents in the soil. Annual inspection and maintenance data do not indicate a history of remedy problems or potential remedy failure, which could place protectiveness at risk. Review of the site inspection reports from FY2012 through FY2016 identified active ant mounds, missing OU signs, and evidence of hog damage. These findings were resolved soon after discovery.
- Consolidation of contaminated soil in the in situ grouted mass under a cover system is effective in eliminating the inhalation, ingestion, and direct exposure pathways associated with the LAOCB soils. Leachability and unconfined compressive strength (UCS) tests were performed on the stabilized material during the remedial action. The results as reported in the Post Construction Report (PCR) / Final Remediation Report (FRR) for the LAOCB, met the acceptance criteria (UCS $\geq$ 50 psi and leachability index $\geq$ 6.0) (WSRC 2001). As reported in the PCR, the low-permeability soil cover test results met the acceptance criteria for hydraulic conductivity (< 1.0E-05 cm/s).
- The selected remedy of In-Situ Stabilization and Capping of the LAOCB soil and In-Situ Stabilization and Disposal of the LAOCB pipeline are effective in preventing the leaching and migration of COCs to the groundwater. Stabilization of the contaminated soil and the presence of a positive drainage soil cover over the stabilized soil reduce infiltration within the area of LAOCB and mitigate the potential for contaminants to migrate to the groundwater. Monitoring wells that were suspected of providing a conduit for contaminant transfer to the groundwater were appropriately abandoned during the remedial action.

- Monitoring the effectiveness of the soil stabilization and soil cover over LAOCB with respect to groundwater concentrations is being addressed in the LASG OU Monitored Natural Attenuation remedial action. The technical evaluation of the groundwater data indicates that the well abandonment and soil stabilization in LAOCB are preventing the migration and leaching of COCs to the groundwater (SRNS 2010, SRNS 2012).

The Land Use Control Implementation Plan for LAOCB OU is located in Appendix A of the PCR/FRR and governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (WSRC 2001). All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. There have been no changes in physical conditions at the LAOCB OU that would affect the protectiveness of the remedy. Because the contaminants have been stabilized and exposure to the contaminated soil has been mitigated via the placement of a low permeability cover, exposure pathways have been eliminated and the selected remedy continues to be protective. Based on this assessment and review of exposure assumptions, the RAOs used at the time of remedy selection are still valid.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the LAOCB OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for the LAOCB OU.

X. Protectiveness Statement(s)

The remedy at the LAOCB OU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by stabilization and capping of contaminated soil, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the OU for industrial use only (SRS is a secured government facility with land use restrictions), and warning signs and land use restrictions via the SRS Site Use/Site Clearance Program.

Groundwater contamination associated with the LAOCB is co-mingled with contamination from other sources; therefore, the groundwater remediation is being addressed by the LASG OU and controls are in place to prevent exposure to or ingestion of contaminated groundwater.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS

OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2010. *Biennial Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the L-Area Southern Groundwater (LASG) Operable Unit (OU)(U), 2008 through 2009*, SRNS-RP-2010-00989, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2012. *Biennial Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the L-Area Southern Groundwater (LASG) Operable Unit (OU)(U), 2010 through 2011*, SRNS-RP-2012-00169, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina*, SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2014. Letter, B. T. Hennessey (DOE) to S. B. Fulmer (SCDHEC) and R. H. Pope (EPA), *Request to Change the Inspection Frequency for Operable Units Based on the Recommendation in the Fourth Five-Year Remedy Review Report for the Savannah River Site (SRNS-RP-2012-00011, Revision 1.1, November 2013)*, CERCLIS Numbers: 13, 14, 16, 17, 20, 23, 26, 32, 39, and 66, ACP-14-125, dated February 6, 2014, Department of Energy, Savannah River Operations Office, Aiken, SC

WSRC, 1997. *Record of Decision Remedial Alternative Selection for the L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) (U)*, WSRC-RP-97-

143, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site,* WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 2001. *Post-Construction Report (PCR)/Final Remediation Report (FRR) for the L-Area Oil and Chemical Basin Operable Unit (Bldg. 904-83G) (U),* WSRC-RP-2001-4078, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist L-Area Oil Chemical Basin (904-83G), (U),* ER-IDS-019-007, Inspection period 2012 through 2016 (semiannually through 2014/ annually thereafter)

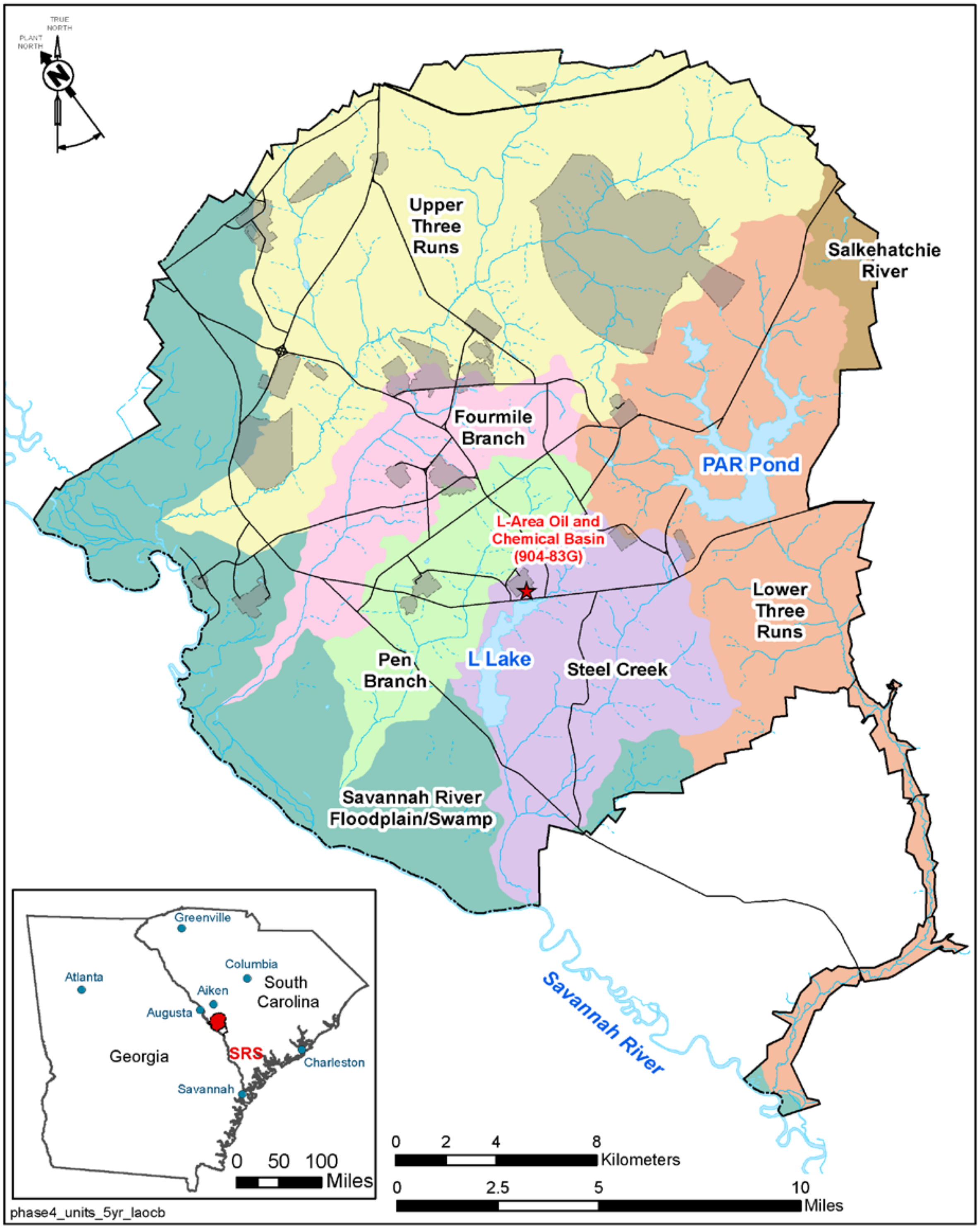


Figure K-1. Location of the L-Area Oil and Chemical Basin OU at SRS

Figure K-2. Photographs of the LAOCB OU Prior to and During Remediation

Figure K-3. Photograph of the Remediated LAOCB OU (2016)

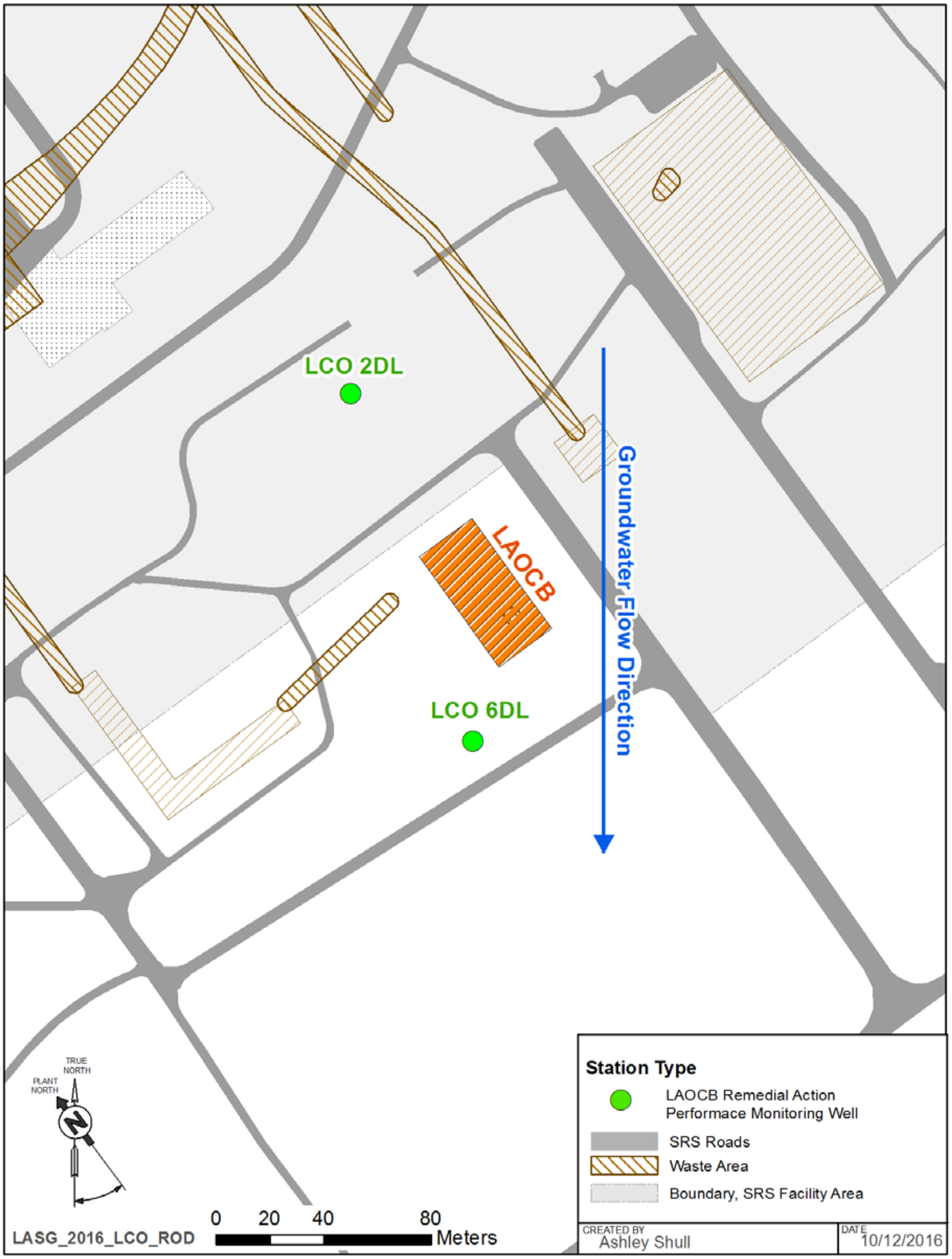


Figure K-4. Locations of the LAOCB Monitoring Wells

Table K-1. Chronology of OU Events

Event	Date
RCRA Facility Investigation/Remedial Investigation Field Start/Complete	1993 / February 1996
ROD Issuance	November 10, 1998
Remedial Action Start/Complete	August 31, 1998 / May 7, 2001
Previous Five-Year Reviews Issuance	February 12, 2004 / January 29, 2009 / February 4, 2014

Table K-2. COCs and RGs for LAOCB Future On-Unit Worker

Subunit	Medium	HH COC*	RG	Unit
LAOCB Soils	Soil	Americium-241	1.20E+01	ρCi/g
		Antimony-125	5.30E-01	ρCi/g
		Cesium-137	3.20E-01	ρCi/g
		Cobalt-60	7.50E-02	ρCi/g
		Curium-244	2.00E+01	ρCi/g
		Europium-152	1.80E-01	ρCi/g
		Europium-154	1.60E-01	ρCi/g
		Plutonium-238	1.50E+01	ρCi/g
		Plutonium-239	1.40E+01	ρCi/g
		Potassium-40	1.20E+00	ρCi/g
		Strontium-90	9.00E+01	ρCi/g
		Uranium-234	2.00E+02	ρCi/g
		Uranium-235	2.60E+00	ρCi/g
		Uranium-238	1.20E+01	ρCi/g
		Chromium	3.50E+02	mg/kg
		Lead	4.00E+02	mg/kg

*	RGs to achieve 1E-06 Risk and HI = 1 for future on-unit worker
HH COC	Human health constituent of concern
HI	Hazard index
RG	Remedial Goal

Table K-3. Comparison of Actual vs. Estimated O&M

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	11,156	12,360	8,408	7,612	12,965	52,501
Total ROD Estimated Direct O&M Costs *($)	109,980	9,980	9,980	9,980	9,980	149,900

* Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Table K-4. LAOCB OU Groundwater Sampling Results – August 2016

	Carbon-14 (ρCi/L)	Cobalt-60 (ρCi/L)	Gross Alpha (ρCi/L)	Nonvolatile Beta (ρCi/L)	Potassium-40 (ρCi/L)	Strontium-90 (ρCi/L)	Tritium (ρCi/mL)
MCL/PRG	***2,000***	***2.6***	***15***	***50***	***0.83***	***8***	***20***
LCO 2DL	ND	ND	ND	4.84 (J)	ND	ND	0.718 (J)
LCO 6DL	352	ND	2.81 (J)	ND	ND	ND	1.5

ND – Non-Detect
J – Estimated Value

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit

SITE INFORMATION

Site Name:	**L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit**	**Date of Inspection:**	**8/31/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #17**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**79°F** **Partly Cloudy**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Consolidation, In-situ Stabilization

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

I. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. Local Regulatory Authorities and Response Agencies (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

4. Other Interviews *(Optional):* ☐ Report Attached ____________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. O&M Documents:

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for L-Area Oil and Chemical Basin (U)*, ER-IDS-019-007

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☒ N/A

Remarks: Water elevation records only.

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House

☐ PRP In-House

☒ Other: SRS

☐ Contractor for State

☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place

☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A

Remarks: Signs are in good condition.

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Brian Hennessey (Name) FFA Program Manager (Title) 11/21/2016 (Date) 803-952-8365 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Survey monuments were located and in good condition.

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☐ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:

B. Other Site Conditions

Remarks: For inspections performed at the LAOCB from FY2012 through FY2016 (semiannually through 2014; annually thereafter), the following issues were identified: active ant mounds, missing waste unit signs, and hog damage. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent________ Depth________
Remarks:

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths________ Widths________ Depths________
Remarks:

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent________ Depth________
Remarks:

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent________ Depth________
Remarks:

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☒ No signs of stress
Areal extent________ Depth________
Remarks: Vegetation mowed routinely.

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent________________ Depth________________

Remarks:____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent________________

☐ Ponding ☐ Location shown on site map Areal extent________________

☐ Seeps ☐ Location shown on site map Areal extent________________

☐ Soft subgrade ☐ Location shown on site map Areal extent________________

Remarks:____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent________________

Remarks:____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident
Areal extent__________________ Depth_____________________
Remarks:____

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent__________________ Type_____________________
Remarks:____

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________________ Depth_____________________
Remarks:____

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks:____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☒ N/A

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☐ Applicable ☒ N/A

D. Monitoring Data ☒ Applicable ☐ N/A

Monitoring Data:
☒ Is routinely submitted on time ☒ Is of acceptable quality

Monitoring Data:
☐ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining
Remarks: Monitoring data evaluates the effectiveness of the cover system

E. Monitored Natural Attenuation ☐Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Consolidation, In situ Stabilization ☒ Applicable ☐ N/A
Consolidation and in situ stabilization were performed at LAOCB. The remedy is performing as designed.

Attachment K-1. Five-Year Review Site Inspection Checklist – L-Area Oil and Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G) Operable Unit *(continued)*

OVERALL OBSERVATIONS

Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU is consolidation of contaminated soil and debris and disposal of the LAOCB pipeline in the LAOCB, in-situ stabilization with low permeability cover for the LAOCB and institutional controls. The remedy is functioning as designed.

Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of site inspections and site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the integrity of the surface soils, the condition of the grass and vegetative cover and warning signs is good. There are no issues requiring corrective actions.

Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

L-AREA REACTOR SEEPAGE BASIN (904-64G) OPERABLE UNIT AND C- AREA REACTOR SEEPAGE BASIN (904-67G)

I. Introduction

This report is the third five-year review for the L-Area Reactor Seepage Basin (904-64G) (LRSB) Operable Unit (OU) and C-Area Reactor Seepage Basin (904-67G) (CRSB) Basin 2. The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the LRSB and CRSB Basin 2 at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the LRSB and CRSB Basin 2 is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table L-1 lists the chronology of site events for LRSB and CRSB OUs.

III. Background

LRSB and CRSB OUs are Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) units in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media associated with the LRSB and CRSB Basin 2 is soil.

The scope of the CRSB OU originally included all three CRSBs (904-66G, 904-67G, and 904-68G). However, documentation for remedial action at CRSB Basin 2 (904-67G) was combined with LRSB (904-64G) via a Plug-In ROD Amendment (WSRC 2002b) since both basins were closed similarly without the need for soil stabilization. The remedy review for CRSB Basin 1 (904-66G) and Basin 3 (904-68G) are discussed in Appendix D.

Physical Characteristics

The LRSB and the CRSB Basin 2 are located in the central portion of SRS, southeast of the L-Reactor facility and west of the C-Reactor facility, respectively (Figure L-1). The LRSB includes the basin, concrete pad, buffer area, perimeter, and process sewer line. The LRSB is an L-shaped unlined earthen basin with dimensions of 60 m (200 ft) on each outer side of the L-shape, 10.8 m (36 ft) in width and 2.1 m (7 ft) in depth (Figure L-2). The basin was not backfilled to grade prior to the remedial action. A process sewer line that is approximately 135 m (450 ft) long extends from the L-Reactor disassembly basin to the discharge point at the north end of the basin.

The CRSB Basin 2 is an unlined (earthen) basin constructed in 1957. The basin is in an open fenced area with sparse vegetative cover. Basin 2 was constructed with an approximate outside dimension of 90 x 18 m (300 x 60 ft) and a depth of 3.3 m (11 ft) below ground surface. The ground slopes southwestward toward an unnamed tributary of Fourmile Branch approximately 180 m (600 ft) to the west. The unlined earthen basin was designed to hold contaminated wastewater that was not appropriate for discharge to local streams due to elevated radiological activity. Prior to remediation, the basin was open and had not been backfilled to grade.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999a) designates the LRSB and CRSBs OUs as being within an industrial area. The LRSB lies within the land use control (LUC) boundary of the L-Area Southern Groundwater Operable Unit, which is also designated as an industrial area. The future land use is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

In 1958, the process sewer line began conveying low-level radioactive purge water from the L-Reactor Disassembly Basin to the LRSB. The LRSB received purge water from

1958 to 1968 and from 1985 to 1988. The L-Reactor was not in operation from 1969 to 1984 and no purge water was generated. However, from 1985 to 1988, mixed-bed deionizers and sand filters intercepted the purge water before it was discharged into the LRSB. In 1988, L-Reactor was placed on warm standby; in 1993, it was placed in shutdown status and has not been restarted.

The CRSB Basin 2 was used from 1959 to 1970 to dispose of low-level radioactive process purge water from the reactor disassembly basin. In 1963, disassembly basin wastewater was deionized and filtered prior to discharge, which reduced radioactivity and removed solids and sludges. The seepage basin was not used from 1971 to 1977 while purge water was mixed with large volumes of heat exchanger cooling water and discharged to area streams. After improvements for processing disassembly basin water, purge water discharges to the seepage basins resumed in 1978. The C-Reactor was shut down for repairs in 1985, placed on cold standby in 1987, followed by shutdown. The CRSB Basin 2 has not received wastewater since 1987.

Initial Response

At CRSB Basin 2, a time-critical removal action was performed in 1997 in accordance with Section 300.415 of the National Oil and Hazardous Substances Pollution Contingency Plan and FFA Section XIV to remove and dispose of contaminated vegetation from the unit. Due to the plant uptake of radiological constituents, vegetation became radiologically contaminated. As the vegetation died, the potential for contamination spreading due to wind and bioturbation increased, which warranted the time-critical removal action. No early actions were performed at LRSB.

Basis for Taking Action

The basis for taking action at the LRSB OU and the CRSB Basin 2 is that these waste units were determined to meet the criteria for the Plug-In ROD as demonstrated in the Technical Evaluation Reports (TERs) (WSRC 2000b, WSRC2001c). Risk levels exceed 1E-03 for an industrial worker scenario based on exposure to cesium-137 in the CRSB soils and cobalt-60 in LRSB soils. Additionally, strontium-90 was identified as a concern with respect to migration to groundwater at the LRSB OU.

The LRSB has been contaminated with radionuclides from past activities at SRS. Radiological risk assessments for humans are more conservative than ecological health risk assessments. Therefore, only human health risk evaluations were considered. The cumulative radiological risk to the industrial worker from the LRSB is 3E-03, which exceeds the principal threat source material (PTSM) target threshold of 1E-03. The primary risk driver is cobalt-60. PTSM is present to a depth of 0.3 m (1 ft) in LRSB. As stated in the TER (WSRC 2001c), the radiological activity of cobalt-60 will decline below the PTSM threshold by 2006.

The results of the contaminant migration (CM) analysis for the LRSB found that strontium-90, present in both the buffer area and in the basin, poses a potential threat to future groundwater.

CRSB Basin 2 PTSM is a result of cesium-137 contamination (Figure L-3). The PTSM threshold was exceeded in the soil samples at 0.3 to 1.2 m (0 to 4 ft) below the basin bottom. A TER of radiological activities indicates that the cesium-137 will be below the PTSM threshold by 2002 (WSRC 2001a).

IV. Remedial Actions

Remedy Selection

The plug-in Record of Decision (ROD) process was designed to present a common remedy for high-risk radioactively contaminated OUs at SRS with similarities in history of use, contaminants, risk, and location within current industrial areas. For radiologically contaminated soil that represents PTSM, in situ stabilization was selected as the common remedy for open reactor seepage basin candidates in the *Plug-in Record of Decision for In Situ Stabilization with a Low Permeability Soil Cover for Radiological Contaminants in Soil* (WSRC 1999b) approved in October 1999. The process streamlined the normal CERCLA documentation process for units that were similar and met the criteria defined in the plug-in ROD. In lieu of Proposed Plan and ROD documents, an Explanation of Significant Difference (ESD) (WSRC 2000a) was submitted and was approved in August 2000. The approved ESD is the document that amends the approved plug-in ROD to include the LRSB OU and CRSB OU. TERs (WSRC 2001a, WSRC 2001c) were prepared and verified that LRSB and CRSB Basin 2 met the plug-in ROD criteria.

After the original Plug-In ROD was signed, it was recognized that contaminants would be reduced to below PTSM levels by the year 2006 for LRSB and 2002 for CRSB Basin 2 from radioactive decay. The USDOE, the U.S. Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) agreed that a low permeability soil cover with LUCs would effectively protect human health and the environment and in situ stabilization as prescribed in the Plug-in ROD would not be necessary. An amendment to the Plug-in ROD (WSRC 2002b) for LRSB and CRSB Basin 2 to alter the remedy was approved in October 2002.

As stated in the Plug-in ROD (WSRC 1999b), the following remedial action objectives (RAOs) were established for the LRSB and CRSB Basin 2:

- Prevent human exposure to contaminated basin soils (PTSM) by installing a low permeability soil cover. For soils present at PTSM levels, the remedy will also include implementing stabilization treatment to the extent practicable. Reduce risks to the future worker from surface soils (0.3 to 1.2 m [0 to 1 ft]) outside the basin by establishing remedial goals (RGs) for contaminants of concern (COCs) at concentrations equivalent to 1E-06 for carcinogens and a hazard quotient of 1 for noncarcinogens or background (where background levels of COCs exceed 1E-06).
- Prevent the release of COCs in soil to groundwater beneath the unit above maximum contaminant levels (MCLs) or risk-based concentrations (RBCs) (when MCLs are not available). The soil RGs are back-calculated based on these values.
- Protect the ecological receptors indigenous to the area by preventing or limiting contact with contaminated basin soil/pipelines and preventing plants and animals from bringing contaminants up towards the surface.

The original selected remedy in the plug-in ROD consisted of institutional controls, in situ stabilization of PTSM, a low-permeability soil cover system, consolidation of contaminated soil, and grouting of pipelines. Table L-2 includes a discussion of the primary risk-drivers for LRSB and CRSB Basin 2, demonstrating that the risk levels will be less than the PTSM threshold by 2006 and 2002, respectively. As a result, an amendment to the plug-in remedy was prepared that did not require in-situ stabilization for the basin soils.

Per the Plug-in ROD as amended (WSRC 2002b), the selected remedial actions for LRSB and CRSB Basin 2 consisted of the following components:

- Consolidation of contaminated soil and pipelines into the basins;
- Installation of a low permeability soil cover designed to reduce water infiltration and to prevent human exposure to PTSM and prevent the release of COCs in the soil to groundwater beneath the unit above MCLs; and
- LUCs including an OU-specific perimeter fence around the basins for the time period that the contaminated soil is considered PTSM and warning signs.

Periodic groundwater monitoring to confirm the soil cover effectiveness for the LRSB is addressed as part of the L-Area Southern Groundwater OU.

Remedy Implementation

Implementation of the selected remedy at the LRSB OU included the following activities:

- Consolidated approximately 47.1 m (157 ft) of a 15-cm (6-in) process pipe by grouting along with a 3.75-cm (1.5-in) domestic water line into the LRSB. A 7.5-cm (3-in) high-density polyethylene pipe was grouted and left in place. The excavated areas were backfilled to grade and re-vegetated.
- Consolidated concrete pad, associated piping and handrails, contaminated chipped vegetation in LRSB. Consolidation of the soil outside the basins was not performed because the soil did not exceed PTSM criteria, leachability RGs or surficial exposure RGs.

- Installed a 0.7-hectares (1.73-acres), 1.8-m (6-ft) minimum thick low permeability soil cover system over the LRSB consisting of three layers - grading fill, 0.6-m (2-ft) minimum thick low permeability soil and 45-cm (18-in) minimum thick vegetative common fill and topsoil. The low permeability layer was designed to qualitatively meet the 1E-05 cm/s minimum hydraulic conductivity criteria. Figure L-4 shows the before, during, and after construction of the soil cover system at the LRSB.
- Established LUCs for 0.7-hectares (1.73 acres).

Implementation of the selected remedy at the CRSB OU included the following activities:

- Consolidation of contaminated soil outside the basins exceeding PTSM criteria, leachability RGs, or surficial exposure RGs. In accordance with the Unit-Specific Plug-In TER (WSRC 2000b), this action was not performed because the contaminated soil outside the basins did not exceed PTSM criteria, leachability RGs or surficial exposure RGs.
- In situ stabilization by grouting was used to address long-term PTSM soil that posed a risk in excess of 1E-03 for future industrial workers.
- Installation of a 1.8-m (6-ft) minimum thick low permeability soil cover system over the basin to reduce water infiltration and to provide shielding to potential receptors on the surface (WSRC 2003). Although no CM COCs were identified that could impact groundwater in the future (1000 years), the soil cover system was designed with a 0.6-m (2-ft) minimum thick low permeability soil layer. Figure L-5 shows the before, during, and after construction of the soil cover system at the CRSB.
- Grouting of process piping to stabilize any potential contamination left inside and to prevent access by small animals.
- Establishment of institutional controls (i.e., LUCs).

Figure L-6 presents current photographs of the LRSB OU and CRSB Basin 2.

System Operations/Operation and Maintenance

There are no system operation requirements for LRSB or CRSB Basin 2.

The following maintenance activities are ongoing as long as the waste remains a threat to human health or environment:

- Visual inspections for evidence of damage to the soil cover due to erosion or intrusion by burrowing animals are being performed annually as a minimum. The inspections also address upkeep of the vegetative cover and access control barriers (e.g., OU-specific warning signs and perimeter fence).
- Necessary repairs (e.g., replacing eroded or disturbed soil, sign repair, etc.) and vegetation management (e.g., mowing, removal of larger vegetation, etc.) are being performed when required.
- LUCs including OU-specific perimeter fencing and warning signs are being enforced to preclude access through the SRS Site ~~/~~Use~~–~~/Site Clearance program and SRS site security.

Table L-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 2002b) for the LRSB OU. The costs for CRSB Basin 2 are evaluated with the costs for the CRSB OU in Appendix D. The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $117,250 for inspections, maintenance, and LUCs. The actual O&M cost for FY2012 to FY2016 is $59,133. The actual O&M costs are less than expected because no cover repairs were necessary and inspections are performed annually instead of monthly as originally estimated.

V. Progress since Last Review

The previous protectiveness statement from the last five-year review concluded that because the remedial actions at LRSB and CRSB Basin 2 are protective, the site is protective of human health and the environment. The PTSM in LRSB and CRSB Basin 2 has radioactively decayed to levels that no longer pose a 1E-03 risk to future industrial workers. In accordance with the Remedial Action Implementation Plan for the LRSB (WSRC 2002a), risk to the future industrial workers will remain above 1E-06 beyond the year 2033. Strontium-90 was identified as a CM COC at LRSB; therefore, remedial actions intended to prevent the release of strontium-90 to the groundwater above MCLs is still applicable.

There were no recommendations or follow-up actions from the last five-year review.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Confirmed remedial action start;
- Inspected the OUs, interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment L-1 with the purpose of assessing the protectiveness of the remedy and functionality of the controls;
- Reviewed groundwater monitoring data associated with the LRSB; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Groundwater monitoring well LSB-4 is sampled once every five years for strontium-90 to assess the effectiveness of the LRSB cover system in preventing contaminants from migrating to the groundwater above MCLs. LSB-4 was sampled and analyzed for strontium-90 in the third quarter of 2016. The strontium-90 result was below the detection limit. The absence of strontium-90 in LSB-4 indicates that the installation of a low permeability cover over the LRSB is preventing release of COCs in the soil to groundwater beneath the unit above MCLs. There were no CM COCs associated with the CRSB OU.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified as an outcome of these interviews.

The LRSB was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 21, 2016. The CRSBs were inspected by SRNS and USDOE personnel on November 4, 2016. Discussions pertaining to the CRSBs inspections are included in Appendix D. No issues were identified for the LRSB during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding the remedy of these OUs were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 identified active ant mounds, overgrown vegetation, and broken barbed-wire fencing for CRSB OU. Scheduled annual site inspections conducted from FY2012 through FY2016 identified active ant mounds, a broken support post, and overgrown vegetation for LRSB. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended as demonstrated below:

- The low permeability soil covers with LUCs is effective in preventing human exposure and ecological receptors to contaminated media. LRSB and CRSB Basin 2 were initially identified to have PTSM based on the concentrations of cobalt-60 and cesium-137, respectively. The risk from PTSM was expected to be reduced over time due to radioactive decay to below 1E-03 by the year 2006 for LRSB and 2002 for CRSB Basin 2. The low permeability soil covers with institutional controls (i.e., LUCs) are still effective in preventing human exposure that could result in risk of 1E-06 to a future industrial worker. A review of the inspection records for CRSB and LRSB indicate that the soil covers are in good condition with no evidence of erosion or subsidence. Active ant mounds are frequently observed and are treated upon discovery.

- The low permeability soil cover is effective in preventing the release of COCs in the soil to groundwater beneath the unit above MCLs or RBCs. A review of the Post Construction Report (PCR) / Final Remediation Report (FRR) for LRSB (WSRC 2004) provided evidence that the cover system met the low permeability performance requirements as follows: (1) minimum soil cover thickness is 1.8 m (6 ft) including a 0.6-m (2-ft) thick low permeability soil layer; (2) an 45 cm (18 inch) vegetative layer; and (3) a minimum slope of 3% to reduce infiltration.
- There were no CM COCs associated with the CRSB OU; therefore, periodic groundwater monitoring for the effectiveness of the soil cover as part of the C-Area Groundwater OU is not required.
- Groundwater monitoring data with respect to the performance of the cover system for the LRSB OU is collected as part of the L-Area Southern Groundwater OU monitoring program. The CM COC, strontium-90, remains non-detect in monitoring well LSB 4 during the third quarter 2016 sampling, demonstrating the effectiveness of the cover system in preventing migration of contaminants to the groundwater.

The Land Use Control Implementation Plan (LUCIP) for LRSB OU is located in Appendix A of the PCR/FRR for the LRSB OU (WSRC 2004), and the LUCIP for the CRSB Basin 2 is located in Appendix A of the PCR/FRR for the CRSB OU (WSRC 2003). Both LUCIPs govern LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs. All LUC objectives are being met.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions at the LRSB OU or CRSB Basin 2 that call into question the protectiveness of the remedy.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the LRSB OU and CRSB Basin 2 were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the LRSB and CRSB Basin 2 is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated media. All threats associated with exposure to contaminated soil have been addressed with the placement of a low permeability cover system, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the LRSB and CRSB Basin 2 for industrial use only, OU-specific perimeter fencing and warning signs, and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999a. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 1999b. *Plug-In Record of Decision for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil (U),* WSRC-RP-98-4099, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2000a. *Explanation of Significant Difference (ESD) for the Plug-In ROD for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil – C-Area Reactor Seepage Basin (U)*, WSRC-RP-2000-4032, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2000b. *Unit-Specific Plug-In Technical Evaluation Report for the C-Reactor Seepage Basins (904-66G, 904-67G, and 904-68G) Operable Unit (U),* WSRC-RP-2000-4008, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC 2001a. *Addendum for the Unit Specific Plug-In Technical Evaluation Report for the C-Reactor Seepage Basin (904-67G) Operable Unit (U),* WSRC-RP-2001-4224, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2001b. *Remedial Action Implementation Plan (RAIP) for the C-Area Reactor Seepage Basin (U),* WSRC-RP-99-4213, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2001c. *Unit Specific Plug-In Technical Evaluation Report for the L-Reactor Seepage Basin (904-64G) Operable Unit (U),* WSRC-RP-2000-4130, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002a. *Remedial Action Implementation Plain (RAIP) for the L-Area Reactor Seepage Basin (LRSB) (904-64G) (U),* WSRC-RP-2002-4117, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2002b. *Unit-Specific Plug-In Record of Decision Amendment for the C-Area Reactor Seepage Basin (904-67G) and L-Area Reactor Seepage Basin (904-64G) (U),* WSRC-RP-2002-4063, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003. *Post-Construction Report (PCR)/Final Remediation Report (FRR) for the C-Area Reactor Seepage Basin (904-66G, -67G, and -68G) Operable Unit (U),* WSRC-RP-2002-4149, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004. *Post Construction Report (PCR)/Final Remediation Report (FRR) for the L-Area Reactor Seepage Basin (LRSB) (904-64G),* WSRC-RP-2003-4118, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist for C-Reactor Seepage Basin (904-66G, 904-67G, 904-68G) (U)*, ER-IDS-019-013, Inspection Period 2007 through 2011 (annually)

Various - Inspection Data Sheets – Field Inspection Checklist for L-Reactor Seepage Basin (904-64G) (U), ER-IDS-019-025, Inspection Period 2012 through 2016 (annually)

This page is intentionally left blank.

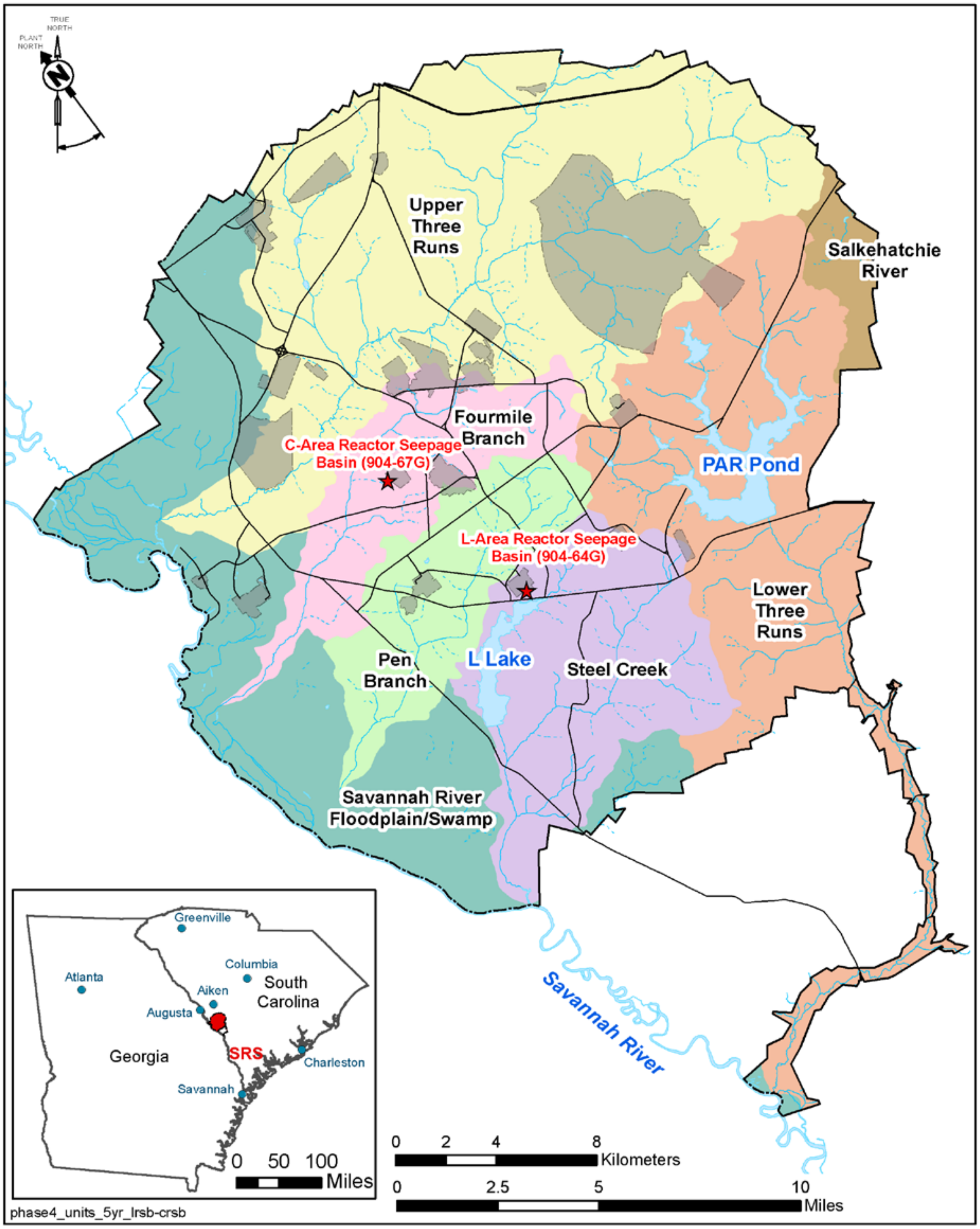


Figure L-1. Location of C & L Reactor Seepage Basins OUs at SRS

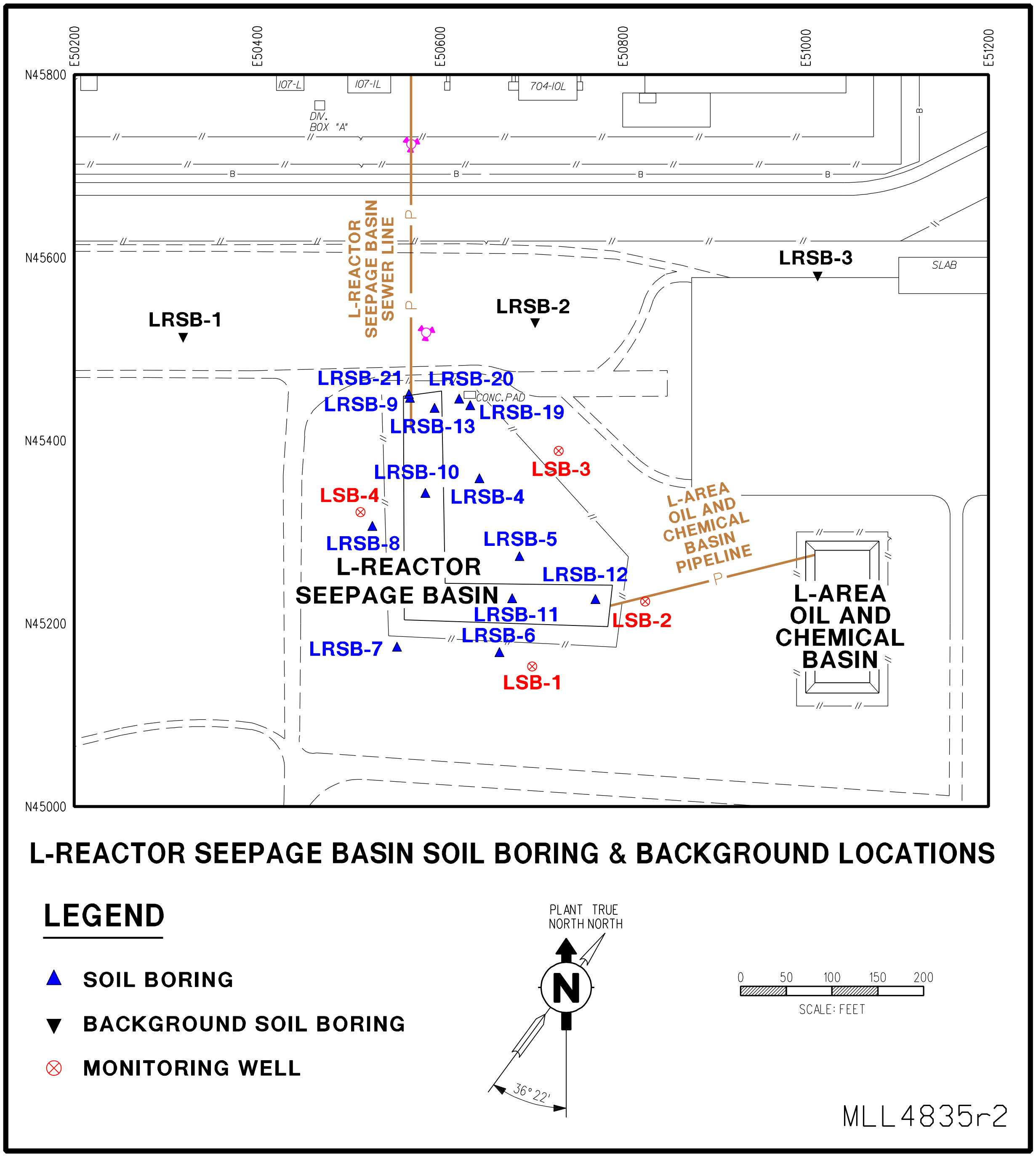


Figure L-2. Layout of the LRSB OU

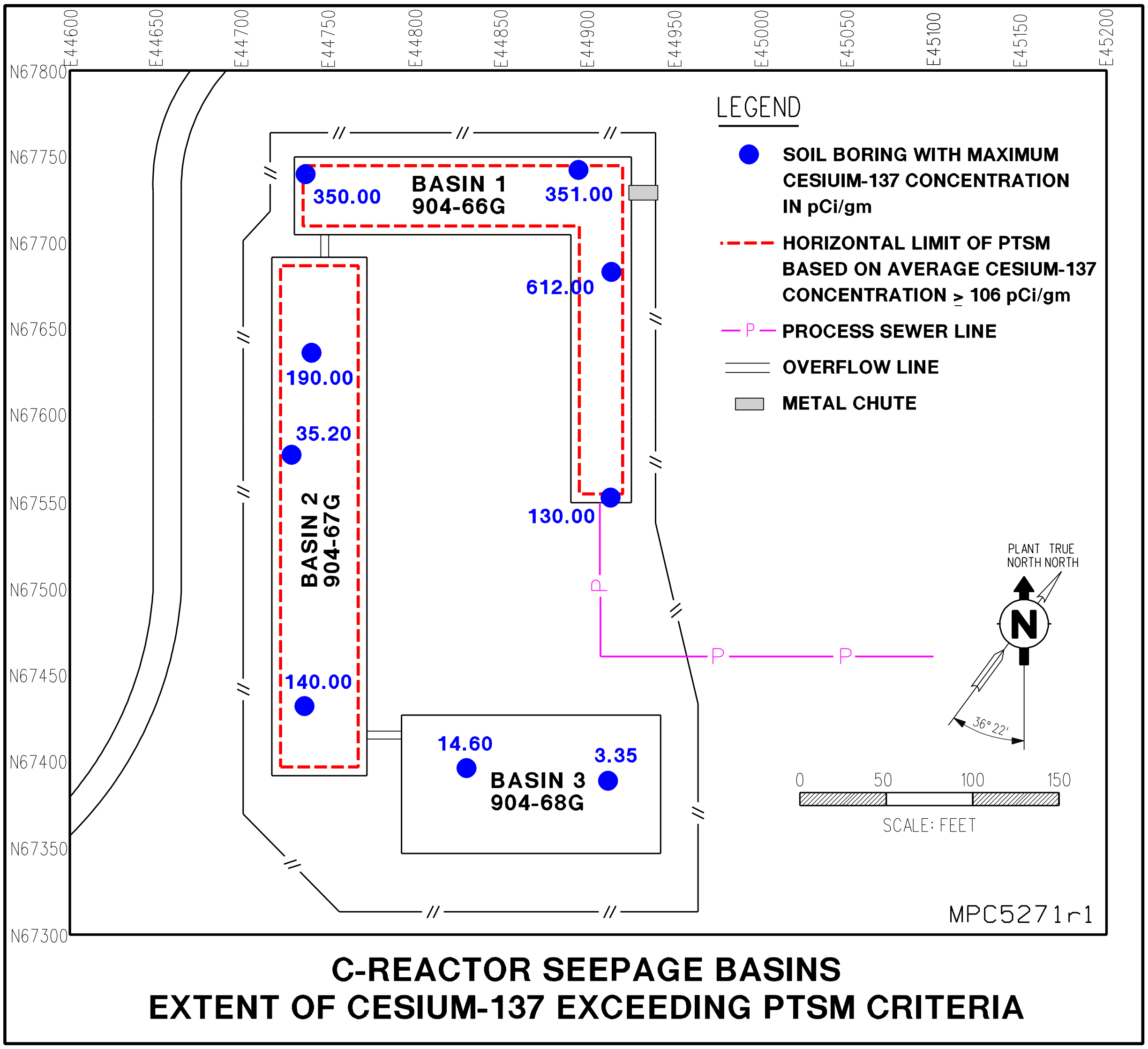


Figure L-3. Layout of the CRSB OU

Figure L-4. Before, During, and After Remedial Action at LRSB OU

Figure L-5. Before, During, and After Remedial Action at CRSB OU Basin 2

Figure L-6. **Current Photographs after Remedial Action (2016) (Top Photo LRSB OU, Bottom Photo CRSB OU)**

Table L-1. Chronology of OU Events

Event	Date
Remedial Investigation Start/Complete	July 1998 / February 13, 2002
Time-Critical Removal Action Start/Complete	1997 / 1997
Plug-in ROD Issuance	November 29, 1999
CRSB ESD Issuance	October 18, 2000
CRSB and LRSB ROD Amendment	December 5, 2002
CRSB Remedial Action Start/Complete	February 5, 2001 / June 12, 2002
LRSB Remedial Action Start/Complete	October 30, 2002 / April 22, 2003
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table L-2. Risk Drivers in LRSB and CRSB Basin 2OUs Soils

Basin	Radionuclide Risk Drivers in Basin Soils	Discussion
LRSB (904-64G)	• Cobalt-60 (primary driver) • Cesium-137 • Strontium-90 • Promethium-147	Tritium was the predominant radionuclide released to LRSB, but cobalt-60 is the main contaminant remaining in the basin soils. Concentrations of cobalt-60 in the LRSB soils were considered PTSM with cancer risk to industrial workers of 3E-03. Radionuclides in the soil were expected to decay below PTSM level (risk >1E-03) by 2006, but will still be above human health limits (1E-06) for many years. A low permeability soil cover and institutional controls can effectively protect human receptors.
CRSB Basin 2 (904-67G)	• Cesium-137 (64%, Main driver) • Strontium-90 (12%) • Carbon-14 (8%) • Nickel-63 (3%) • Naturally occurring radionuclides such as Potassium-40 and Radium-228 (11%)	Tritium was the predominant radionuclide released to the CRSBs (56,000 Ci), but cesium-137 is the main contaminant remaining in the basin soils. Concentrations of cesium-137 in the CRSB soils were considered PTSM with cancer risk to industrial workers of 2E-03. The radionuclides in the soil were expected to decay below PTSM level (risk >1E-03) by 2002, but will still be above human health limits (1E-06) for many years. A low permeability soil cover and institutional controls can effectively protect human receptors.

Table L-3. Comparison of Actual vs. Estimated O&M Costs for the LRSB OU

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	12,730	13,933	9,472	8,724	14,276	59,133
Total ROD Estimated Direct O&M Costs* ($)	23,450	23,450	23,450	23,450	23,450	117,250

* Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit

I. SITE INFORMATION

Site Name:	**L-Area Reactor Seepage Basin (904-64G) Operable Unit**	**Date of Inspection:**	**8/31/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #76**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**9°F** **Partly Cloudy**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Consolidation

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

Agency: ______________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

4. **Other Interviews** *(Optional):* ☐ Report Attached ______________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019*, *Field Inspection Checklist for L-Area Reactor Seepage Basin*, ER-IDS-019-025, and *Field Inspection Checklist for C-Area Reactor Seepage Basin*, ER-IDS-019-013.

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State
☐ PRP In-House ☐ Contractor for PRP
☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☒ Location shown on site map ☒ Gates secured ☐ N/A
Remarks: OU-specific perimeter fencing is required by the remedial action. Perimeter fencing is in good condition.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Brian Hennessey (Name) FFA Program Manager (Title) 11/21/2016 (Date) 803-952-8365 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Survey monuments were located and in good condition.

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:

B. Other Site Conditions

Remarks: Annual site inspections conducted from FY2012 through FY2016 for CRSB have identified active ant mounds, overgrown vegetation, and broken barbed wire fencing. Annual site inspections conducted from FY2012 through FY2016 for LRSB have identified active ant mounds, broken support post, and overgrown vegetation. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent____ Depth____
Remarks:

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths____ Widths____ Depths____
Remarks:

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent____ Depth____
Remarks:

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent____ Depth____
Remarks:

5. Vegetative Cover: ☒ Grass ☐ Cover properly established ☒ No signs of stress
Areal extent____ Depth____
Remarks:

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

VII. COVER SYSTEMS *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A
Remarks:____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident
Areal extent__________________ Depth____________________
Remarks:____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________________
☐ Ponding ☐ Location shown on site map Areal extent______________________
☐ Seeps ☐ Location shown on site map Areal extent______________________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________________
Remarks:____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent__________________
Remarks:____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Cover Penetrations ☐ Applicable ☒ N/A

F. Gas Collection and Treatment ☐ Applicable ☒ N/A

G. Cover Drainage Layer ☐ Applicable ☒ N/A

H. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

I. Retaining Walls ☐ Applicable ☒ N/A

J. Perimeter Ditches/Offsite Discharge ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Attachment L-1. Five-Year Review Site Inspection Checklist – L-Area Reactor Seepage Basin (904-64G) Operable Unit *(continued)*

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Consolidation ☒ Applicable ☐ N/A

Consolidation was performed at LRSB OU and CRSB Basin 2. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU is institutional controls, contaminated soil consolidation and pipeline grouting, and a soil cover system. PTSM in the LRSB and CRSB has radioactively decayed to levels that no longer pose a 1 x 10^{-3} risk to future industrial workers. Groundwater monitoring is conducted every 5 years as part of the L-Area Southern Groundwater OU to verify effectiveness of the LRSB cover. The remedy is fully established and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance of the low permeability soil covers, current access controls, and the SRS Site Use and Site Clearance Program are effectively maintaining the long-term protectiveness of the remedy.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

OLD F-AREA SEEPAGE BASIN (904-49G) OPERABLE UNIT

I. Introduction

This report is the fifth five-year review for the Old F-Area Seepage Basin (904-49G) (OFASB) Operable Unit (OU). The review was conducted from August 2016 through November 2016. Contaminants have been left in place at the OFASB OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the OFASB OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table M-1 lists the chronology of site events for the OFASB OU.

III. Background

The OFASB OU is listed as a Resource Conservation and Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media associated with the OFASB OU is soil. The groundwater associated with the OFASB OU is addressed as part of the General Separations Area (GSA) Western Groundwater OU (WSRC 2004).

Physical Characteristics

The OFASB is located approximately 9.7 km (6 mi) from the nearest SRS boundary, as shown in Figure M-1. The OFASB OU is located approximately 180 m (600 ft) north of F Area and at an elevation of 85.5 m (285 ft) above mean sea level. The water table is approximately 22.5 m (75 ft) below ground surface (bgs). The OFASB was an unlined seepage basin (approximately 90 m [300 ft] long by 60 m [200 ft] wide and 3 m [10 ft] deep) and covers 0.53 hectares (1.3 acres). The unit includes an effluent ditchline adjacent to the basin which leads toward Upper Three Runs Creek and one process sewer line which fed the basin and has an average depth of 2.7 to 3 m (9 to 10 ft) bgs and is about 240 m (800 ft) in length.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the OFASB OU as being within an industrial area. The future land use for the OFASB OU is reasonably anticipated to remain industrial with U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The OFASB was designed and constructed for the purpose of reducing radioactive substance concentrations in wastewater prior to discharge to Upper Three Runs Creek. The OFASB received 34- to 53-million L (9- to 14-million gal) of low radioactivity wastewater between November 1954 and mid-May 1955. Wastewater included overhead condensates from evaporates, laundry wastewater, non-reactor cooling water from F and H Areas, and possibly other chemicals. After 1955, the OFASB received occasional discharges of cooling water and rainfall runoff. During a three-month period in 1969, spent nitric acid solutions used to etch depleted uranium were discharged (via tanker truck) to the basin. Wastewater disposal was discontinued after the 1969 discharge (WSRC 1995a).

An estimated 1.8 Ci of radioactivity was released to the basin during its use. Due to natural radioactive decay, an estimated inventory of less than 0.8 Ci remained in the basin as recorded in the Statement of Basis/Proposed Plan (WSRC 1996a) for this unit.

Initial Response

In 1986, a Preliminary Unit Evaluation was conducted on the OFASB and a determination was made that hazardous substances had been deposited in the unit. Therefore, the unit was targeted for a full RCRA Facility Investigation (RFI) / Remedial Investigation (RI) study. Characterization data was collected and evaluated in the RFI/RI Report (WSRC

1995a) and the Baseline Risk Assessment (WSRC 1995b). Figure M-2 depicts the basin prior to any remedial activities.

Basis for Taking Action

Source area (basin) soil sampling was conducted in 1986 and groundwater monitoring had been ongoing since 1984. As part of the RFI/RI process additional source area soils were sampled along with source area sediments, soils outside the basin periphery and beneath the abandoned process sewer line leading to the basin, groundwater, surface water and sediment downgradient of the OU. These included a dry, shallow ravine north of the unit, a wetland area, the effluent ditchline, and a point in Upper Three Runs Creek.

Analytical data pertaining to the OFASB OU indicated that radionuclide-contaminated soils associated with the OFASB posed the main risk to both the future resident and industrial worker. These radionuclide risks were primarily associated with external radiation from the top 0.6 m (2 ft) of the former basin bottom soils. Major contaminants included cesium-137 and mercury. The top 0.6 m (2 ft) of the former basin bottom soils contained 53% of cesium-137 and 97% of mercury. Groundwater monitoring data also revealed that iodine-129, nitrate, strontium-90, and tritium were present in the groundwater above maximum contaminant levels (MCLs). Uranium was also detected above proposed MCLs. Although radium-228 had been decreasing over time, it has also exceeded MCLs. The groundwater plume in the water table aquifer migrated beyond the surface boundaries of the OFASB by more than 60 m (200 ft) towards Upper Three Runs Creek, which is more than 750 m (2,500 ft) to the north (WSRC 1995a, WSRC 1995b).

Based on the risk analysis, the OFASB soils posed a risk to human health. The carcinogenic risk to the potential future resident and worker was driven by exposure from direct radiation in the basin soils. These soils were contaminated with cesium-137 to a depth of 0 to 0.6 m (0 to 2 ft) and overflow ditchline soils to a depth of 0 to 0.6 m (0 to 2 ft). Carcinogenic risks to the potential future resident were also driven by exposure from ingestion of groundwater contaminated with iodine-129, tritium, strontium-90, and radium-228 in the water table aquifer. The contaminants of concern (COCs) and remedial goals (RGs) associated with the future industrial worker for the OFASB are summarized in Table M-2.

IV. Remedial Actions

Remedy Selection

The remedial action objectives (RAOs), developed for the OFASB in the Record of Decision (ROD) (WSRC 1997), are as follows:

- Prevent external exposure to radiological constituents;
- Prevent inhalation of radiological constituents;
- Prevent ingestion of soil or produce grown in soil with radiological constituents;
- Prevent or mitigate the release of COCs to the groundwater;
- Prevent or mitigate the impact to the nearest surface water receptor located at the Upper Three Runs Creek;
- Prevent or mitigate the impact to the nearest groundwater receptor located at the Upper Three Runs Creek;
- Restore the aquifer through natural groundwater mixing processes and other processes (radioactive decay) to achieve MCLs throughout the groundwater plume (groundwater mixing zone application modeling estimates that MCLs throughout the entire groundwater aquifer will be achieved in approximately 200 years); and
- Achieve State of South Carolina groundwater mixing zone objectives: a) control source to minimize addition of contaminants to the groundwater; b) establish plume monitoring and compliance wells to ensure compliance with mixing zone concentrations limits and/or maximum contaminant levels established in the groundwater mixing zone application; and c) monitor to ensure contaminated groundwater remains on SRS until MCLs are achieved throughout the plume and to ensure groundwater area or plume is decreasing in concentrations.

Upon amendment of the ROD (WSRC 2004), the last three RAOs listed above were no longer applicable to the remedy because the groundwater component was removed from this OU. RAOs that address groundwater will be developed as a part of the GSA Western Groundwater OU.

The amendment to the ROD (WSRC 2004) will not result in any permanent impact to the expected outcome for the OFASB OU remedial action. The groundwater monitoring activities will continue as part of the GSA Western Groundwater OU.

As stated in the ROD (WSRC 1997), the selected remedy is composed of the following remedial actions:

- Vegetation: Remove and dispose at an off-unit facility
- Pipeline and Pipeline Soils: Institutional controls, which include restricting land to future industrial use, limit access to the soil through use of SRS site use and site clearance permits. Access controls will include filling or grouting the pipeline manholes and posting signage indicated the area was used for the disposal of waste material and contains buried waste. Long-term controls, if the property is ever transferred to non-federal ownership, will include the U.S. Government creating a deed that will comply with Section 120(h) of CERCLA and providing a certified survey plat.
- Soils (basin and ditchline): Remove the top 0.6 m (2 ft) of soils in the ditchline and place it in the OFASB. This would be followed by in situ stabilization of the top 0.6 m (2 ft) of basin soils and the ditchline soils placed in the basin. Construct a low permeability cap over the stabilized materials. Implement institutional controls, as above.
- Groundwater: Continue existing institutional controls and monitor the extent of the groundwater contaminant plume.

In September 1998, an Explanation of Significant Differences (ESD) to the ROD was approved to change the disposal of vegetation from off-unit disposal to on-unit disposal (WSRC 1998). The vegetation would be placed within the OFASB and undergo in situ stabilization/solidification along with the basin and ditchline soils.

In June 2003, an agreement was made between USDOE, South Carolina Department of Health and Environmental Control (SCDHEC), and U.S. Environmental Protection Agency (USEPA) to include OFASB OU groundwater in the GSA Western Groundwater OU. The amended ROD removed the groundwater component from the remedial action (WSRC 2004)

Remedy Implementation

Implementation of the OFASB OU remedial action included the following activities (WSRC 2001):

- Grouting manholes #2, #3 and #4 (manhole #1 was not grouted) with 2,000 psi concrete;
- Consolidating chipped vegetation (approximately 218 m^3 [285 yd^3]) with placement in clean backfill in basin;
- Consolidating the top 0.6 m (2 ft) minimum of OFASB side slopes and ditchline soils, and a 37.5-cm (15-in) vitrified clay process sewer line and its surrounding soil from manhole #4 to basin (approximately 30 m [100 ft]) with placement in the OFASB bottom;
- In situ stabilizing of approximately 7,770 m^3 (10,154 yd^3) of contaminated soil via grouting the top 0.6 m (2 ft) of basin bottom soils and consolidated soils and piping placed in the basin;
- Backfilling the basin with clean soil and chipping vegetation with compaction to grade;
- Placing a 0.7 hectare (1.8 acre) low-permeability soil cover (minimum 1E-05 cm/s hydraulic conductivity) over the OFASB area to minimize surface infiltration;
- Revegetating the cover system;
- Disposing of radioactive low-level secondary wastes generated during remediation activities in a waste trench adjacent to the grouted and covered OFASB basin,

stabilizing the secondary waste, followed by placement of a low permeability cover system;

- Establishing a monitoring well network consisting of seven new monitoring wells to supplement the existing well network;
- Implementing institutional controls; and
- Establishing land use controls (LUCs) for 0.7 hectare (1.8 acres).

Figures M-2 and M-3 are photographs of the OFASB OU before and after remediation.

System Operations/Operation and Maintenance

There are no system operational requirements.

The following maintenance activities are ongoing:

- Site inspections (semiannual through 2014; annual thereafter) and site maintenance (repair of erosion damage, cover maintenance, mowing, and warning signs); and
- LUCs including warning signs, site controls, and use restrictions via SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit. LUCs will be maintained until the identified COCs no longer pose a threat under the residential (unrestricted) land use scenario.

Table M-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the Corrective Measures Study/Feasibility Study (CMS/FS) report (WSRC 1996b). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $170,000 for inspections and maintenance and LUCs. The actual O&M cost for FY2012 to FY2016 is $55,952. The actual O&M costs are less than expected because the estimated cost for five-year remedy reviews were significantly overestimated.

V. Progress since Last Review

The previous protectiveness statement concluded that because the remedial actions at OFASB OU are protective, the site is protective of human health and the environment. The grouting and soil cover remedy at OFASB OU is protective of human health and the environment for soil contamination and prevents external exposure to radiological contaminants. LUCs (site use/site clearance and security measures) are in place and ensure the protectiveness of the remedy.

In the fourth five-year remedy review, SRS recommended that the OFASB cover inspection frequency be reduced to annual (SRNS 2014a). This reduction would provide adequate monitoring and consistency since the majority of OU covers at SRS are currently inspected annually. On February 6, 2014, the USDOE submitted a letter (USDOE 2014) to USEPA and SCDHEC to reduce inspection frequencies from semiannual to annual. USEPA and SCDHEC approved the request on March 20, 2014 and March 7, 2014, respectively. Annual inspections for OFASB began in 2015.

VI. Five-Year Review Process

The following tasks were performed as part of the five-year review process:

- Reviewed the documents listed in Section XII, Documents Reviewed;
- Evaluated and confirmed the implemented remedial action (in-situ stabilization and soil cover system) is operating effectively;
- Inspected the OU, interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment M-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls;
- Performed a data review; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Review of the groundwater data (SRNS 2012, SRNS 2013, SRNS 2014b, and SRNS 2015) indicate exceedances of MCLs for several contaminants in the FNB well series that are monitored as part of the GSA Western Groundwater OU North Plume. As represented by the tritium plume (Figure M-4), contamination exists upgradient of the OFASB. It is likely that multiple facilities are contributing to the groundwater plumes near the OFASB. Volatile organic carbons, gross alpha, nonvolatile beta, nitrate, iodine-129, strontium-90, and tritium have been measured at levels greater than MCLs during the period 2012 through 2016. While most were at concentrations slightly greater than their respective MCL, iodine-129, strontium-90, and tritium were several times their respective MCL with maximum values of 10.1 pCi/L, 11.9 pCi/L, and 5.8 pCi/mL, respectively. Review of the plume maps generated as part of the GSA Western Groundwater OU annual reporting (SRNS 2012, SRNS 2013, SRNS 2014b, and SRNS 2015) suggests that the OFASB is only one of several potential sources contributing to these contaminant plumes (Figure M-4). Time trends of iodine-129, strontium-90, and tritium over the period 2000 through June 2016 show concentrations in the wells closest to the OFASB are decreasing, indicating any potential impact to groundwater from the basin is decreasing.

Well FNB2 is the closest downgradient well to the OFASB. In order to understand the impact of the stabilization and capping of the basin on the groundwater, a decay curve was calculated using the maximum concentration of tritium detected at this well after the cap was installed (Figure M-5). While the time period cannot be definitively identified, there would have been a span of time after the stabilization/capping occurred for the system to return to steady state, as there would have been a reduction in flux of water through the basin. It can be assumed that period of time is represented by the steeper decrease in concentrations from the period 2001 through September 2004. As can be seen from the trend line associated with the measured data, upon reaching the new steady state the concentrations are decreasing at a rate consistent with the decay curve. A similar time trend was developed for the iodine-129 data (Figure M-6). As the half-life for iodine-129 is 1.57E+07 years, decay has no impact on the time trend of this contaminant. Thus, the decreasing time trend for iodine-129 would indicate the stabilization/capping has had a positive impact (decrease in mass) on the release of contaminants from the OFASB to the groundwater.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified during these interviews.

The OFASB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 14, 2016. No issues will be identified for the OFASB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, February 28, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled inspections conducted at the OFASB from FY2012 to FY2016identified active ant mounds, brush around underground piping signs that needed to be cut, and overgrown vegetation. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The review of documents, applicable or relevant and appropriate requirements, risk assumptions, and the results of the site inspection indicate that the remedy is functioning as intended by the ROD. Placement and maintenance of a protective multi-layer cover system over the basin is effective in meeting the RAOs of preventing physical exposure, inhalation, and ingestion of contaminants. Based on the above review, the stabilization and capping of the OFASB has had a positive impact on the release of contaminants from the OFASB to the groundwater.

Maintenance and inspection of the cover system has been effective. Review of the semiannual (annual as of 2015) inspection reports for the period 2012 through 2016 indicate the in-place remedy is functioning properly. The prevalent findings were active ant mounds and vegetation in drainage ditches in need of mowing which were addressed in an expedient manner. Review of the inspection reports indicates the maintenance is operating effectively and efficiently.

The institutional controls (i.e., LUCs) that are in place include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.); administrative controls that maintain the OU for industrial use only (SRS is a secured government facility with land use restrictions); and fencing, warning signs and use restrictions via the SRS Site Use/Site Clearance Program. No activities were observed that would have violated the institutional controls.

The Land Use Control Implementation Plan for the OFASB OU is located in Appendix A of the Post-Construction Report and governs LUC implementation, maintenance, monitoring, reporting, and enforcement (WSRC 2001). All LUC objectives are being met.

Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still Valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in the physical conditions of the OFASB that would affect the protectiveness of the remedy. The remedy remains protective as the exposure pathways have been eliminated through in situ grouting of the contaminated materials (soil and vegetation) in the basin followed by placement of a low-permeability cover system.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the OFASB were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU with the exception of further investigation needed for 1,4-dioxane.

Due to the widespread usage of chlorinated solvents at SRS and the use of 1,4-dioxane as a stabilizer in chlorinated solvents, paint strippers, greases, and waxes, SRS began sampling for this constituent at the OFASB as part of the GSA Western Groundwater OU groundwater evaluation in 2010. Fifty-one records were reviewed over the period 2010 through February 2012 representing five sampling events of five monitoring wells, three seepline piezometers, and two surface water sampling locations. All results were non-detects, which provides evidence that 1,4-dioxane is not a COC for the OFASB.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site operations, conditions, or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the OFASB is protective of human health and the environment.

All threats posed by contamination at the OU have been addressed through in situ stabilization of the contaminated materials, a low permeability cover system, and institutional controls (i.e., LUCs) to maintain industrial land use. Exposure pathways that could result in unacceptable risks are controlled through LUCs which include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain this site for industrial use only (SRS is a secured government facility with land use restrictions), and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2012. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)*, ERD-EN-2005-0127, August 2012, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2013. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)*, ERD-EN-2005-0127, August 2013, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014a. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina*, SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2014b. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)*, ERD-EN-2005-0127, September 2014, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2015. *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (U)*, ERD-EN-2005-0127, September 2015, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2014. Letter, B. T. Hennessey (DOE) to S. B. Fulmer (SCDHEC) and R. H. Pope (EPA), Request to Change the Inspection Frequency for Operable Units Based on the

Recommendation in the Fourth Five-Year Remedy Review Report for the Savannah River Site (SRNS-RP-2012-00011, Revision 1.1, November 2013), CERCLIS Numbers: 13,14,16,17,20,23,26,32,39, and 66, ACP-14-125, dated February 6, 2014, Department of Energy, Savannah River Operations Office, Aiken, SC

WSRC, 1995a. *RCRA Facility Investigation/Remedial Investigation Report for the Old F-Area Seepage Basin*, WSRC-RP-94-942, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1995b. *Baseline Risk Assessment for the Old F-Area Seepage Basin (U)*, WSRC-RP-94-1174, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1996a. *Statement of Basis/Proposed Plan for the Old F-Area Seepage Basin (904-49G) (U)*, WSRC-RP-95-1557, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1996b. *Corrective Measures Study/Feasibility Study Report for the Old F-Area Seepage Basin (904-49G) (U)*, WSRC-RP-95-385, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1997. *Record of Decision Remedial Alternative Selection for the Old F-Area Seepage Basin (904-49G) (U)*, WSRC-RP-96-872, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1998. *Explanation of Significant Differences to the Revision 1.1 Record of Decision for the Old F-Area Seepage Basin* (U), WSRC-RP-98-4123, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2001. *Post-Construction Report for the Old F-Area Seepage Basin (904-49G) (U)*, WSRC-RP-2000-4100, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004. *Record of Decision Amendment for the Old F-Area Seepage Basin (904-49G)* (U), WSRC-RP-2003-4136, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

Various - *Field Inspection Checklists for the Old F-Area Seepage Basin (904-49G)*, ER-IDS-019-008, Inspection Period 2012 through 2016 (semiannually through 2014; annually thereafter)

This page is intentionally left blank.

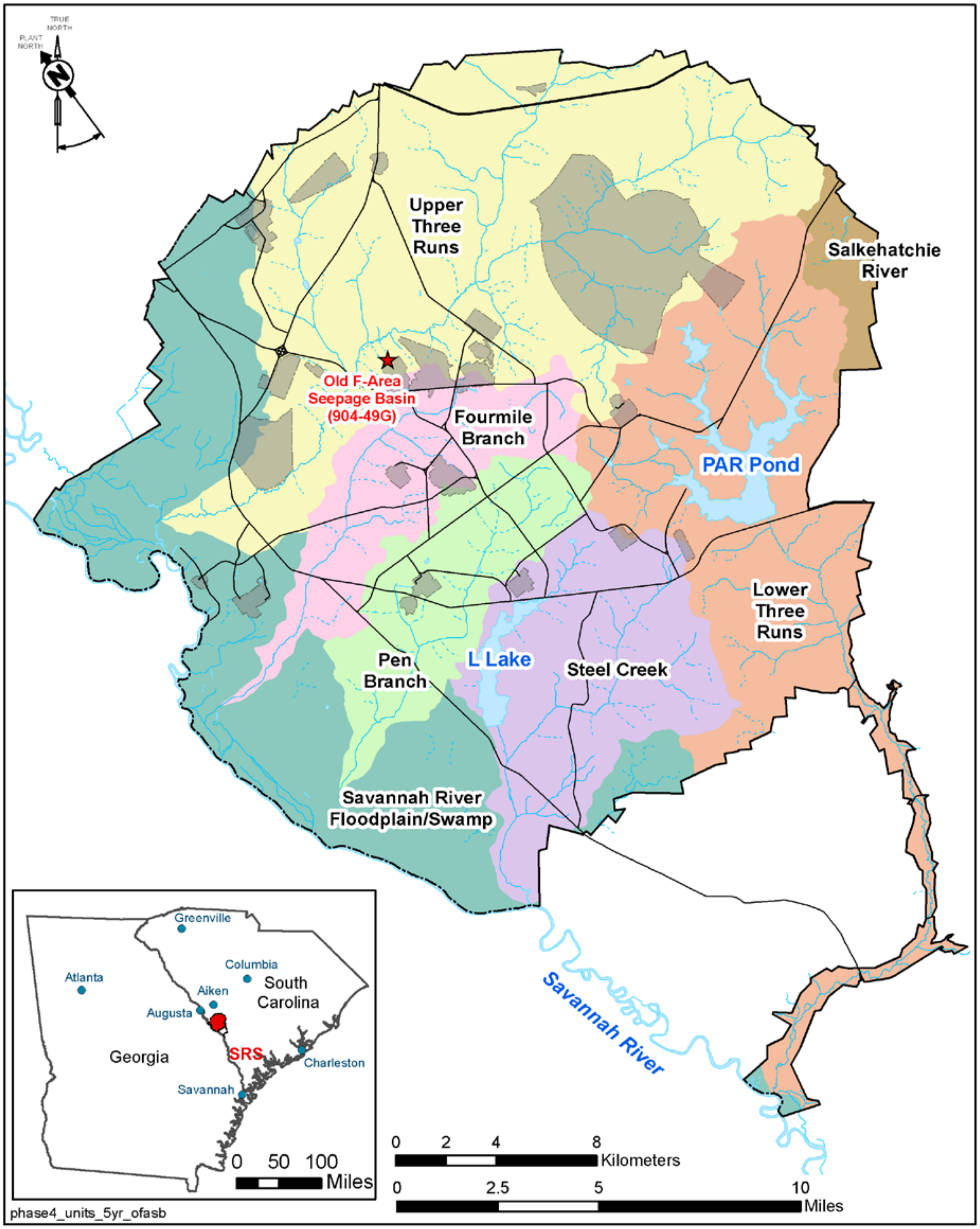


Figure M-1. Location of the Old F-Area Seepage Basin OU at SRS

Figure M-2. OFASB OU Prior to Remediation

Figure M-3. Current Photograph of OFASB OU (2016)

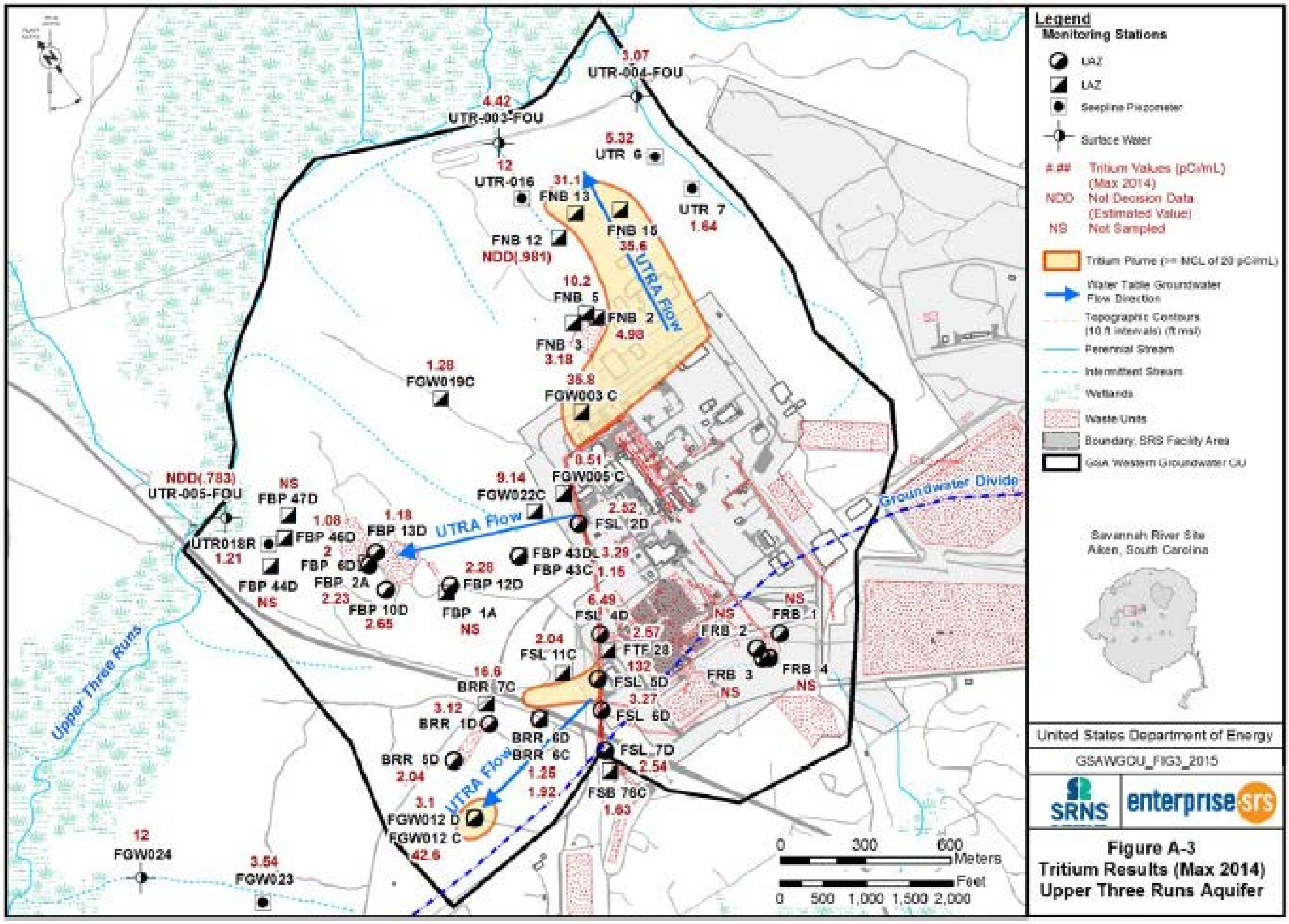


Figure M-4. Tritium Plume Map for the Western GSA Groundwater OU – 2014 (SRNS 2015)

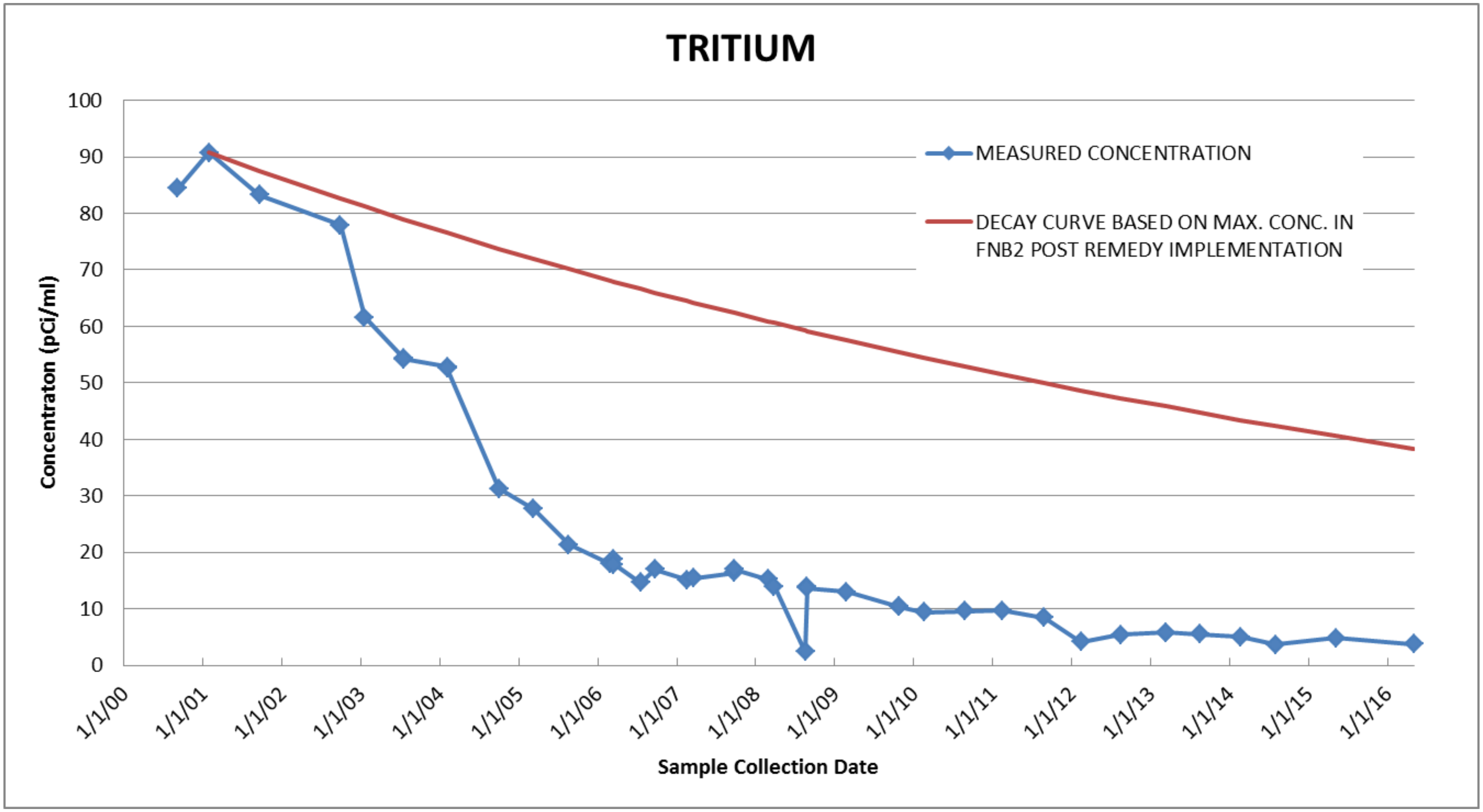


Figure M-5. **Effect of Remedy on Release of Tritium from the OFASB OU**

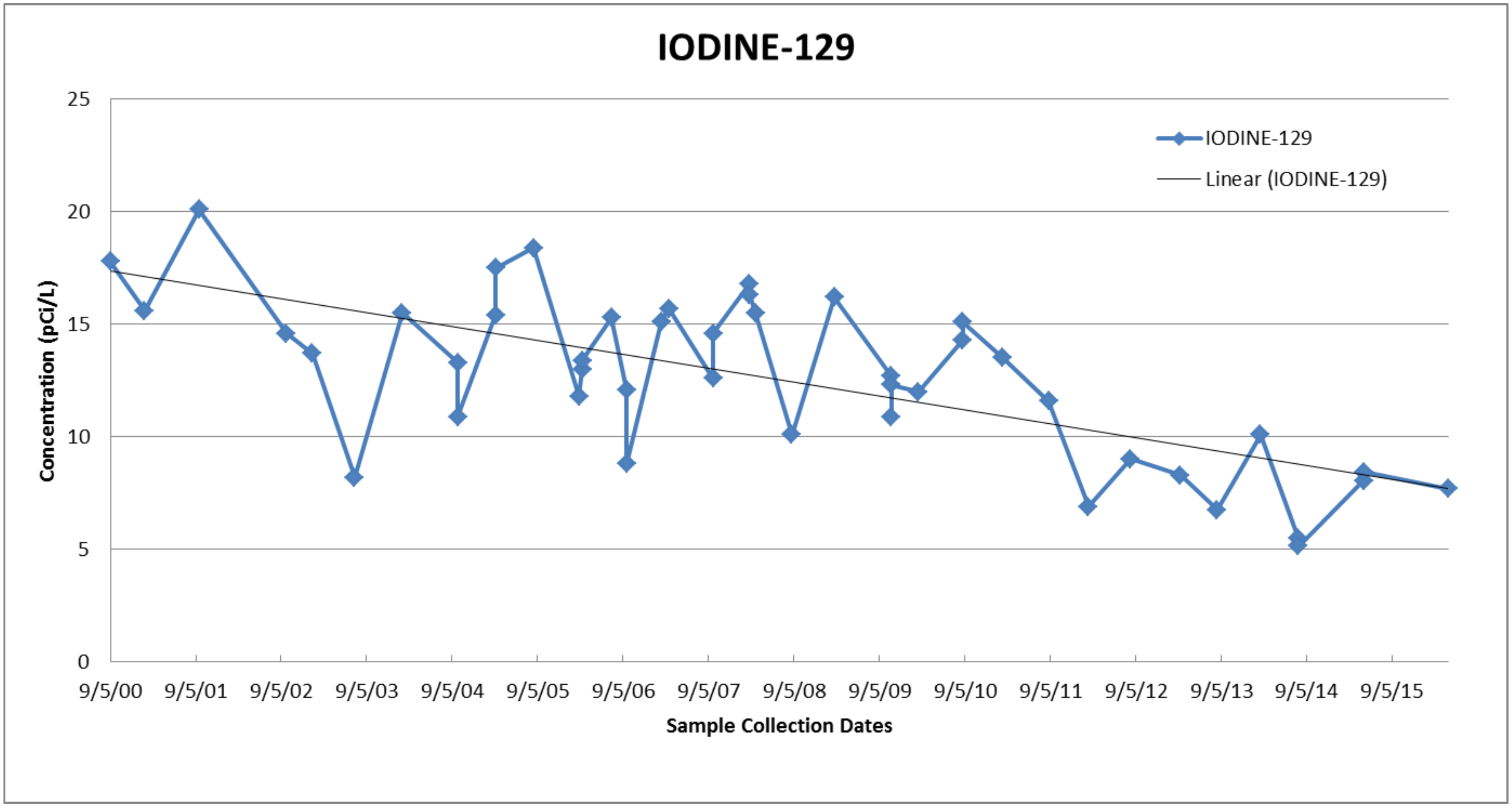


Figure M-6. **Effect of Remedy on Release of Iodine-129 from the OFASB OU**

Table M-1. Chronology of OU Events

Event	Date
RFI/RI Field Start / Complete	July 1993 / February 13, 1996
Final ROD Issuance	July 3, 1997
ESD Issuance	December 16, 1998
Remedial Action Start/Complete	September 10, 1998 / November 17, 2000
Decision to manage groundwater as a part of GSA Western Groundwater OU	August 2002
ROD Amendment Issuance	December 17, 2004
Previous Five-Year Reviews Issuance	August 27, 1997 / February 12, 2004 / January 29, 2009 / February 4, 2014

Table M-2. COCs and RGs for 1E-06 Risk to Future Industrial Worker (WSRC 1996b)

Subunit	Medium	Exposure Pathway	COC	Original RG
Process Sewer	Soil	N/A	N/A	N/A
Seepage Basin	Soil	Direct Radiation	Cesium-137	4.2E-02 ρCi/g
			Potassium-40	0.15 ρCi/g
			Americium-241	7.51 ρCi/g
			Cobalt-60	9.7 ρCi/g
			Europium-154	2.0E-02 ρCi/g
			Niobiuim-95	3.2E-02 ρCi/g
			Radium-228	2.9E-02 ρCi/g
Effluent Ditch	Soil	Direct Radiation	Cesium-137	4.2E-02 ρCi/g
Groundwater	Water	Ingestion	Iodine-129	0.84 ρCi/L

* Source of COCs and RGs – CMS/FS (WSRC 1996b)
N/A – not applicable

Table M-3. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	11,750	12,905	9,113	8,349	13,834	55,952
Total ROD Estimated Direct O&M Costs* ($)	114,000	14,000	14,000	14,000	14,000	170,000

*Source of estimate – CMS/FS (WSRC 1996b), pages APP B-1, Table B-5 provides $14,000/year inspection and maintenance and Table B-1 provides $100,000 every 5 years for the Five-Year Reviews. Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU

I. SITE INFORMATION

Site Name:	**Old F-Area Seepage Basin (904-49G) OU**	**Date of Inspection:**	**7/27/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #16**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**86°F and Sunny**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other In-situ grouting of basin bottom soils and basin side slopes, ditchline soils and piping placed in basin bottom.

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

Agency: ____________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

4. **Other Interviews** *(Optional):* ☐ Report Attached ____________________

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: Annual site inspections are performed per SRS procedure ER-SOP-019, *Waste Unit Inspection and Maintenance*, and ER-IDS-019-008, *Field Inspection Checklist for the OFASB.*

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☐ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS
☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A

Remarks: Signs are in good condition.

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Phil Prater (Name) IACD Program Manager (Title) 11/14/2016 (Date) 803-952-9333 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks: Gravel

B. Other Site Conditions

Remarks: The MOX facility is under construction near the Old F-Area Seepage Basin OU. Site inspections conducted (semiannually through 2014; annually thereafter) from FY2012 through to FY2016 have identified active ant mounds, brush around underground piping signs needs to be cut, and overgrown vegetation. These findings were resolved soon after discovery.

VII. COVER SYSTEMS ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent________ Depth________
Remarks:

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths________ Widths________ Depths________
Remarks:

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent________ Depth________
Remarks:

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent________ Depth________
Remarks:

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☒ No signs of stress
Areal extent________ Depth________
Remarks:

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

VII. COVER SYSTEMS *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A
Remarks:______________________________
____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident
Areal extent______________ Depth______________
Remarks:______________________________
____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks:______________________________
____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent______________
Remarks:______________________________
____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

VII. COVER SYSTEMS *(Continued)*

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident
Areal extent__________ Depth__________
Remarks:______________________________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent__________ Type__________
Remarks:______________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________ Depth__________
Remarks:______________________________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks:______________________________

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. In-situ grouting and Consolidation. ☒ Applicable ☐ N/A
In situ grouting and consolidation was performed at OFASB. The remedy is performing as designed.

Attachment M-1. Five-Year Review Site Inspection Checklist – Old F-Area Seepage Basin (904-49G) OU *(continued)*

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

Remedy for this site is: (1) In-situ grouting of basin bottom soils and basin side slopes, ditchline soils and piping placed in basin bottom; (2) backfill of the basin with clean soil with compaction to grade; (3) low-permeability soil cover system; (4) institutional controls. The cover system is intact, long-term grasses have been fully established. The in-situ grouting and soil cover system remedy are functioning as designed. Drainage channel function adequately.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the physical integrity of the soil cover, the condition of the grass and vegetative cover and warning signs is good. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

P-AREA OPERABLE UNIT

I. Introduction

This report is the second five-year review for the P-Area Operable Unit (PAOU). The review was conducted from August 2016 through November 2016. This report documents the results of the review. Contaminants have been left in place at PAOU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at PAOU is protective of human health and the environment.

II. OU Chronology

Table N-1 lists the chronology of events for the PAOU.

III. Background

The PAOU is listed as a Resource Conservation and Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media of concern is surface soil, vadose zone soil, rail bed materials, metal components, concrete, and sediment. Groundwater is addressed separately under the P-Area Groundwater (PAGW) OU.

Physical Characteristics

The PAOU is located in south-central SRS approximately 4.0 km (2.5 mi) east-southeast of the geographical center of SRS and about 6.4 km (4 mi) west of the nearest site boundary (Figure N-1). PAOU is approximately 50 hectares (126 acres) (including the P-Area Ash Basin (188-P) and Outfall P-007). It is located in an upland area between Steel Creek and Lower Three Runs watersheds and has a flat to gently rolling topography. Figures N-2 and N-3 show before and after remedial activities photographs of P Area. PAOU is approximately 96 m (315 ft) above mean sea level.

The PAOU is comprised of the following subunits (Figure N-4):

- P-Reactor Building (105-P) and its Ancillary Structures including Engine House (108-lP) and Engine House (108-2P) with Standby Pumphouse (191-P);
- Disposition of Water in the P-Reactor Disassembly Basin (no building number [NBN]);
- Potential Release from the P-Area Reactor Cooling Water System (186/190-P);
- Potential Release from the P-Area Disassembly Basin (105-P);
- Process Sewer Lines As Abandoned (NBN) (PSLs) (including the Spill on 03/15/79 of 5000 gallons of Contaminated Water; and various components of the PSLs including Process Water Storage Tank (106-P), Process Water Storage Basin (109-P); Cooling Water Effluent Sump (107-P/107-1P), outfalls, manholes, and miscellaneous weirs and boxes; sumps, etc.);
- P-Area Reactor Area Cask Car Railroad Tracks (CCRTs) as Abandoned (NBN);
- All railroad tracks within the P-Area fence;
- High Contamination Area (HCA) associated with the P-Area CCRT;
- P-Area Ash Basin (188-P) (including Outfall P-007);
- Slab Associated with Containment Tank within Emergency Cooling Water Retention Basin (904-86G);
- Slab Associated with Pipe Fabrication Shop Building (717-9P);
- Slab Associated with Radiological Zone Storage Building (710-P);
- Slab and Sumps Associated with No. 2 & 5 Basin Deionizers Pad (105-1P);
- Potential Source Area (PSA) 1 - Emergency Cooling Water Retention Basin (904-86G);
- PSA 2 - Area around the Cooling Water Effluent Sump (107-P/107-1P);
- PSA 3A - Area near the Northern end of the P-Reactor Building (105-P);
- PSA 3B - Area West of the Administrative/Maintenance Slab;
- PSA 4 - Area East of the P-Reactor Building (105-P);

- PSA 5 - Two localized areas in the Southwestern part of P Area; and
- Outfall P02.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates PAOU as being within the site industrial area. The future land use for PAOU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

In February 1954, P-Reactor began operations. It was taken off-line for maintenance and safety upgrades in 1987, placed in warm standby in 1988, and placed in shutdown status in 1991. In 1993, P-Reactor was placed in cold shutdown with no capability of restart. The primary sources of radioactive contamination in P Area are activation products, fission products, and tritium, the majority of which were the consequence of P-Reactor operations. Spills, leaks, accidental releases, or simply the operation itself resulted in releases of hazardous and/or radioactive substances.

Initial Response

No initial response actions were taken at the PAOU prior to issuance of the Early Action Record of Decision (EAROD) (WSRC 2008a), which is described in Section IV.

Basis for Taking Action

The nature and extent of contamination in soil, sediment, gravel, and ash at the PAOU were characterized from 2005 through 2007. A comprehensive approach was implemented to address potential impact to human and ecological receptors at the PAOU. Overall, soil-gas samples were collected from 69 locations, groundwater samples were collected from 139 locations, soil samples were collected from 116 locations, gravel samples were collected from eight locations, and ash samples were collected from nineteen locations.

Results from the past characterization activities (WSRC 2008b) and recent monitoring have demonstrated that radiological and volatile organic contaminants are exceeding PAOU remedial goals (RGs) at specific subunits. PAOU subunits for which refined contaminants of concern (COCs) were determined for human health include: HCA associated with the P-Area CCRTs, P-Reactor Building (105-P) Complex, and P-Area Ash Basin (188-P) (including Outfall P-007) (Table N-2). Additionally, COCs were qualitatively identified for the P-Area PSLs based on the potential for fixed contamination within the lines. Each of the above subunits, including the P-Area PSLs, has been addressed by early remedial actions or Non-Time Critical Removal (NTCR) actions. Risks from these subunits are discussed below. The RGs for the PAOU are listed in Table N-2.

- The early remedial action (soil removal to 1 ρCi/g cesium-137) has been completed for the HCA associated with the P-Area CCRTs subunit. Additionally, this subunit will be managed with the land use controls (LUCs) selected for the entire PAOU to prevent unrestricted use.
- The early remedial action **for** the P-Reactor Building (105-P) Complex has been completed and radioactive contaminants have been left in place. Additionally, this subunit will be managed with the LUCs selected for the entire PAOU to prevent unrestricted use.
- The removal action for the P-Area PSLs has been completed and radioactive contaminants have been left in place. The subunit requires LUCs selected for the entire PAOU to prevent unrestricted use.
- A contaminant migration analysis was performed to identify contaminant migration COCs (WSRC 2008b). The results of the contaminant migration evaluation identified contaminant migrations COCs for: P-Reactor Building (105-P) Complex, PSA 3A, and PSA 3B.
- A principal threat source material (PTSM) evaluation for the PAOU subunits determined refined COCs for the HCA associated with the P-Area CCRTs and P-Reactor Building (105-P) Complex. The radioactive inventory located in the P-Reactor Building

(105-P) has been estimated to be 2.40E+05 Ci (WSRC 2008b). Cumulative risk for the P-Reactor Building (105-P) Complex was estimated at 2.19E+04.

IV. Remedial Actions

An area-based remedial strategy has been implemented in P Area, excluding prior remedial decisions for the P-Area Reactor Seepage Basins and the P-Area Burning/Rubble Pits in their respective Records of Decisions (RODs).

In 2009, the USDOE decided to proceed with removal actions to support accelerated remediation of the remainder of the PAOU under the American Recovery and Reinvestment Act of 2009. The removal actions included the details of in situ decommissioning (ISD) for the P-Reactor Complex, as described in the Explanation of Significant Difference (ESD) to the EAROD (SRNS 2009a), and the NTCR actions for the P-Area PSLs (SRNS 2009c), and the P-Area Ash Basin (188-P) (including Outfall P-007) (SRNS 2009b).

The following remedial and removal actions are considered to be the final actions for these subunits (WSRC 2008a, SRNS 2009a, SRNS 2009b, SRNS 2009c):

- PSA 3A - Area near the Northern end of the P-Reactor Building (105-P) – Soil Vapor Extraction (SVE) with Fracturing and Chemical Oxidation Injection;
- PSA 3B - Area West of the Administrative/Maintenance Slab - SVE.
- HCA associated with the P-Area CCRTs - Excavate/Remove and Backfill;
- P-Area Ash Basin (188-P) (including Outfall P-007) - Remove, Consolidate, Cover;
- P-Area PSLs (including the Spill on 03/15/79 of 5,500 Gallons of Contaminated Water; and various components of the PSLs including Process Water Storage Tank (106-P), Process Water Storage Basin (109-P), Cooling Water Effluent Sump (107-P/107-1P) outfalls, and manholes, miscellaneous weirs and boxes; sumps, etc.) - Plugging, Grouting, Equipment Removal;
- Disposition of Water in the P-Reactor Disassembly Basin - Forced Evaporation; and

- P-Reactor Building (105-P) and its Ancillary Structures including Engine House (108-1P), Engine House (108-2P) with Standby Pumphouse (191-P) - ISD.

The following subunits require institutional controls (i.e., LUCs) only because of their close proximity to the P-Reactor (105-P) Reactor Building and being located within the industrial zone (SRNS 2010d):

- Potential Release from the P-Area Reactor Cooling Water System (186/190-P);
- Potential Release from the P-Area Disassembly Basin (105-P);
- P-Area Reactor Area CCRTs as Abandoned (NBN);
- All railroad tracks within the P-Area fence;
- Slab Associated with Pipe Fabrication Shop Building (717-9P);
- Slab Associated with Radiological Zone Storage Building (710-P);
- Slab and Sumps Associated with No. 2 & 5 Basin Deionizers Pad (105-1P);
- PSA 2 - Area around the Cooling Water Effluent Sump (107-P/107-1P);
- PSA 4 - Area East of the P-Reactor Building (105-P); and
- PSA 5 - Two localized areas in the Southwestern part of P Area.

The following subunits required no action since it had been determined that these subunits pose no impact to human health or the environment based on an unrestricted land use scenario:

- Slab Associated with Containment Tank within Emergency Cooling Water Retention Basin (904-86G);
- PSA 1 - Emergency Cooling Water Retention Basin (904-86G); and
- Outfall P02.

Remedy Selection

As stated in the ROD (SRNS 2010d), the Remedial Action Objectives (RAOs) for the PAOU are as follows:

- Eliminate or control all routes of exposure to residual radioactive or chemical contamination posing risks exceeding 10E-06 to the industrial worker or the resident in media or structures associated with the P-Reactor Building (105-P) Complex including the water in the P-Reactor Disassembly Basin, the HCA associated with the P-Area CCRTs, the P-Area PSLs, PSA 3Aand 3B, and the P-Area Ash Basin (188-P) (including Outfall P-007);
- Prevent exposure of potential contamination in media or structures to a residential receptor associated with the following subunits:
    - Potential Release from the Reactor Cooling Water System (186/190-P);
    - Potential Release from the P-Reactor Disassembly Basin (105-P);
    - P-Area Reactor Area CCRTs as Abandoned (NBN);
    - All Railroad Tracks within the P-Area Fence;
    - Slab Associated with Pipe Fabrication Shop Building (717-9P);
    - Slab Associated with Radiological Zone Storage Building (710-P);
    - Slab and Sumps Associated with No. 2&5 Basin Deionizers Pad (105-1P);
    - PSA 2 - Area around the Cooling Water Effluent Sump (107-P/107-1P);
    - PSA 4 - Area East of the P-Reactor Building (105-P); and
    - PSA 5 - Two localized areas in the Southwestern part of P Area.

The remedial actions selected to meet the RAOs and the threshold criteria to provide overall protection of human health and the environment and comply with applicable or relevant and appropriate requirements for the PAOU are as follows:

- P-Reactor Building Complex – ISD End State;
- PSA-3A Volatile Organic Carbon (VOC) Source Area – SVE with soil fracturing and chemical oxidation;
- PSA-3B VOC Source Area – Conventional SVE;

- HCA at the CCRTs – Excavation and Disposal of contaminated media, backfill with clean soil;
- P-Area Ash Basin (188-P) (including Outfall P-007) - Soil removal at the Outfall P-007, consolidate, and soil cover over the P-Area Ash Basin (181-P) and Outfall P-007;
- Reactor Building (105-P) Complex PSLs - Plugging, grouting, equipment removal
- P-Reactor Disassembly Basin - Evaporate the basin water; and
- LUCs to maintain industrial land use.

The following LUC objectives are necessary to ensure protectiveness of the remedy:

- Restrict unauthorized worker access and prevent contact, removal, or excavation of contaminated waste, pipelines, equipment, and buildings;
- Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and playgrounds;
- Maintain the integrity of any current or future remedial or monitoring system, such as SVE systems, soil covers, or groundwater monitoring wells; and
- Prevent construction of inhabitable buildings without an evaluation of indoor air quality to address vapor intrusion.

Remedy Implementation

The selected remedies met the RAOs at PAOU based on successful completion of the early action remedial actions and NTCR actions, as listed below:

- Installed ten SVE wells using MicroBlowers™ and BaroBalls™, enhanced with soil fracturing and chemical oxidation at PSA 3A to treat 0.40 hectare (1 acre) at a depth of 6.1-15.2 m (20-50 ft) below ground surface (bgs);
- Installed five SVE wells using MicroBlowers™ and BaroBalls™ at PSA 3B to treat 0.5 hectare (0.5 acre) at a depth of 6.1-15.2 m (20-50 ft) bgs;

- Removed 54 m^3 (70 yd^3) of contaminated media at the CCRTs HCA by excavating to a depth of 45 cm (18 in) and transporting to the E-Area Low-Level Waste Facility Slit Trench Disposal Units for disposal and then backfilling excavated areas with clean soil to grade;
- Excavated 6,116 m^3 (8,000 yd^3) of soil and ash containing concentrations of cesium-137 greater than 10 ρCi/g at the Outfall P-007 and transported the soil and the ash to the E-Area Low-Level Waste Facility for disposal;
- Placed a 0.6 m (2-ft) thick soil cover over Outfall P-007 (approximately 1.82 hectares [4.5 acres]) and P-Area Ash Basin (5.54 hectares [13.7 acres]) consisting 0.5 m (1.67 ft) of common fill and 10 cm (4 in) of topsoil layers;
- Dewatered P-Area PSLs (lines/structures); Isolated/plugged contaminated process sewer and storm water lines; Grouted accessible openings to grade including structures, manholes, catch basins, inlet pipes, outfalls, and other miscellaneous access points; Installed concrete plugs in openings and/or placed concrete covers over entire structures, where required; Removed equipment associated with the P-Area PSLs external to the P-Reactor Building (105-P);
- ISD of the P-Reactor Building (105-P) Complex included:
    - Leaving the P-Reactor Building (105-P) Complex (Process, Purification, and Assembly Areas) and the Actuator Tower in place;
    - Installing ten evaporators to treat the P-Reactor Disassembly Basin water;
    - Demolishing the above-grade structure of the Disassembly Area to grade-level;
    - Grouting the below grade portions of the P-Reactor Building (105-P) including Disassembly Basin and the Purification Area (86,170 m^3 [112,706 yd^3] total) to stabilize contaminants;
    - Removing the stack above the plus 16.8-m (55-ft) elevations;
    - Constructing a new partial roof over the shield door slots to prevent rainwater ingress;

  - Grouting the Reactor Vessel in place (90.2 m^3 [118 yd^3]) and placing a 1.2-m (4-ft) thick constructed concrete cover over the Reactor Vessel; cover is sloped to allow water runoff in the event of future rainwater ingress;
  - Leaving the Process Room, an above-grade structure, in its current state; and
  - Placing a sloped concrete cover over the grouted Disassembly Basin;
- Monitoring the groundwater adjacent to the P-Reactor Building (105-P) Complex via eight monitoring in order to verify the effectiveness of the ISD remedy; and
- LUCs were placed on the 50 hectares (126 acres) comprising the PAOU and include the following:
  - For the near term, signs would be posted to alert on-site workers to the presence of hazardous substances and to prevent unauthorized entry and unrestricted uses:
  - Access controls and use restrictions for on-site workers via the Site Use/Site Clearance Program. Other administrative controls to ensure worker safety include work controls, worker training, and worker briefings of health and safety requirements;
  - SRS access controls to prevent exposure to trespassers, as described in the 2013 RCRA Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary; and
  - In the long term, if the property or any portion thereof, is ever transferred from USDOE, notice of the type and quantity of any hazardous substances that were known to have stored (for more than one year), released, or disposed of on the property will be provided. In addition, if the property or any portion thereof, is every transferred by deed, the U.S. Government will satisfy the requirements of CERCLA 120(h)(3) to include a description of the remedial action taken, a covenant, and an access clause.

System Operations/Operation and Maintenance

Currently, there are no systems in operation at the PAOU: Operations are complete for two systems: 1) the ten evaporators, which treated 15.1 million L (4 million gal) of Disassembly Basin water; and 2) PSA-3A and PSA-3B SVEs because the RGs have been met.

The following maintenance activities are ongoing:

- Monitoring of groundwater adjacent to the P-Reactor Reactor Building (105-P) per the PAOU Effectiveness Monitoring Plan (EMP) (SRNS 2010c); and
- Annual site inspections that include:
    - The roof structure of the P-Reactor Building (105-P) to ensure that it is functioning properly. Herbicides will be applied as necessary to prevent the growth of woody vegetation on the roof structure;
    - The doors into the P-Reactor Building (105-P) to ensure they remain sealed;
    - The Disassembly Basin cover to ensure that excessive deterioration has not occurred and no woody vegetation is growing on the cover;
    - The P-Area Ash Basin (188-P) cover to verify that significant erosion has not occurred (60 cm [2 ft] thickness maintained), to ensure that no woody vegetation is growing on the cover, and to confirm that no burrowing or mounding animals are present;
    - The PAOU to ensure that are no unauthorized excavations, digging, or construction activities have occurred within the LUC boundaries; and
    - Inspection and maintenance of access control warning signs.

Table N-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (SRNS 2010d). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $901,200 for annual inspections, maintenance, groundwater monitoring, and LUCs. The actual O&M cost for

FY2012 to FY2016 is $541,096. The actual costs are lower than estimated because the estimated costs in the ROD extended beyond the end of SVE activities in 2013.

V. Progress since Last Review

The previous protectiveness statement concluded that the remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated groundwater and soil media. All threats to contaminated soil at the PAOU have been addressed through implementation of soil covers, ISD, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the PAOU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

Monitoring activities since the last review indicate tritium concentrations are consistent with previous sampling results.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII, References;
- Confirmed the implementation of the Remedial Actions;
- Inspected the OU, interviewed maintenance personnel and documented the results on the Inspection Checklist provided in Attachment N-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Groundwater monitoring data collected per the PAOU EMP (SRNS 2010c) was evaluated to assess the effectiveness of the ISD portion of the remedy (Table N-4). Groundwater is addressed separately in the PAGW OU.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, on September 20, 2016, and Steve Willingham, O&M staff member, on September 20, 2016 at the O&M organization offices. No issues were identified during these interviews.

The PAOU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 17, 2016. No issues were identified for the PAOU during this inspection. A site inspection was conducted by U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 to FY2016 identified overgrown vegetation and evidence of hog damage. These findings were documented on the field inspections checklists and resolved soon after discovery.

In May 2017, SRNS personnel observed a flaw on the southeast corner of the 105-P Actuator Tower concrete roof slab (Figure N-6). Additional investigation and review of annual aerial photography taken after roof construction showed that the flaw was present within one year after the roof slab placement in 2011. The flaw exposed a small portion of the epoxy coated rebar, but no visible corrosion was observed. SRNS initiated a structural evaluation of the integrity of the concrete cap and determined that the flaw does not threaten the underlying Actuator Tower (SRNS 2017). There is no indication the flaw will allow water to enter the building and the roof slab continues to function properly as designed.

A description of the roof slab flaw and the structural evaluation was transmitted to the USEPA and SCDHEC on June 12, 2017. SRNS will continue to evaluate the flaw for signs of degradation during the PAOU annual inspections and document any changes on the Field Inspection Checklist.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedies selected from the PAOU are functioning as expected as described below:

PSA 3A and 3B

Based on the soil sampling results, vadose zone soil concentrations are below the RG (0.53 mg/L) for trichloroethylene (TCE) and tetrachloroethylene (PCE) (SRNS 2013). Therefore, the operations associated with the MicroBlower™ and passive BaroBall™ systems at PSA 3A and 3B have been completed.

High Contamination Area (HCA) at the P-Area Cask Car Railroad Tracks

The removal action was completed and met the removal action objectives (SRNS 2010a). LUCs were required to prevent exposure to any potential residual contamination. Annual inspections have indicated that no disturbance has occurred in the area.

P-Area Ash Basin (188-P) (including Outfall P-007)

The removal action was completed and met the removal action objectives (SRNS 2012), of excavating cesium-137-contaminated soil/ash exceeding 10 ρCi/g, consolidating soil and ash into the P-Area Ash Basin, and installing a 0.6-m (2-ft) thick soil cover over P-Area Ash Basin (188-P) and Outfall P-007 to prevent exposure of the industrial worker to carcinogenic risk exceeding 1E-06. Annual inspections have indicated that the soil cover continues to be in good condition.

P-Area Process Sewer Lines As Abandoned (PSLs)

The dewatering of the P-Area PSLs (lines/structures), isolating/plugging of contaminated process sewer and storm water lines, grouting accessible openings to grade, including structures, manholes, catch basins, inlet pipes, outfalls, and other miscellaneous access points, installing concrete plugs in openings and/or placing concrete covers over entire structures, removing equipment associated with P-Area PSLs external to the P-Reactor Building (105-P); and sealing/plugging outfalls, prevents exposure of the industrial worker to carcinogenic risk exceeding 1E-06. Annual inspections have indicated that no disturbance has occurred in the area.

ISD of the P-Reactor Building (105-P) Complex

The activities and operations that have been completed for ISD of the P-Reactor Complex (SRNS 2012) prevent exposure to the industrial worker to carcinogenic risks exceeding 1E-06, and include the following:

- Leaving the P-Reactor Building (105-P) Complex (Process, Purification, and Assembly Areas) and the Actuator Tower in place;
- Dewatering and grouting of P-Reactor Disassembly Basin and placing a concrete cover over the grouted basin;
- Demolishing the above-grade structure of the Disassembly Area to grade-level;
- Grouting the below-grade portions of the P-Reactor Building (105-P);
- Removing the Stack above the plus 16.8-m (55-ft) elevations;
- Constructing a new partial roof over the shield door slots;
- Grouting the Reactor Vessel in place and placing a 1.2-m (4-ft) thick constructed concrete cover over the Reactor Vessel;
- Leaving the Process Room, an above-grade structure, in its current state;
- Monitoring the groundwater adjacent to the P-Reactor Building (105-P) Complex via eight monitoring in order to verify the effectiveness of the ISD remedy; and
- Placing LUCs on the 50 hectares (126 acres) comprising the PAOU.

The Land Use Control Implementation Plan for PAOU governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (SRNS 2010b). All LUC objectives are being met.

Per the EMP (SRNS 2010c), groundwater monitoring will take place at eight wells located around the P-Reactor Building (105-P) (Figure N-5). Because the timeframe for groundwater impacts (if any) is over 1,000 years, groundwater sampling will occur every five years to support the remedy review analysis.

The 2012 sampling results for all contaminant migration constituents of concern (CMCOCs) are shown on Table N-4. In addition, a comparison of the 2012 results to the 2014 sampling results for lead and tritium are included in Table N-4. All other radionuclides were non-detects. The maximum concentration of lead (7.1 µg/L) is below the maximum contaminant limit (MCL) (15 µg/L), as listed in the EMP (SRNS 2010c). Only two of the eight tritium samples had concentrations exceeding the MCL (20 ρCi/ml) with the maximum concentration being 33.5 ρCi/ml. These results are consistent with prior results that indicate tritium is present in the groundwater in the vicinity of the P-Reactor Building (105-P).

The annual site inspection confirmed that the roof structure and the P-Reactor Disassembly Basin covers are functioning properly, the doors are sealed, the P-Area Ash Basin (188-P) cover is in good condition, and the LUCs are preventing human health exposure (Attachment N-1).

Overall Technical Assessment

The early remedial actions, removal actions, and final remedial action are meeting the RGs established for the PAOU, as discussed in Section IV, by eliminating or controlling all routes of exposure to residual radioactive or chemical contamination to the industrial worker, eliminating water flow through the P-Area PSLs, preventing the migration of VOCs from the vadose zone to the groundwater, and preventing the exposure of contaminated media or structures to residential receptors.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid. There have been no changes in the physical conditions at the PAOU that would affect the protectiveness of the remedy.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the PAOU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

With regard to the CCRTs and P-007 subunits, more stringent 2016 preliminary remediation goals (PRGs) / regional screening levels (RSLs) would not impact the protectiveness of the remedy because excavation of highly contaminated media followed by application of clean soil to grade eliminates exposure of human receptors to remaining soil contaminants left in place. Similarly, installation of a soil cover eliminates the human health exposure pathway at the P-Area Ash Basin (188-P) and Outfall P-007. Exposure to contamination left in place at the P-Reactor Building Complex has been eliminated by the ISD remedy as well as grouting the points of access at the PSL subunit. There have been no changes in the MCLs for TCE and PCE that would have impacted SVE operations in PSA 3A and PSA 3B vadose zones that were completed in 2013. Finally, more stringent PRGs/RSLs would not impact the LUCs that are in place to prevent exposure to contaminated media at the PAOU.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy from being protective.

IX. Recommendations and Follow-up Actions

An evaluation of the CMCOCs included as part of the groundwater monitoring to verify the effectiveness of the ISD remedy was conducted. Ten radionuclides in addition to lead are identified as CMCOCs (Table N-4). However, none of these radionuclides are predicted to impact groundwater sooner than the year 2230, and many are not predicted to impact groundwater over 1,000 years (SRNS 2010c). In addition, many of the radionuclides require specialized analytical methods, as they are very uncommon. All results from the 1Q2012 sampling event were non-detect. Thus, SRS proposes to reduce the analytical list to those constituents that have the fastest travel times as predicted by the model (220 years for carbon-14, chlorine-36, and technetium-99). An addendum to the PAOU Effectiveness Monitoring Plan (SRNS-RP-2010-00894) will be completed to reflect this change.

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

X. Protectiveness Statement(s)

The remedy at PAOU is expected to be protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated groundwater and soil media. All threats to contaminated soil at the PAOU have been addressed through implementation of soil covers, in situ decommissioning, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the PAOU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2009a. *Explanation of Significant Difference to the Revision 1.1 Early Action Record of Decision for the P-Area Operable Unit (U),* SRNS-RP-2009-00704, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2009b. *Removal Site Evaluation Report / Engineering Evaluation / Cost Analysis for the P-Area Ash Basin (including Outfall P-007) (188-P) and the R-Area Ash Basin (188-R) (U),* SRNS-RP-2009-01064, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2009c. *Removal Site Evaluation Report / Engineering Evaluation / Cost Analysis for the P-Area Process Sewer Lines As Abandoned (NBN) Subunit for the P-Area Operable Unit (U),* SRNS-RP-2009-01046, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010a. *Early Action Post Construction Report for the P-Area Cask Car Railroad Tracks Subunits (U),* SRNS-RP-2010-00796, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010b. *Land Use Control Implementation Plan for the P-Area Operable Unit (U)*, SRNS-RP-2010-00619, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010c. *P-Area Operable Unit Effectiveness Monitoring Plan*, SRNS-RP-2010-00894, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2010d. *Record of Decision Remedial Alternative Selection for the P-Area Operable Unit (U)*, SRNS-RP-2009-01368, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2012. *Post Construction Report for the P-Area Operable Unit (U)*, SRNS-RP-2011-01582, Revision 0, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2013. *Performance Evaluation Report for the P-Area Operable Unit Potential Source Areas 3A and 3B Subunits*, SRNS-RP-2012-00335, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2017. *105-P Actuator Tower Roof Slab Flaw at the Southeast Corner*, SRNS-E3520-2017-00008-SM, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2008a. *Early Action Record of Decision Remedial Alternative Selection for the P-Area Operable Unit (U)*, WSRC-RP-2008-4037, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2008b. *RCRA Facility Investigation / Remedial Investigation (RFI/RI) Report with Baseline Risk Assessment and Corrective Measures Study / Feasibility Study (CMS/FS) for the P-Area Operable Unit (U)*, WSRC-RP-2007-4032, Revision 1.2, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

Various – Inspection Data Sheets - *Field Inspection Checklist for P-Area Ash Basin and P-007 Outfall*, ER-IDS-019-061, Inspections begin in 2012 (annually)

Various – Inspection Data Sheets - *Field Inspection Checklist for P-Area Operable Unit*, ER-IDS-019-066, Inspections Period 2012 through 2016(annually)

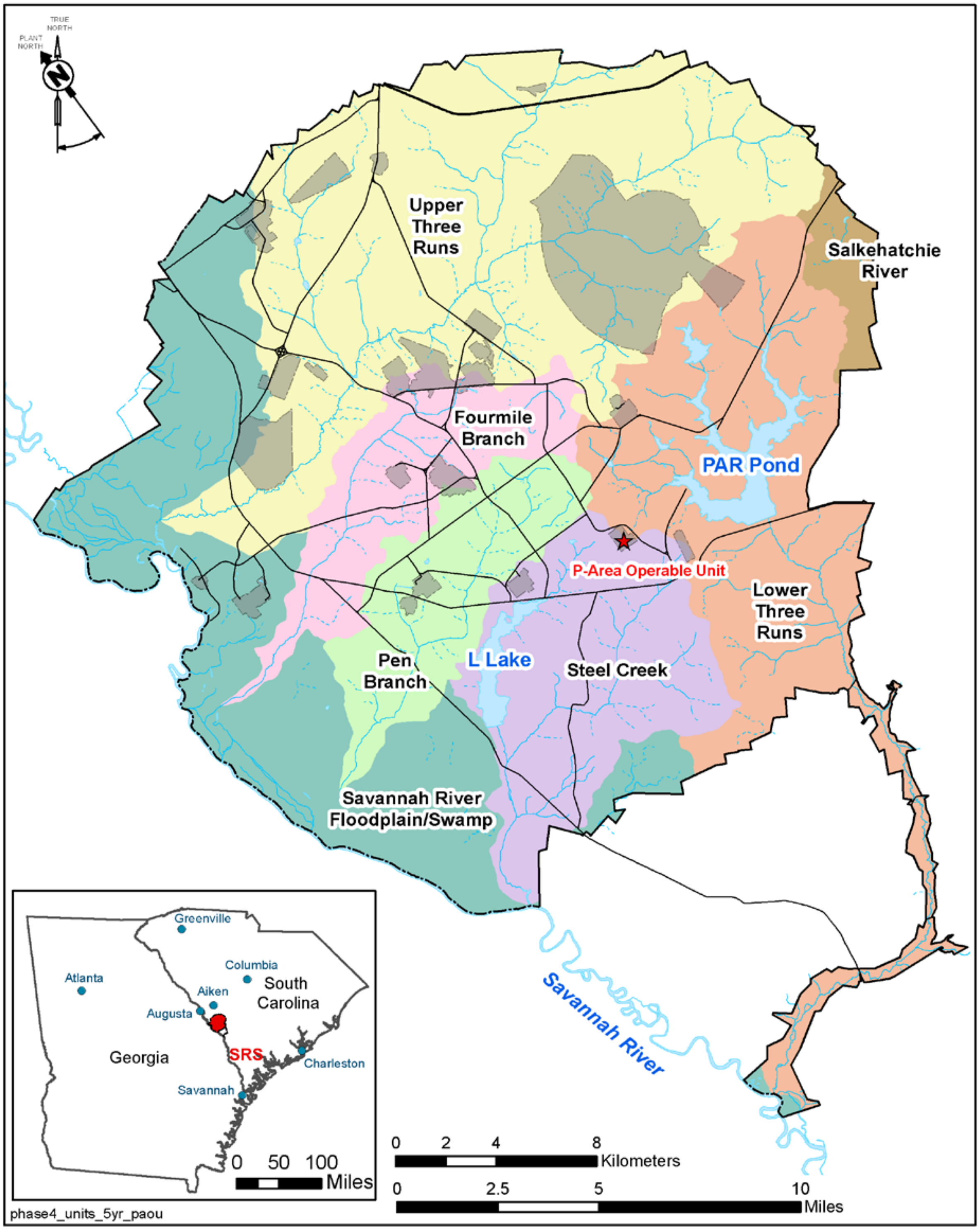


Figure N-1. Location of PAOU at SRS

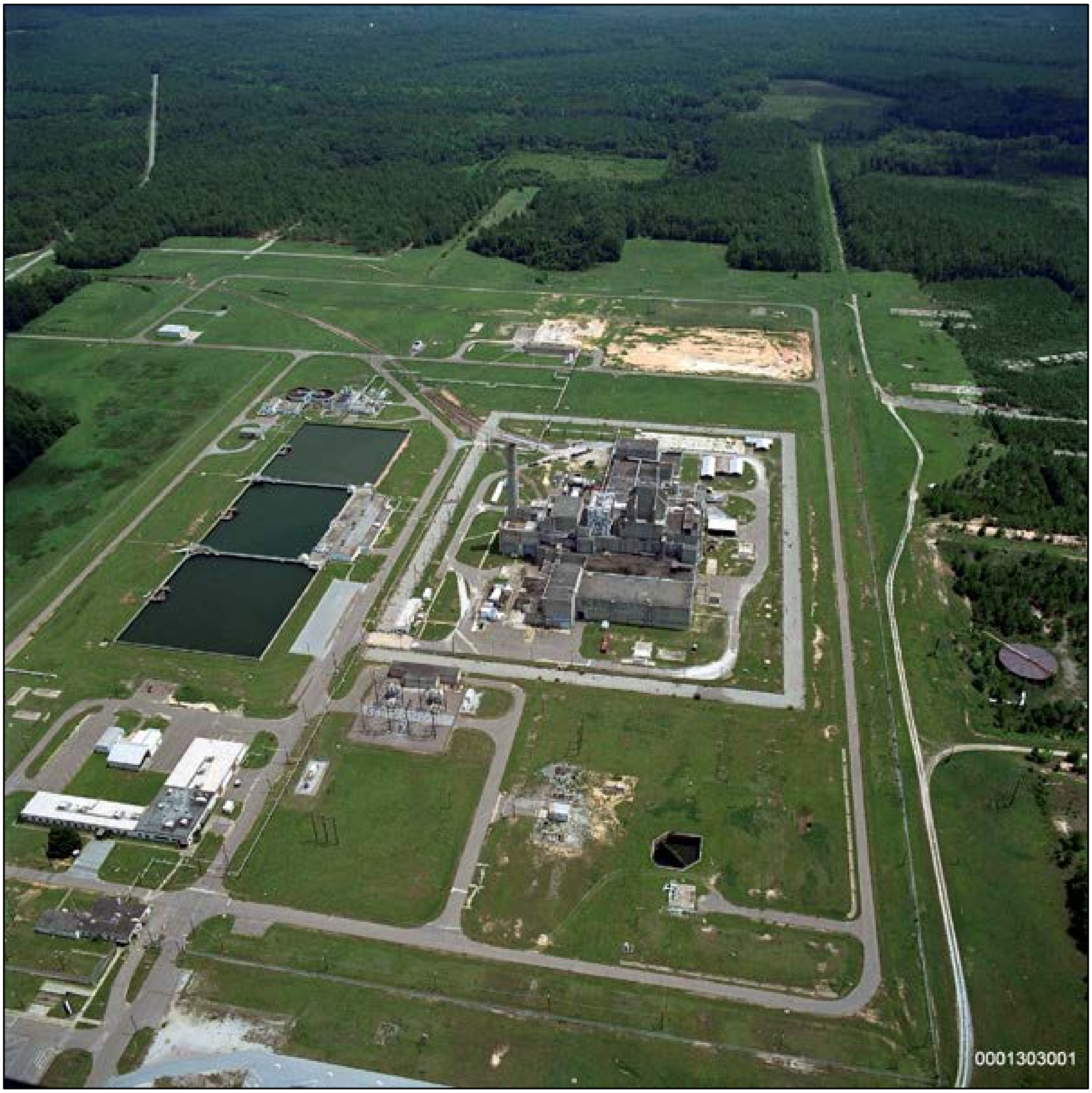
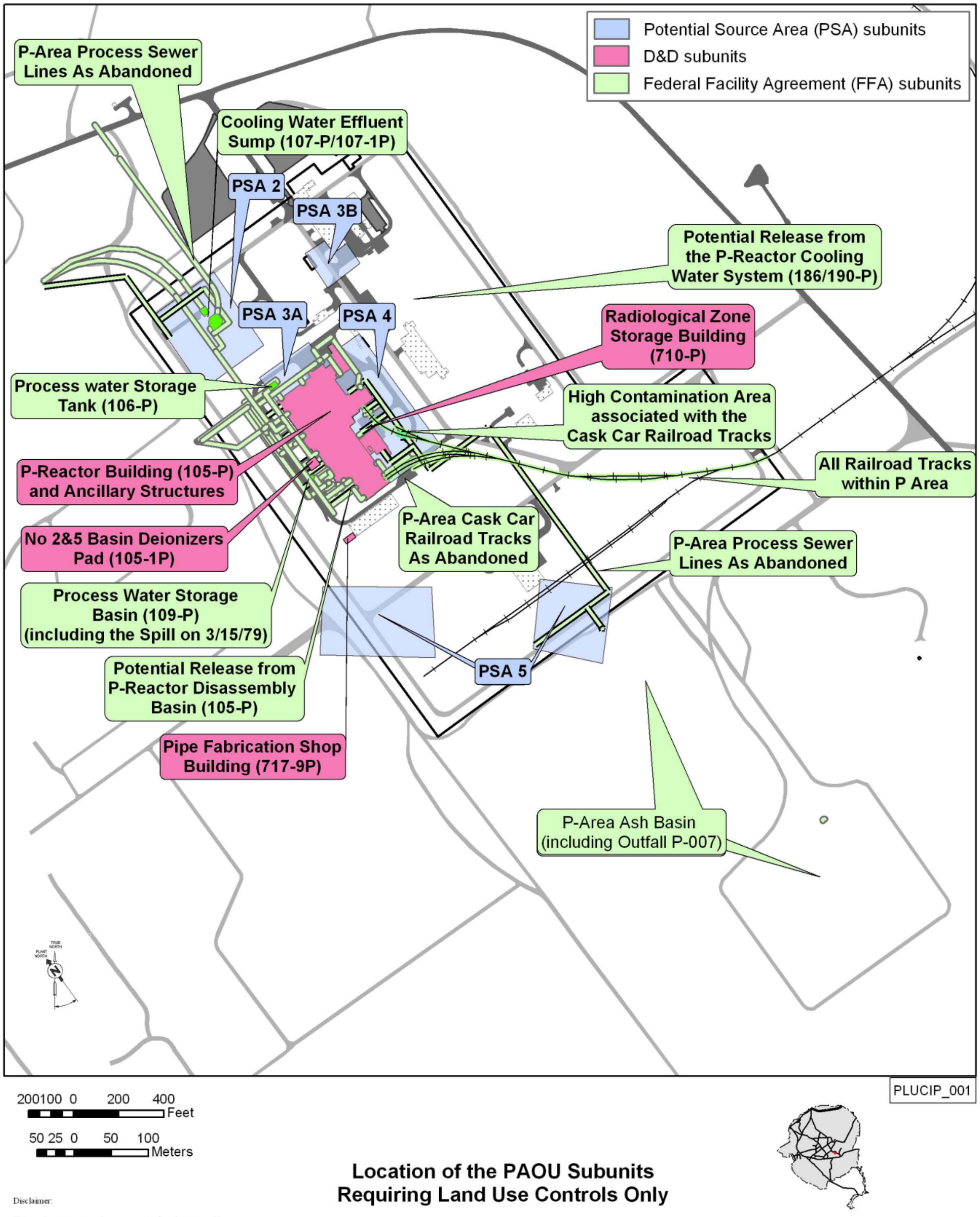


Figure N-2. Photograph of PAOU Before Remedial Activities (2000)

Figure N-3. Photograph of PAOU after Remedial Activities (2011)



Location of the PAOU Subunits Requiring Land Use Controls Only

Projection: Universal Transverse Mercator
Datum: North American Datum 1927
Zone: 17

To place on the North American Datum 1983, move the projection line 13 meters south and 15 meters west.

Figure N-4. Location of PAOU Subunits

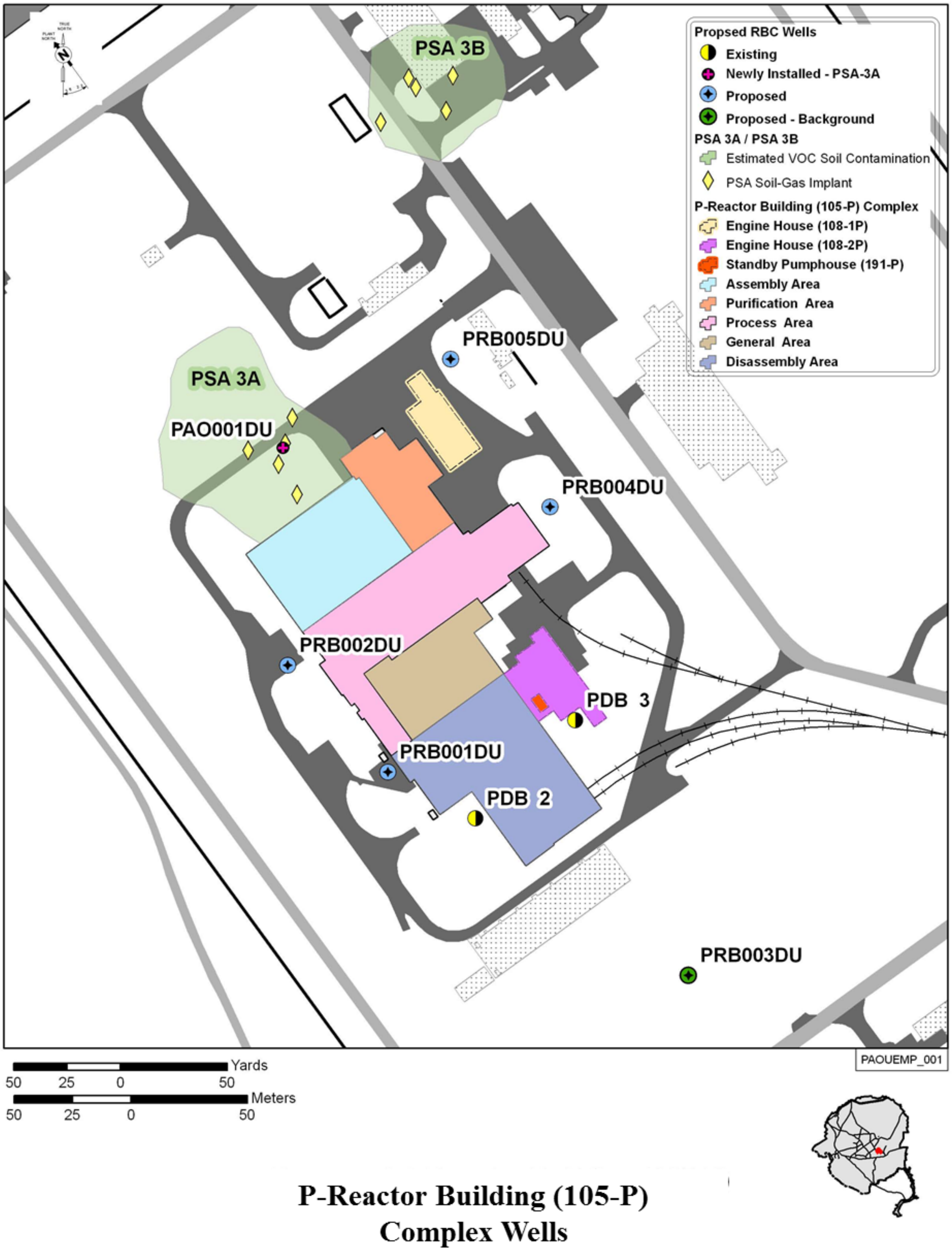


Figure N-5. Location of Groundwater Wells Monitoring the P-Reactor Building (105-P)

Figure N-6. View of 105-P Actuator Tower Roof Cap Flaw (2017)

Table N-1. Chronology of OU Events

Event	Date
EAROD Issuance	January 29, 2009
ESD Issuance	October 27, 2009
Early Action Construction Start/Complete – PSAs, CCRT, PSLs, P-Area Ash Basin, P-Reactor Building (105-P)	November 24, 2009 / August 19, 2011
Early Action Operations Start / Complete – PSA	November 3, 2010 / May 15, 2013
ROD Issuance	July 22, 2010
Final Remedial Action Construction Start / Finish	November 29, 2010 / September 16, 2011
Previous Five-Year Reviews Issuance	February 4, 2014

This page is intentionally left blank.

Table N-2. PAOU Refined COCs and RGs

Waste Unit	Refined COCs	Units	Type of Refined COCs				RG
			PTSM	HH	ECO	CM	
P-Area Ash Basin (including Outfall P-007) (ash/soil media)	Arsenic	mg/kg		X			8.20E+00
	Potassium-40	ρCi/g		X			3.30E+00
	Cesium-137 (+D)	ρCi/g		X			1.00E+00[1]
	Cobalt-60	ρCi/g		X			5.96+E-02
	Radium-226 (+D)	ρCi/g		X			1.20E+00
	Radium-228 (+D)	ρCi/g		X			2.20E+00
	Thorium-228 (+D)	ρCi/g		X			2.20E+00
	Uranium-238 (+D)	ρCi/g		X			1.79E+00
PSA-3A - Area Near Northern End of Reactor Building (soil media)	Trichloroethylene	mg/kg				X	5.30E-01
PSA-3B - Area West of Administration/ Maintenance Slab (soil media)	Tetrachloroethylene	mg/kg				X	5.30E-01
High Contamination Area (HCA) Associated with the P-Area Reactor Cask Car Railroad Tracks as Abandoned (gravel/soil media)	Cesium-137 (+D)	ρCi/g	X	X			1.00E+00
	Cobalt-60	ρCi/g		X			5.96E-02
105-P Reactor Vessel (metal media)	Barium-133	ρCi/g	X	X			3.06E-01
	Carbon-14	ρCi/g		X		X	8.83E+03
	Cobalt-60	ρCi/g	X	X			6.02E-02
	Europium-152	ρCi/g	X	X			7.37E-02
	Europium-154	ρCi/g		X			8.58E-02
	Iron-155	ρCi/g		X			2.21E+05
	Molybdenum-93	ρCi/g		X		X	8.47E+02
	Nickel-59	ρCi/g		X		X	1.23E+05
	Nickel-63	ρCi/g	X	X			5.55E+04
	Niobium-94	ρCi/g		X			3.00E-02
	Potassium-40	ρCi/g		X		X	2.74E-01
	Technetium-99	ρCi/g				X	
Reactor Building (105-P) and Ancillary Structures (concrete media)	Aroclor 1254	ρCi/g		X			7.44E+00
	Cesium-137 (+D)	ρCi/g	X	X			1.13E-01
	Cobalt-60	ρCi/g	X	X			6.02E-02
	Strontium-90 (+D)	ρCi/g		X			1.43E+01
	Uranium-238 (+D)	ρCi/g		X			1.90E+00

Table N-2. PAOU Refined COCs and RGs *(continued/end)*

Waste Unit	Refined COCs	Units	Type of Refined COCs				RG
			PTSM	**HH**	**ECO**	**CM**	
105-P Disassembly Basin[1] (sediment media)	Americium-241	ρCi/g	X	X			5.71E+00
	Americium-243 (+D)	ρCi/g	X	X			3.41E-01
	Antimony-125 (+D)	ρCi/g	X	X			7.50E-01
	Carbon-14			X		X	1.23E+03
	Curium-243/244	ρCi/g	X	X			6.74E-01
	Curium-245	ρCi/g	X	X			8.70E-01
	Cobalt-60	ρCi/g	X	X			5.96E-02
	Cesium-137 (+D)	ρCi/g	X	X			1.12E-01
	Europium-152	ρCi/g	X	X			7.31E-02
	Europium-154	ρCi/g	X	X			8.50E-02
	Tritium	ρCi/g	X	X			4.23E+00
	Potassium-40	ρCi/g	X	X		X	2.71E-01
	Molybdenum-93					X	
	Sodium-22	ρCi/g	X	X			1.40E-01
	Niobium-94	ρCi/g	X	X			2.97E-02
	Nickel-59					X	
	Nickel-63			X		X	5.55E+03
	Plutonium-238	ρCi/g	X	X			1.66E+01
	Plutonium -239/240	ρCi/g	X	X			1.45E+01
	Radium-228 (+D)	ρCi/g	X	X			1.49E-01
	Thorium-228 (+D)	ρCi/g	X	X			2.52E-01
	Strontium-90 (+D)	ρCi/g	X	X			1.07E+01
	Uranium	mg/kg	X	X			2.04E+02

1 - Only the major risk drivers (i.e., risk > 1E-03) for the Disassembly Basin are identified in this table, unless they are also considered CMCOCs. Several other radiological constituents have a risk < 1E-03 but > 1E-06.

.

Table N-3. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	170,096	33,116	137,867	79,601	120,416	541,096
Total ROD Estimated Direct O&M Costs* ($)	274,700	215,500	215,500	105,500	90,000	901,200

* Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Table N-4. PAOU ISD Well Data

	Lead (MCL 15 µg/L)		Tritium (MCL 20 ρCi/mL)	
Well Name	**2012**	**2014**	**2012**	**2014**
PDB 2	ND	2.9E-01	3.02E+01	5.1E+00
PDB 3	1.48E+00	2.0E+00	8.33E+00	ND
PAO001DU	ND	1.1E+00	2.14E+00	3.8E+00
PRB001DU	ND	1.7E+00	2.50E+01	5.5E+00
PRB002DU	ND	7.1E+00	6.65E+01	2.3E+01
PRB003DU	ND	3.3E-01	1.27E+00	1.24E+00
PRB004DU	ND	2.6E-01	1.62E+01	3.4E+01
PRB005DU	ND	9.8E-01	1.02E+00	6.7E-01

ND = nondetect
Colored blocks indicate results are greater than the MCL.

Table N-5. Recommendations and Follow-up Actions for the P-Area Operable Unit

Issues	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
					Current	Future
Ten radionuclides identified as CMCOCs are not predicted to impact groundwater before the year 2230. Many of these radionuclides require specialized analytical methods.	• Reduce analyte list to radionuclides that have the fastest travel times as predicted by the model (i.e., carbon-14, chlorine-36, technetium-99). • The change to the monitoring strategy will be documented in an addendum to the PAOU Effectiveness Monitoring Plan.	USDOE	USEPA/ SCDHEC	September 2018	N	N

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit

I. SITE INFORMATION

Site Name:	**P-Area Operable Unit**	**Date of Inspection:**	**9/14/2016**
Location and Region	**SRS, USEPA Region 4**	**CERCLIS #:**	**#94**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**89°F** **Cloudy**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other ISD by grouting, SVE

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Post Closure Manager (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: ____________ (Name) ____________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

4. **Other Interviews** *(Optional):* ☐ Report Attached ____________________

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for P-Area Ash Basin and P-007 Outfall*, ER-IDS-019-061, and *Field Inspection Checklist for P-Area Operable Unit*, ER-IDS-019-066

____

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201,HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☒ Air Discharge Permit ☒ Readily Available ☒ Up to Date ☐ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☒ Air ☒ Readily Available ☒ Up to Date ☐ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House ☐ Contractor for State
☐ PRP In-House ☐ Contractor for PRP
☒ Other: SRS

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:________ To:________ ________ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:________ To:________ ________ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:________ To:________ ________ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:________ To:________ ________ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:________ To:________ ________ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ________

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office

Contact:	Phil Prater	IACD Program Manager	11/17/2016	803-952-9333
	(Name)	(Title)	(Date)	(Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:____________________

B. Other Site Conditions

Remarks: Site inspections conducted annually from FY2012 through FY2016 identified overgrown vegetation and evidence of hog damage. These findings were resolved soon after being discovery.
.____________________

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent__________ Depth__________
Remarks:____________________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths__________ Widths__________ Depths__________
Remarks:____________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________ Depth__________
Remarks:____________________

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent__________ Depth__________
Remarks:____________________

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress
Areal extent__________ Depth__________
Remarks:____________________

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:____

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent_________________ Depth____________________

Remarks:____

8. Wet Areas / Water Damage: ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent______________________

☐ Ponding ☐ Location shown on site map Areal extent______________________

☐ Seeps ☐ Location shown on site map Areal extent______________________

☐ Soft subgrade ☐ Location shown on site map Areal extent______________________

Remarks:____

9. Slope Instability: ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent_________________

Remarks:____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident
Areal extent__________________ Depth_____________________
Remarks:____

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent____________________ Type_____________________
Remarks:____

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________________ Depth_____________________
Remarks:____

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks:____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. ISD by grouting, SVE ☒ Applicable ☐ N/A
Operations associated with the SVE were completed in 2013. The remedy is performing as designed.

Attachment N-1. Five-Year Review Site Inspection Checklist – P-Area Operable Unit *(continued)*

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this site is ISD, SVE, cover system, and LUCs to eliminate or control all routes of exposure to residual radioactive or chemical contamination. All systems appear to be functioning as expected. The operations associated with the SVE systems at PSA 3A and 3B were completed in 2013.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (verify no invasive activities have occurred and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining PAOU and the condition of its warning signs is good. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

P-AREA REACTOR SEEPAGE BASINS (904-61G, 904-62G, AND 904-63G) (PRSB) OPERABLE UNIT

I. Introduction

This is the third five-year remedy review for the P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) (PRSB) Operable Unit (OU). This review was conducted from August 2016 through November 2016. Contaminants have been left in place at the PRSB OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the PRSB OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table O-1 lists the chronology of site events for the PRSB OU.

III. Background

PRSB OU is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media associated with this OU is soil.

Physical Characteristics

The PRSB OU is located in the central portion of Savannah River Site (SRS) west of P Area (Figure O-1). The ground slopes southwestward toward Steel Creek, approximately 762 m (2,500 ft) to SRS west. Figure O-2 presents a plan view of the basins. Figures O-3, O-4, and O-5 provide photographs of the OU in 2004 to 2005, 2010 and 2016, respectively. Three unlined (earthen) basins comprise the PRSB OU. Basin 1 (904-61G) is L-shaped and was constructed with approximate outside dimensions of 633.3 x 15 m (211 x 50 ft) in the north-south direction and 76.2 m (254 ft) in the east-west direction at a depth of 3.9 to 5.1 m (13 to 17 ft) below ground surface (bgs). Basin 2 (904-62G) was constructed with approximate outside dimensions of 633.3 x 21 m (211 x 70 ft) at a depth of 2.4 m (8 ft) bgs. Basin 3 (604-63G) was constructed with approximate outside dimensions of 102 x 21 m (340 x 70 ft) at a depth of 2.7 m (9 ft) bgs.

Two inactive process sewer lines (IPSLs) extend from the P-Reactor Disassembly Basin to the eastern end of Basin 1. Both IPSLs are 7.5 cm (3 in) in diameter, approximately 198 m (660 ft) in length, with one having been constructed of high-density polyethylene and the other constructed of carbon steel.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999a) designates PRSB OU as being within the site industrial support area. The future land use for PRSB OU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The basins were constructed in 1957. From 1957 until 1970 and from 1978 until 1991, the IPSLs conveyed low-level radioactive purge water from the P-Reactor Disassembly Basin to the PRSBs. Historical records indicate that the original IPSL leaked in an area east of Basin 1, contaminating the soils in a 4.5 x 9 m (15 x 30 ft) area. A second line was installed as a replacement; however, the contaminated soils at the original leak site were not removed during this installation.

Cascade overflow pipes connect Basin 1 to Basin 2 and Basin 2 to Basin 3. The cascade overflow pipes are 30 cm (12 in) in diameter and are made of corrugated steel. Flow between the basins was via the cascade overflow pipes positioned near the top of the basin walls.

The PRSBs were used from 1957 to 1970 to dispose of low-level radioactive process purge water from the P-Reactor Disassembly Basin. In 1963, disassembly basin wastewater was deionized and filtered prior to discharge, which reduced radioactivity and removed solids and sludges. The seepage basins were not used from 1971 to 1977 and the disassembly basin purge water was mixed with large volumes of heat exchanger cooling water and discharged to area streams. General maintenance was performed on the P-Reactor Disassembly Basin, and purge water discharges to the seepage basins resumed in 1978. The PRSBs did not receive wastewater after P-Reactor was shut down for repairs in 1991.

During the entire operation of the PRSBs, it is estimated that 70,000 Ci of tritium, 4.74 Ci of strontium-90, 19.5 Ci of cesium-137, and 0.835 Ci of other beta-gamma emitters were released to the PRSBs.

Initial Response

No initial response actions were taken at the PRSB OU prior to issuance of the Plug-in Record of Decision (ROD), which is described in Section IV.

Basis for Taking Action

The Plug-In ROD states that constituents of concern (COCs) will be established in the Technical Evaluation Report (TER) for each unit based primarily on principal threat source material (PTSM) criteria, and also considering the conceptual site model, and comparison against the human health and contaminant migration remedial goals (RGs) established in this ROD (WSRC 1999b). As documented in the TER (WSRC 2003a) and summarized in the Explanation of Significant Difference (ESD) (WSRC 2003b) for the PRSB OU, radiologically contaminated soils in the seepage basins presented a significant potential external exposure risk to future industrial workers. Cesium-137 was identified as the main contributor to PTSM at all locations within the OU. PTSM is identified as media that poses a cancer risk to the future industrial worker equal to or greater than 1E-03. In addition, cobalt-60 was a contributor to the PTSM in Basin 1. Two contaminants, arsenic and strontium-90, were identified as having the potential to leach from soils to the groundwater if no action were taken (WSRC 2003a). Upon placement of the low permeability soil cover, no residual contaminants are predicted to leach to groundwater from the PRSB OU.

Thus, cesium-137 and cobalt-60 are considered human health COCs, and strontium-90 and arsenic are considered contaminant migration COCs. PTSM was identified in the soils of Basins 1 and 2 to depths below the basin base of 5.7 m (19 ft) and 1.2 m (4 ft), respectively.

Evaluation of Basin 3 identified no PTSM. Evaluation of the soil contamination area (SCA) / underground radiological materials area (URMA) soils identified PTSM to depths below ground surface of 2.1 m (7 ft). The P-Area groundwater (PAGW) has been identified as a separate OU and is, therefore, considered outside the scope of the PRSB OU remedial action. It will be addressed as part of the PAGW OU (WSRC 2003b).

IV. Remedial Actions

Remedy Selection

The Plug-in ROD process was designed to present a common remedy for high-risk radioactively contaminated OUs at SRS with similarities in history of use, contaminants, risk, and location in current industrial areas. In situ stabilization of radiologically contaminated soil that represents PTSM was selected as the common remedy for open reactor seepage basin candidates in the *Plug-in Record of Decision for In Situ Stabilization with Low Permeability Soil Cover for Radiological Contaminants in Soil* approved on January 19, 2000 (WSRC 1999b) and issued for public notice on January 19, 2000. The process streamlined the normal CERCLA documentation process for units that were similar and met the criteria defined in the plug-in ROD. In lieu of Proposed Plan and ROD documents, an ESD (WSRC 2003b) was issued in October 2003. The approved ESD is the document that amends the approved plug-in ROD to include the PRSB OU based on the results of the TER (WSRC 2003a).

As detailed in the plug-in ROD (WSRC 1999b), the following remedial action objectives (RAOs) were established for PRSB OU Basins 1, 2 and 3 and are as follows:

- Prevent human exposure to highly contaminated basin soils (PTSM) by performing stabilization treatment to the extent practicable and filling the basins. Reduce risks to the future worker from surface soils (0 to 0.3 m [0 to 1 ft]) outside the basin by establishing remedial goals (RGs) for COCs at concentrations equivalent to 1E-06 for carcinogens and a hazard quotient of 1 for noncarcinogens or background (where background levels of COCs exceed 1E-06).

- Prevent the release of COCs in soil to groundwater beneath the unit above maximum contaminant levels (MCLs) or risk-based concentrations (when MCLs are not available).
- Protect the ecological receptors indigenous to the area by preventing or limiting contact with contaminated basin soils and pipelines, and preventing the plant and animals from bringing contaminants up towards the surface.

Because the PRSB OU met all plug-in ROD criteria, the remedy of in situ stabilization with a low permeability membrane cover system was the selected remedy for the PRSB OUs. The selected remedy consisted of five components:

- Consolidation of contaminated soil into Basins 1 and 2.
- Grouting and excavation of the IPSLs with placement in Basin 1.
- Solidification/Stabilization (S/S) of Basins 1 and 2. The S/S component of the remedy was not applicable to Basin 3 since PTSM level contamination was not detected in that basin.
- Installation of a low-permeability geosynthetic closure cover.
- Land use controls (LUCs) (institutional controls) to prevent disturbance of the cover system and excavation of PTSM.

Remedy Implementation

Implementation of the selected remedy included the following:

- Consolidated 30.6 m^3 (40 yd^3) of contaminated soil by excavating the SCA/URMA area and any contaminated soils encountered during removal of the IPSLs, and transporting the excavated soils to Basins 1 and 2 for disposal and inclusion with the S/S treatment.
- Consolidated the IPSLs by grouting, excavating, and transporting to Basin 1 for disposal to stabilize any potential contamination left inside the process pipelines and to prevent access by small animals.

- Consolidated contaminated soil (842 m^3 [1,100 yd^3]) and debris (459 m^3 [600 yd^3]) from the L-Area Hot Shop into Basin 3.
- In situ S/S of 5661 m^3 (7,400 yd^3) of PTSM by grouting Basins 1 and 2. Basin 1 soils were grouted to a depth of 3 m (10 ft) at the eastern end of the basin, with the grout decreasing to 0.6 m (2 ft) at the southern leg of the basin. Operational difficulties made grouting beyond a depth of 3 m (10 ft) impracticable. The untreated PTSM, which extends to a depth of 5.7 m (19 ft), resides in low permeability clay that retards contaminant mobility. The geosynthetic closure cover system and the S/S grouted soils above the untreated PTSM will prevent access and exposure to the untreated PTSM. Basin 2 soils were grouted to a depth of 1.2 m (4 ft) below the basin bottom.
- Installed a 0.93-hectare (2.3-acre) low-permeability geosynthetic closure cover over all three of the basins to prevent human exposure to the contaminated basin soils and to reduce water infiltration. The low permeability geosynthetic closure cover system has a lower permeability than the surrounding soils. To protect potential receptors, the minimum cover thickness from the waste is at least 1.8 m (6 ft) as measured through the low permeability geosynthetic closure cover.
- Established LUCs for 1.23 hectares (3.13 acres) (WSRC 2006) to include the following:
  - SRS boundary security gates to prevent exposure to intruders;
  - Visible warning signs located at the most probable access points requiring contact of the custodian prior to entry to the OU;
  - Site controls and land use restrictions via the Site Use/Site Clearance Program to prevent excavation in the area of the pipeline or cover system and restrict invasive and permanent installation activities at the PRSB OU; and
  - Evaluation of the need for deed notification/restrictions if the property is ever transferred to non-federal ownership.

System Operations/Operation and Maintenance

There are no system operational requirements.

The following maintenance activities are ongoing.

- Visual inspections (conducted semiannual through 2014 and annually thereafter) for evidence of damage to the soil cover due to erosion or intrusion by burrowing animals are being performed. The inspections also address upkeep of the vegetative cover and inspections of access controls (e.g., the warning signs, and institutional controls limiting land use); and
- Necessary repairs (e.g., replacing eroded or disturbed soil, sign repair, etc.) and vegetation management (e.g., mowing, removal of larger vegetation, etc.) are being performed when required.

Table O-2 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 1999b). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $117,250 for inspections and maintenance. The actual O&M cost for FY2012 to FY2016 is $92,965. The actual O&M costs are as expected.

V. Progress since Last Review

The previous protectiveness statement from the last Five-Year Remedy Review concluded that because the remedial actions at PRSB OU are protective, the site is protective of human health and the environment. This remedy is protective because receptors will not be exposed to contamination above the appropriate RGs. Exposure pathways that could result in unacceptable risks are controlled by the soil stabilization, low permeability cover system, and institutional controls. In the fourth five-year remedy review, SRS recommended that the cover inspection frequency for the PRSB OU be reduced to annual (SRNS 2014). This reduction would provide adequate monitoring and consistency since the majority of OU covers at SRS are currently inspected annually. On February 6, 2014, the USDOE submitted a letter (USDOE 2014) to U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) to reduce inspection frequencies from semiannual to annual for PRSB. USEPA and SCDHEC approved the request on March 20, 2014 and March 7, 2014, respectively. Annual inspections for PRSB OU began in 2015.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Inspected and photographed the PRSB OU, interviewed maintenance personnel, and documented the results on the Inspection Checklist provided in Attachment O-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

The Post Construction Report (WSRC 2006) documents that contaminated soils in the SCA/URMA and associated with the IPSL were excavated and placed within the basins. The consolidation minimized the lateral extent of contaminated soils. The S/S of the soils within Basins 1 and 2 followed by placement of a low permeability cover resulted in eliminating the exposure pathway for humans or ecological receptors. Review of maintenance inspection reports and a visual inspection of the PRSB OU indicate the structural integrity of the cap is intact in providing protection to human and ecological receptors.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified during this interview

The PRSB OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 21, 2016. No issues were identified for the PRSB OU during this inspection. A site inspection was conducted by USEPA and SCDHEC personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding the PRSB OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 identified~~:~~ active ant mounds, tree growing on soil cover, and evidence of hog damage. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The review of documents, data, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and the results of the site inspection indicates that the remedy is functioning as intended by the plug-in ROD. The S/S of contaminated soils has achieved the RGs to minimize migration of contaminants to groundwater and to prevent human exposure to highly contaminated basin soils (PTSM).

O&M of the cover system has been effective. The main finding being active ant mounds on the soil cover that have been addressed on the spot.

LUCs, including institutional controls, as implemented and monitored via the annual inspections of this unit, and access controls are preventing human activities (such as excavation, disturbance of the cover system) that could result in exposure to contaminated soil. The Land Use Control Implementation Plan for PRSB OU governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (WSRC 2004). All LUC objectives are being met.

The above remedial activities are meeting the RGs established for the PRSB OU by eliminating or controlling all routes of exposure to human health and ecological receptors.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of final remedy selection are still valid. There have been no changes in the physical conditions of the PRSB OU that would affect the protectiveness of the remedy.

The evaluation conducted in the Plug-In ROD (WSRC 1999b) concluded that the remedy of in situ stabilization with a low permeability soil cover for the radiological contaminants in the soil at reactor seepage basins would meets RAOs, prevent exposure, stabilize PTSM, and be protective of human health and the environment. The OU remains within an industrial area with the remedial action taken making the potential for exposure to any residual contaminants negligible.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the PRSB OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

As the remedial work has been completed, most ARARs for soil contamination cited in the plug-in ROD have been met. ARARs that still must be met at this time and that have been evaluated include the Safe Drinking Water Act (40 CFR 141 and SC R.61-58.5) related to maintaining quality of groundwater through source controls. Groundwater is evaluated under the PAGW OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues for this OU.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU.

X. Protectiveness Statement(s)

The remedy at the PRSB OU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated media All threats to contaminated soil at the PRSB OU have been addressed through soil stabilization, implementation of the low permeability cover system, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the PRSB OU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2014. *Fourth Five-Year Remedy Review Report for the Savannah River Site (U) Aiken, South Carolina,* SRNS-RP-2012-00011, Revision 1.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report,* U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

USDOE, 2014. Letter, B. T. Hennessey (DOE) to S. B. Fulmer (SCDHEC) and R. H. Pope (EPA), *Request to Change the Inspection Frequency for Operable Units Based on the Recommendation in the Fourth Five-Year Remedy Review Report for the Savannah River Site (SRNS-RP-2012-00011, Revision 1.1, November 2013), CERCLIS Numbers: 13, 14, 16, 17, 20, 23, 26, 32, 39, and 66,* ACP-14-125, dated February 6, 2014, Department of Energy, Savannah River Operations Office, Aiken, SC

WSRC, 1999a. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC Savannah River Site, Aiken, SC

WSRC, 1999b. *Plug-In Record of Decision for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil (U)*, WSRC-RP-98-4099, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003a. *Unit-Specific Plug-In Technical Evaluation Report for the P-Area Reactor Seepage Basin (904-61G, 904-62G, and 904-63G) Operable Unit (U)*, WSRC-RP-2002-4082, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2003b. *Explanation of Significant Difference (ESD) for the Plug-In ROD for In Situ Stabilization with a Low Permeability Soil Cover System for Radiological Contaminants in Soil- P-Area Reactor Seepage Basin Operable Unit (U)*, WSRC-RP-2002-4105, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004. *Land Use Control Implementation Plan (LUCIP) for P-Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU (U)*, WSRC-RP-2003-4139, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Post-Construction Report (PCR)/Final Remediation Report (FRR) for the P-Reactor Seepage Basins (U)*, WSRC-RP-2005-4088, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

Various - *Inspection Data Sheets – Field Inspection Checklist, P Reactor Seepage Basin Operable Unit (Bldgs. 904-61G, 904-62G, 904-63G) (U)*, ER-IDS-019-035, Inspection period 2012 through 2016 (semiannually through 2014; annually thereafter)

This page is intentionally left blank.

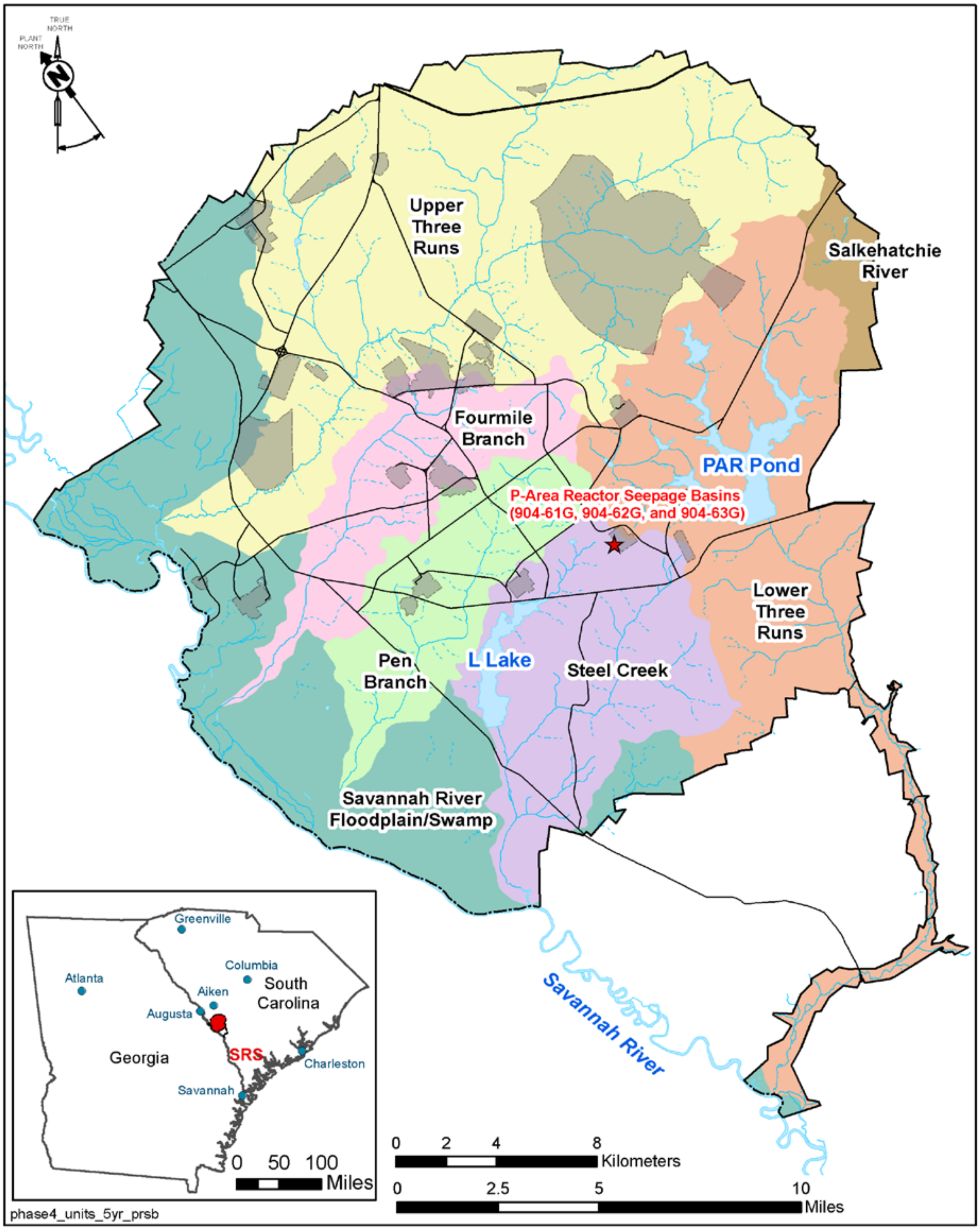


Figure O-1. Location of P-Area Reactor Seepage Basins at SRS

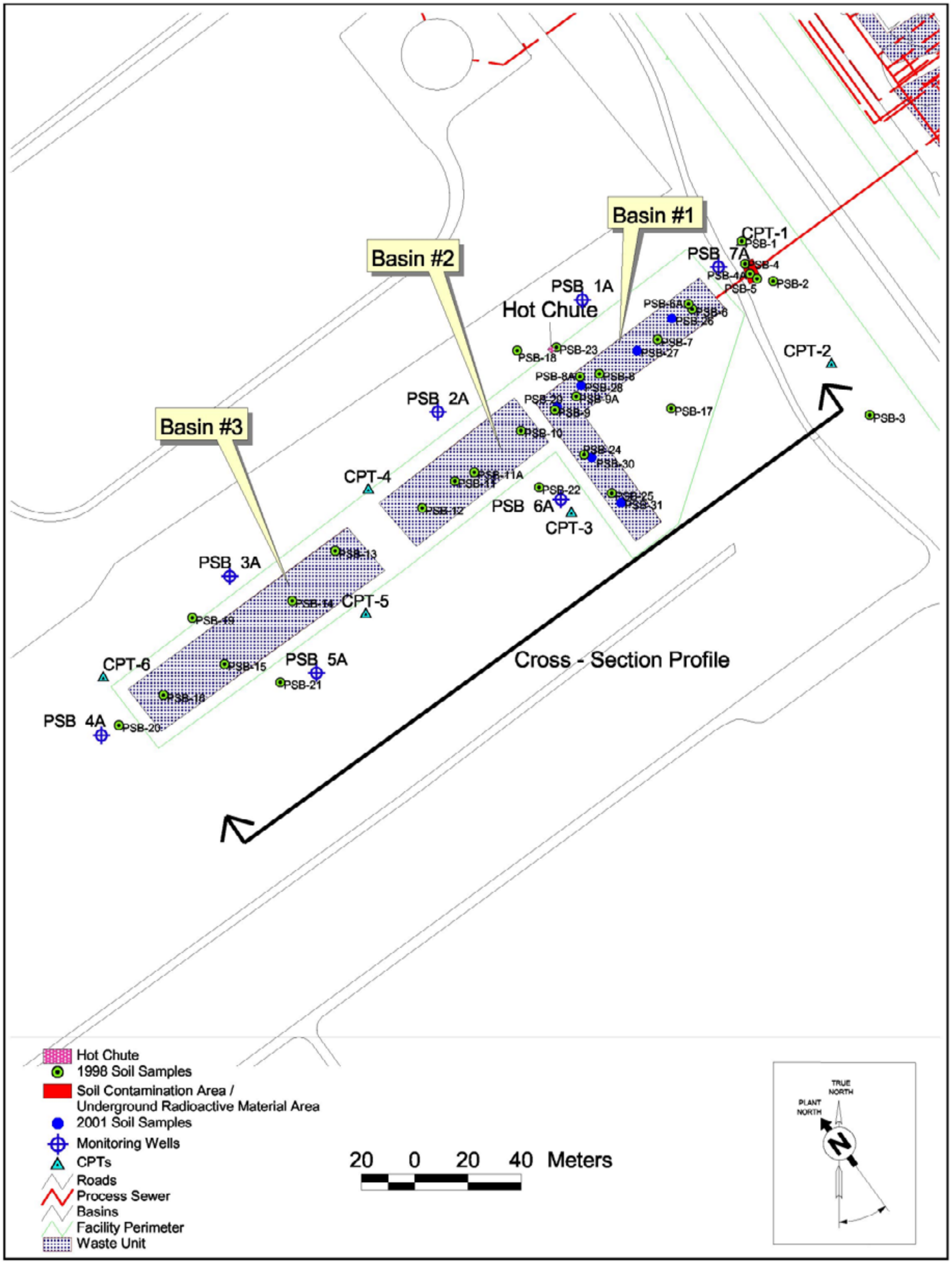


Figure O-2. **Plan View of P-Area Reactor Seepage Basins**

Figure O-3. **Photographs from USDOE Archives Depicting the Remediation of the P-Reactor Seepage Basins (February 2004 through May 2005)**

Figure O-4. **Aerial of the P-Area Reactor Seepage Basins Post-Construction (2010)**

Figure O-5. Photograph of the PRSB OU Cover System (P-Reactor in the Background) (2016)

Table O-1. Chronology of OU Events

Event	Date
Plug-in ROD Issuance	November 29, 1999
ESD Issuance	October 2, 2003
Remedial Action Start/Complete	June 30, 2004 / November 15, 2005
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table O-2. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Cost ($)	18,286	18,904	15,927	16,454	23,395	92,965
Total ROD Estimated Direct O&M Cost * ($)	23,450	23,450	23,450	23,450	23,450	117,250

* Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

This page is intentionally left blank.

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU

I. SITE INFORMATION

Site Name:	**P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU**	**Date of Inspection:**	**9/8/2016**
Location and Region	**SRS, USEPA Region 4**	**CERCLIS OU #:**	**#66**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**92°F and clear**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other In Situ Stabilization, Consolidation, Grouting

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Site Manager:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Post Closure Manager (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ____________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

Agency: ____________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ____________________

____

4. **Other Interviews** *(Optional):* ☐ Report Attached ____________________

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☒ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for P-Area Reactor Seepage Basin*, ER-IDS-019-035.

____

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Contingency Plan/Emergency Response Plan	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Effluent Discharge	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Waste Disposal; POTW	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Other Permits	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Water (Effluent)	☐ Readily Available	☐ Up to Date	☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS
☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached
From:______ (Date) To:______ (Date) ______ (Total Cost) ☐ Breakdown attached

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office

Contact:	Brian Hennessey	FFA Program Manager	11/21/2016	803-952-8635
	(Name)	(Title)	(Date)	(Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:____

B. Other Site Conditions

Remarks: Site inspections conducted annually from FY2012 through FY2016 identified active ant mounds, tree growing on soil cover, and evidence of hog damage. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent__________________ Depth_____________________

Remarks:____

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths_____________________ Widths____________________ Depths_____________________

Remarks:____

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent__________________ Depth_____________________

Remarks:____

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent__________________ Depth_____________________

Remarks:____

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress

Areal extent__________________ Depth_____________________

Remarks: Vegetation is mowed routinely.

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. **Alternative Cover (armored rock, concrete, etc.):** ☒ N/A
Remarks:______________________________

7. **Bulges:** ☐ Location shown on site map ☒ Bulges not evident
Areal extent__________ Depth__________
Remarks:______________________________

8. **Wet Areas / Water Damage:** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent__________
☐ Ponding ☐ Location shown on site map Areal extent__________
☐ Seeps ☐ Location shown on site map Areal extent__________
☐ Soft subgrade ☐ Location shown on site map Areal extent__________
Remarks:______________________________

9. **Slope Instability:** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent__________
Remarks:______________________________

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected:** ☐ Functioning ☒ N/A
Remarks:______________________________

2. **Outlet Rock Inspected:** ☒ Functioning ☐ N/A
Remarks: Where visible the outlet rock was inspected and appears to be functioning.

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☒ Siltation not evident
Areal extent__________ Depth__________
Remarks:__________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent__________ Type__________
Remarks:__________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________ Depth__________
Remarks:__________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks:__________

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. In Situ Stabilization, Consolidation, Grouting ☐ Applicable ☒ N/A

In situ stabilization, consolidation, and grouting were performed at PRSB OU. The remedy is performing as designed.

Attachment O-1. Five-Year Review Site Inspection Checklist – P-Area Reactor Seepage Basins (904-61G, 904-62G, and 904-63G) OU *(continued)*

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The remedy for this OU consists of institutional controls, consolidation and in situ stabilization treatment, and a geosynthetic cover system. In situ stabilization with a low permeability closure system is the final action for the source term for the PRSB operable unit. The remedy is functioning as designed because in situ stabilization is treating the PTSM and a soil cover with institutional controls is providing access controls.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of site inspections and site maintenance (verify no invasive activities have occurred and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining PRSB OU and the condition of its warning signs is good. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

This page is intentionally left blank.

R-AREA BURNING/RUBBLE PITS (131-R AND 131-1R) (RBRP) AND R-AREA RUBBLE PILE (631-25G) (RRP) OPERABLE UNIT

I. Introduction

This is the third five-year review for the R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) Operable Unit (OU). This review was conducted from August 2016 through November 2016. Contaminants have been left in place at the RBRP/RRP OU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the RBRP/RRP OU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table P-1 lists the chronology of site events for the RBRP/RRP OU.

III. Background

The RBRP/RRP OU is a Resource Conservation Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993).

The OU includes five subunits: RBRP (Pit 131-R [Closed Pit] and Pit 131-1R [Open Pit]), the pit perimeter soils, RRP (631-25G), and soil beneath the pile, wetland, and groundwater in the vicinity.

Physical Characteristics

The RBRP/RRP OU is located at SRS, approximately 7.3 km (4.5 mi) from the nearest SRS boundary (Figure P-1). Figure P-2 depicts the site layout of the RBRP/RRP OU. Figures P-3, P-4, and P-5 provide pictures of the three pits/piles before remedial actions. RBRP is located 335 m (1,100 ft) southeast of R-Reactor Area. RBRP is comprised of two parallel burial trenches, each approximately 69 m x 9 m (230 ft x 30 ft). The closed pit (131-R) was backfilled with soil to grade. When operational, this pit was 3.9 m (13 ft) deep. The open pit (131-1R) remained open until 2005. When operational, the open pit was 3 m (10 ft) deep, but waste disposal and subsequent erosion of the side slopes into the pit brought the current floor of the pit to 2.4 m (8 ft) below ground surface (bgs). The combined area of both pits was 1,282 m^2 (13,800 ft^2).

The RRP is an area of approximately 0.3 hectares (0.7 acres) where miscellaneous debris was placed on the ground, forming one contiguous pile generally 0.6 to 0.9 m (2 to 3 ft) deep. RRP is located 701 m (2,300 ft) southeast of R-Reactor Area.

A delineated wetland borders RRP on the east. The total area of the wetland is approximately 5.3 hectares (13 acres).

Groundwater flow is southeast towards Pond 4. The water table aquifer is believed to discharge to Pond 4, approximately 792 m (2,600 ft) southeast of the unit.

Land and Resource Use

The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the RBRP/RRP OU as being near an industrial area. According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The future land use for the RBRP/RRP OU is reasonably anticipated to be industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

Few historical records of specific activities at RBRP are known to exist; however, the general operational history of burning/rubble pits at SRS is known. Burning/rubble pits at SRS were used from 1951 to 1973 for periodic burning of combustible wastes such as wood, cardboard, paper, plastics, rubber, rags, oils, and organic liquids of unknown use or origin. Burning in open pits at SRS was discontinued in 1973; after that time, the pits that were still active continued to receive inert debris such as scrap metal and construction materials. Disposal in burning/rubble pits at SRS ended by 1983. Because R Area ceased operation in May 1964, disposal activities at RBRP probably ceased before 1964 or shortly thereafter. A historical document search indicates that RBRP was active in 1959 and suggests that low-level radiological waste was inadvertently placed in the pit. Concrete monuments, typical of those used to mark radiological waste burial sites, are installed at both ends of the closed pit (131-R). However, no radiological contamination has been found at RBRP.

Disposal practices at the RRP likely consisted of dumping truckloads of debris on the land surface. An abandoned road constructed prior to SRS operations passes through the southwestern corner of RRP. The road was paved, and residual asphalt is visible. RRP was in the process of being cleaned up under the SRS general maintenance housekeeping program in January 1991 when workers discovered protective boot covers similar to those used in radioactive work among the debris. The work was halted, and a radiation survey was performed on February 3, 1991. No detectable contamination was found, indicating the boot covers were disposed of as clean waste. The pile consisted of a mixture of debris and soil. Debris identified in the pile included miscellaneous construction materials, friable asbestos material, stainless steel shavings, empty 55 gallon drums, approximately fifteen 25 gal containers, railroad ties, building insulation, floor and ceiling tiles, lawn wastes, light bulbs, coiled metal, and small amounts of coal and ash. Friable asbestos was present in a large portion of the unit, which had been barricaded to prevent unprotected personnel from entering the area. The disposal dates are unknown, but because R Area was shut down in May 1964, disposal activities probably ceased before 1964 or shortly thereafter.

The wetland is addressed as a subunit of the RBRP/RRP OU based on its proximity to the rubble pile. The wetland was dry during pre-work plan characterization in 2000. However, it became saturated during the spring of 2003 and is now occasionally wet. No drainage pathways such as ditches have been identified that would transport contamination from RRP to the wetland.

Initial Response

There were no prior removals or remedial actions for this OU.

Basis for Taking Action

The RCRA Facility Investigation (RFI)/Remedial Investigation (RI) with Baseline Risk Assessment for the RBRP/RRP (WSRC 2003) concluded that RBRP and RRP have refined constituents of concern (RCOCs) and need remedial action. No RCOCs and thus no problems warranting action were identified for the perimeter pit soils, groundwater, or wetland.

Characterization of the RBRP indicated that contaminated soil was confined to the pits. Highest concentrations of contaminants were located at the bottom of the open pit (131-1R) and at the original base of the closed pit (131-R) (3.9 m [13 ft] bgs). COCs were metals (cadmium, copper, lead, manganese, thallium, and zinc), tetrachloroethylene (PCE), and dioxins/furans.

Characterization of the RRP indicated that contamination was confined to the rubble pile and 0.3 m (1 ft) of soil beneath the rubble pile. COCs were metals (cadmium, lead, copper, barium, and zinc) and asbestos.

The following problems warranting action at the RBRP subunit are identified as:

- Cadmium, copper, lead, manganese, thallium, and PCE may leach to groundwater above the maximum contaminant level (MCL) or preliminary remediation goal (PRG) (manganese) in less than 1,000 years and have been identified as contaminant migration (CM) RCOCs in the pits.
- Dioxins/furans in the surface soil exceed a risk of 1E-06 for the future industrial worker (risk = 4.2E-05) and are identified as Human Health (HH) RCOCs.
- Lead, zinc, and dioxins/furans exceeded the hazard quotient (HQ) of 1 for the insectivorous birds and mammals, and are identified as ecological RCOCs in the open pit (131-1R).

The following problems warranting action at the RRP subunit are identified as:

- Cadmium, copper, and lead may leach to groundwater above the MCL in less than 1,000 years and have been identified as CM RCOCs in the pile.
- Friable asbestos has been observed in the pile and has been identified as a HH RCOC.
- Ecological RCOCs in the pile (barium, cadmium, copper, lead, and zinc) exceeded the HQ of 1 for the soil-dwelling organisms, herbivorous mammals, and insectivorous birds and mammals.

Table P-2 presents a summary of the RCOCs and remedial goals (RGs) for the RBRP/RRP OU (WSRC 2004).

IV. Remedial Actions

Remedy Selection

Per the Record of Decision (ROD) (WSRC 2004), the following remedial action objectives (RAOs) have been established for the RBRP and are as follows:

- Prevent contaminants from leaching to groundwater above maximum contaminant levels/preliminary remediation goals (MCLs/PRGs);
- Prevent future industrial worker and residential exposure to soil contaminants;
- Prevent ecological receptors from exposure to soil contaminants; and
- Prevent residential exposure to soil contaminants.

Per the ROD, the RAOs for RRP are as follows:

- Prevent constituents from leaching to groundwater above MCLs/PRGs;
- Prevent ecological receptors from exposure to pile and soil contaminants; and
- Prevent future industrial worker exposure to lead and friable asbestos; and to prevent residential exposure to soil contaminants.

Per the ROD, the selected remedy for the RBRP/RRP OU is:

- Consolidation of RCRA non-hazardous rubble pile material into/over the open rubble pit subunit;
- Low permeability cover over the combination (pits and non-hazardous pile material);
- Offsite disposal of any RCRA hazardous pile materials; and
- Institutional controls for RBRP.

Remedy Implementation

Implementation of the selected remedy included the following:

- Removing soils and debris to achieve residential RGs at the RRP. Removing 191 m^3 (250 yd^3) of contaminated RRP soil by excavating all soils that exceeded the industrial RG levels from the rubble pile material (including 0.3 m [1 ft] beneath the rubble pile). Performing confirmatory sampling to verify the absence of contamination at RRP;
- Segregating excavated material from the RRP based on regulatory requirements. The non-hazardous soil was placed with chipped vegetation into the open RBRP subunit. Approximately 66 m^3 (220 yd^3) of hazardous soil was shipped offsite to Chemical Waste Management, Inc. in Emelle, AL. Approximately 23 m^3 (30 ft^3) of CERCLA non-hazardous waste (non-friable flooring tile) was shipped to Three Rivers Landfill. Seven lighting ballasts were shipped to the Clean Harbors Environmental distribution facility in Reidsville, North Carolina;
- Backfilling, grading, and seeding excavated areas with rubble pile material.
- Installing a low permeability cover system, consisting of a grading/structural fill layer, a geosynthetic clay layer, a geocomposite drainage layer and a vegetative layer, over RBRP covering 0.13 hectares (0.32 acres);
- Posting warning signs; and
- Establishing land use controls (LUCs) for 0.18 hectares (0.44 acres) to ensure no construction on, excavation of, or breaching of the low-permeability cover. These controls consist of (1) requiring that a Site Use and Site Clearance Permit for any

proposed use of land within the OU area, which is applicable to all activities and personnel on site; (2) maintaining the site access controls (24-hour surveillance system, artificial and natural barriers, control entry systems, and warnings signs) in place at the SRS boundary to comply with the security requirements for a RCRA-permitted facility; and (3) in the long-term, if the property is ever transferred to non-federal ownership, the US Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Those actions will include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the site.

Figures P-6 and P-7 present photographs of the RBRP/RRP OU in the current condition.

System Operations/Operation and Maintenance

There are no systems operating at the RBRP/RRP OU.

The following operations and maintenance (O&M) activities are ongoing:

- Institutional controls (i.e., LUCs) consist of long-term site maintenance (repair of erosion damage and maintenance of warning signs) and site controls and use restrictions to prevent construction on, excavation of, or breaching of the low-permeability cover, and to prevent unrestricted land use.
- Continued groundwater monitoring. No remedial action is warranted for groundwater for the RBRP/RRP OU. However, groundwater monitoring data is collected once every five years to evaluate RBRP cap performance (WSRC 2006) in immobilizing the buried RCRA non-hazardous waste.

Table P-3 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 2004). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $30,000 for soil cover inspection and repairs, erosion control, and institutional controls. The actual O&M cost for FY2012 to FY2016 is $58,972. The actual O&M costs are higher than expected because groundwater monitoring and well maintenance was not included in the ROD estimate.

V. Progress since Last Review

The previous protectiveness statement from the last five-year review concluded that because the remedial actions at RBRP/RRP OU are protective, the site is protective of human health and the environment. This remedy is protective because receptors will not be exposed to contamination above the appropriate RGs. This remedy is also protective because of the permanent removal of RCRA hazardous waste from RRP. Exposure pathways that could result in unacceptable risks are controlled by the low permeability cover system and LUCs.

The recommendation from the last five-year review to reduce sampling frequency from annual to every five years has been implemented for the RBRP/RRP OU (SRNS 2012). The five-year sampling frequency coincides with the five-year remedy reviews.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Reviewed existing groundwater data and annual inspection reports of the OU as part of the evaluation of the effectiveness of the RBRP cover system;
- Inspected the OU, photographed the OU, interviewed maintenance personnel, and documented the results on the Inspection Checklist provided in Attachment P-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and
- Reviewed changes in standards and to-be-considered guidance.

Data Review

Groundwater samples were collected in October 2016 and the maximum results are provided in Table P-4. The data review indicates that the cover system continues to be protective and decreases the potential for contaminant transport to groundwater. Review of depth to groundwater data indicates at least a 1.5 m (5 ft) distance between the bottom of the RBRP (location of waste) and the water table. Thus, the cap is maintaining an acceptable level of protectiveness in terms of the groundwater.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M staff member, on September 20, 2016, at the O&M organization offices. No issues were identified during this interview.

The RBRP/RRP OU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 15, 2016. No issues were identified for the RBRP/RRP OU during this inspection. A site inspection was conducted by U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control personnel, accompanied by USDOE and SRNS personnel, on February 23, 2017. No significant problems regarding the RBRP/RRP OU were identified during the inspection.

Scheduled annual site inspections conducted at the RBRP/RRP OU from FY2012 through FY2016 identified~~:~~ active ant mounds, bare spots in the grass, and subsidence on cap. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The remedy is functioning as intended by the decision document as demonstrated below:

- Based on the data review, provided in Section VI, the cover system is protective, decreasing the potential for contaminant transport to groundwater. In addition, the cap is maintaining an acceptable level of protectiveness in terms of source contaminants leaching from the soil into the groundwater.
- The cover system maintenance program and LUCs have been effective in maintaining the integrity of the cover system and preventing human and ecological exposure.

> Review of the annual maintenance inspection reports and a visual inspection of the OU indicate the structural integrity of the cap is intact and is providing protection to ecological receptors, industrial workers, and future residents.

Land use controls include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the RBRP/RRP OU for industrial use only, and warning signs and site use restrictions via the SRS Site Use/Site Clearance Program for the RBRP/RRP OU. The Land Use Control Implementation Plan for RBRP/RRP OU governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (WSRC 2005). All LUC objectives are being met.

The basis for exposure of human receptors, as well as ecological receptors, to the soil is contact with the soils. The implemented remedy removed hazardous materials from the RRP and shipped it off-site for treatment. Also, friable asbestos materials, as well as other miscellaneous construction debris, were excavated and transported off-site for proper disposal. Upon removal of these materials a low permeability cover system was installed; thus, breaking the exposure pathway. Review of the groundwater data and the annual inspection reports indicate the remedy is functioning properly, thus providing evidence that the exposure pathways to potential receptors remain broken.

Optimization of the frequency of sampling the wells associated with this OU was implemented during the five year review period. The frequency of groundwater sampling was reduced without diminishing the overall protectiveness of the monitoring program, because concentrations of metals are low and consistent with natural background. PCE has never been detected in wells RRP 3 or RRP 4, and the transport time for contaminants is very long due to the presence of the low-permeability cover.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions at the RBRP/RP

OU that would affect the protectiveness of the remedy. Excavation of contaminated soil and debris at the RRP subunit followed by application of clean backfill to surface grade eliminates the human health and ecological exposure pathway. Similarly, installation of a soil cover at the RBRP subunit prevents exposure of human and ecological receptors to contaminants left in place. In addition, LUCs are in place to prevent exposure to contaminated media at the RBRP/RRP OU.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the RBRP/RRP OU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues for this OU.

IX. Recommendations and Follow-up Actions

There are no recommendations or follow-up actions for this OU

X. Protectiveness Statement(s)

The remedy at RBRP/RRP OU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by land use controls to prevent exposure to or ingestion of contaminated soil. All threats to remaining contaminated soil have been addressed through removal of waste and backfill at the RRP, installation of the low permeability cover system at the RBRP, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the RBRP/RRP OU for industrial use only (SRS is a secured government facility with land use restrictions), and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2012. *EC&ACP Groundwater Monitoring Optimization Report: A Comprehensive, Technical Approach for the Evaluation and Optimization of Groundwater Monitoring and Reporting*, SRNS-RP-2012-0196, Revision 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site*, WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2003. *RCRA Facility Investigation/Remedial Investigation Work Plan Addendum Including Baseline Risk Assessment for the R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit*, WSRC-RP-2002-4183, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2004. R*ecord of Decision Remedial Alternative Selection for the R-Area Burning/Rubble Pits (131-R and 131-1R) and Rubble Pile (631-25G) Operable Unit (U)*, WSRC-RP-2004-4004, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005. *Land Use Control Implementation (LUCIP) for R-Area Burning/Rubble Pits (131-R and 131-1R) and R-Area Rubble Pile (631-25G) Operable Unit (U)*, WSRC-RP-2004-4119, Revision 0, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006. *Post-Construction Report/Corrective Measures Implementation Report/ Final Remediation Report for the R-Area Burning/Rubble Pits (131-R And 131-1R) and R-Area Rubble Pile (631-25G) Operable Unit (U)*, WSRC-RP-2006-4002, Washington Savannah River Company, Savannah River Site, Aiken, SC

Various - Inspection Data Sheets – *Field Inspection Checklist, R-Area Burning Rubble Pits and Rubble Pile, Operable Pit Remediation (U)*, ER-IDS-019-036, Inspection period 2012 through 2016 (annually)

This page is intentionally left blank.

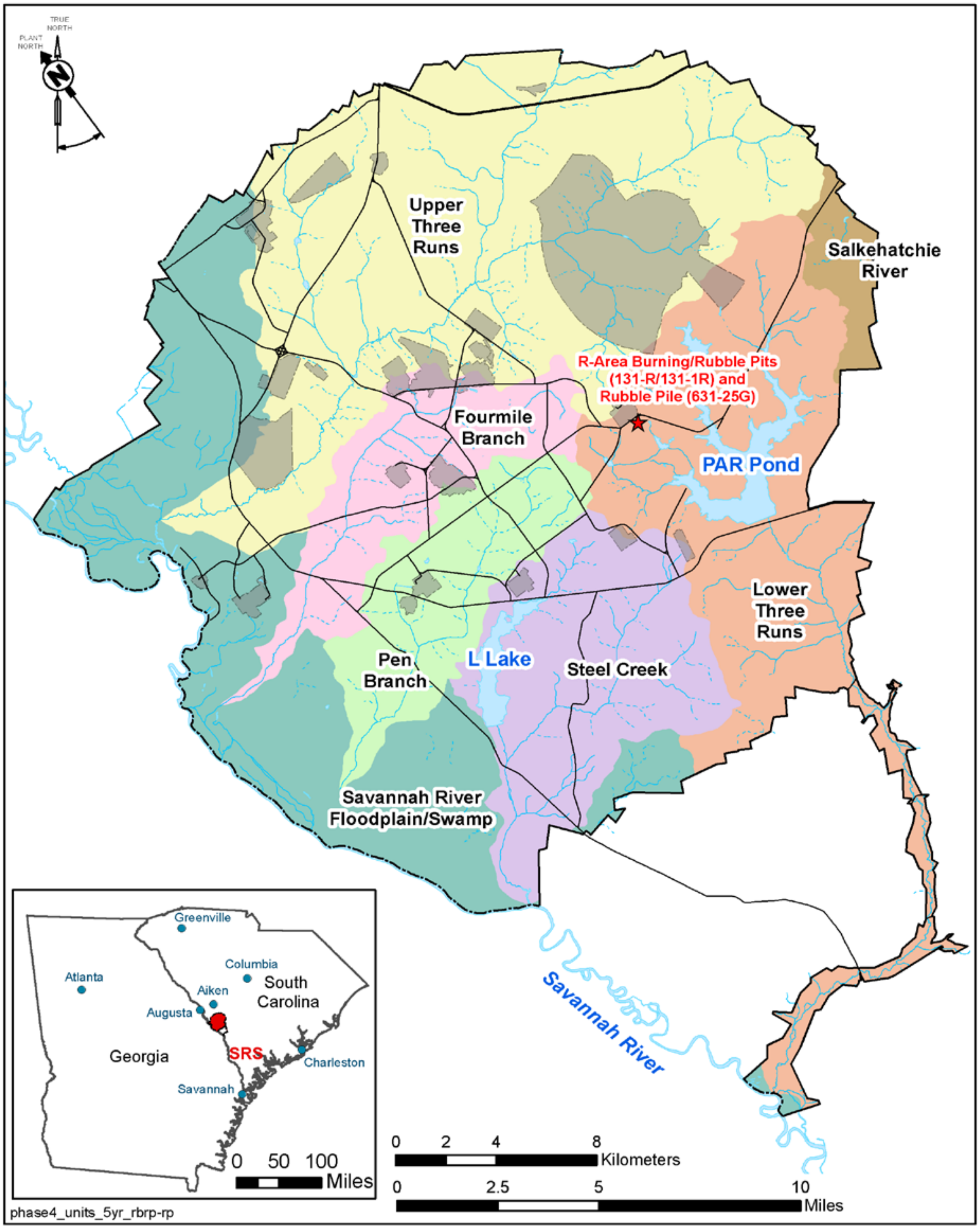


Figure P-1. Location of the RBRP/RRP OU at SRS

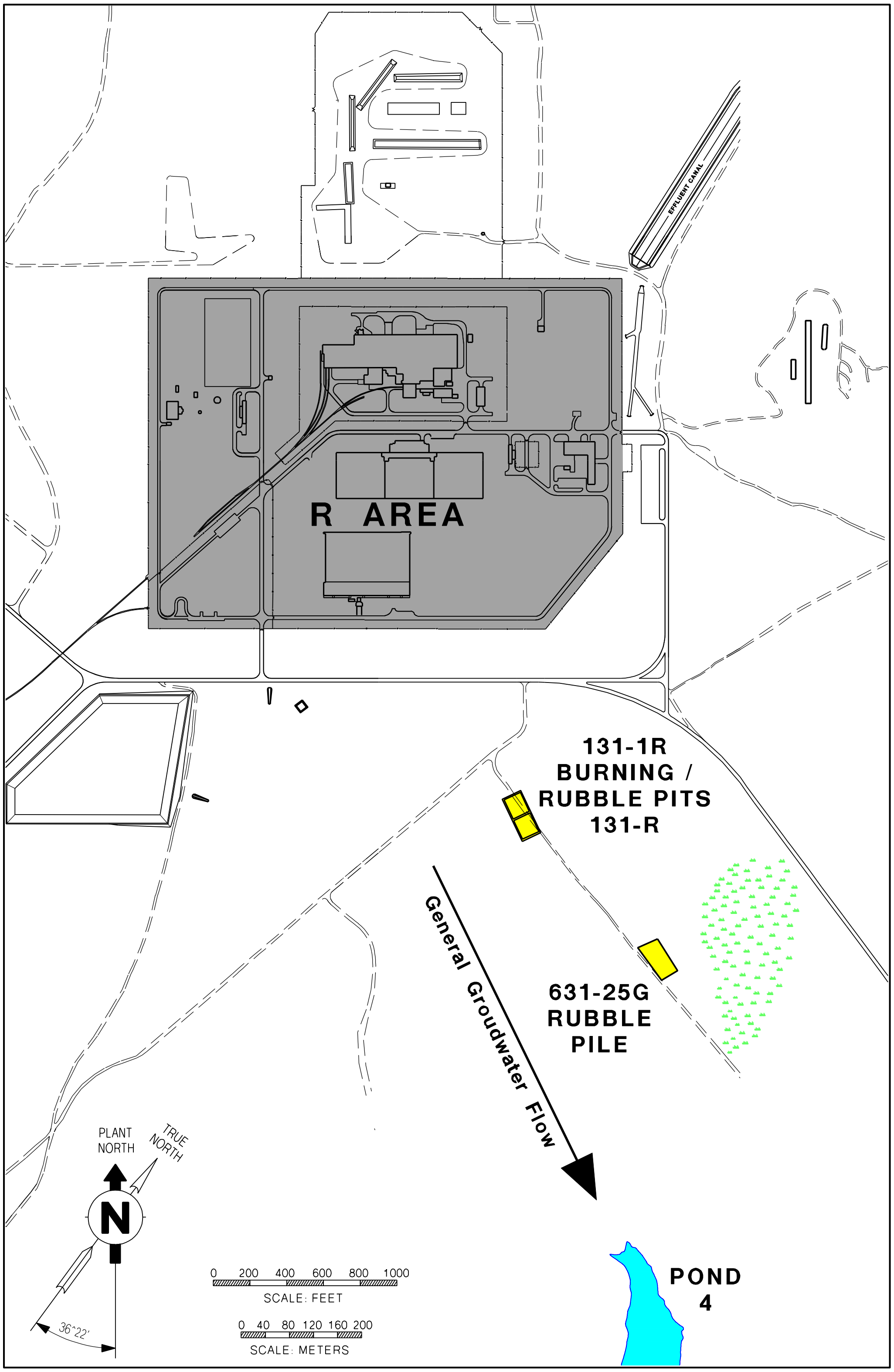


Figure P-2. **Layout of the RBRP/RRP OU**

Figure P-3. **Photograph of RBRP, 131-R (Closed Pit), Prior to Remedial Activity**

Figure P-4. **Photograph of RBRP, 131-1R (Open Pit), Prior to Remedial Activity**

Figure P-5. **Photograph of RRP, 631-25G, Prior to Remedial Activity**

Figure P-6 **Photograph of RBRP (131-1R and 131-R) (2016)**

Figure P-7 **Photograph of RRP (631-25G) (2016)**

This page is intentionally left blank.

Table P-1. Chronology of OU Events

Event	Date
RFI/RI Field Start/Complete	1999 / July 2, 2003
ROD Issuance	September 28, 2004
Remedial Action Start/Complete	September 22, 2005 / January 25, 2006
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table P-2. Summary of Remedial Goals for RBRP/RRP OU Soils

Sub-unit	RCOC	CM RGO (mg/kg)	HH Industrial RGO (mg/kg)	ECO RGO (mg/kg)	2X Avg. Background (mg/kg)	RG (mg/kg)
RBRP	Cadmium	6.70E-01			1.59E+00	1.59E+00
	Copper	1.82E+02			9.10E+00	1.82E+02
	Lead	2.17E+01		2.65E+01	1.10E+01	2.17E+01
	Manganese	2.35E+02			2.88E+01	2.35E+02
	Thallium	5.35E-01				5.35E-01
	Zinc			5.49E+01	1.24E+01	5.49E+01
	Tetrachloroethylene	1.50E-02				1.50E-02
	1,2,3,4,6,7,8-Heptachlorodibenzo – p- dioxin			3.22E-04		3.22E-04
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin			3.22E-05		3.22E-05
	2,3,7,8-Tetrachlorodibenzo-p-furan			1.31E-06		1.31E-06
	Heptachlorodibenzo-p-dioxin isomers		1.67E-03	3.22E-04		3.22E-04
	Hexachlorodibenzo-p-dioxin isomers			3.22E-05		3.22E-05
	Octachlorodibenzo-p-dioxin		1.67E-02	3.22E-03		3.22E-03
	Pentachlorodibenzo-p-dioxin isomers		3.35E-05			3.35E-05
	Pentachlorodibenzo-p-furan isomers		3.35E-05	3.67E-05		3.35E-05
	Tetrachlorodibenzo-p-dioxin isomers		1.67E-05	3.22E-06		3.35E-05
	Tetrachlorodibenzo-p-furan isomers		1.67E-04	1.31E-06		1.31E-06
RRP	Barium			2.35E+02	2.78E+01	2.35E+02
	Cadmium	6.70E-01		1.38E+00	1.59E+00	1.59E+00
	Copper	1.82E+02		5.00E+01	9.10E+00	5.00E+01
	Lead	2.17E+01		2.65E+01	1.10E+01	2.17E+01
	Zinc			5.49E+01	1.24E+01	5.49E+01

RGO Remedial Goal Options

Table P-3. Actual versus Estimated O&M Costs

	FY2012	FY2013	FY2014	FY2015	FY2016	5-Year Total
Total Actual O&M Costs ($)	12,533	14,710	10,181	8,147	13,401	58,972
Total ROD Estimated Direct O&M Costs * ($)	18,000	3,000	3,000	3,000	3,000	30,000

*Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Table P-4. Review of Groundwater Data from Monitoring Wells RRP3 and RRP4

COC	MCL (µg/L)[a]	Maximum (µg/L) Pre-remedy (prior to 2006) [# samples]	Maximum (µg/L) Post-remedy (2006-2011) [# samples]	Maximum (µg/L) Current (2016) [# samples]
Cadmium	5	ND [17]	ND [5]	ND [2]
Copper	1300	67.9 [14]	9.08 [5]	1.05 [2]
Lead	15	26 [28]	4.15 [5]	0.82 [2]
Manganese	50[b]	682 [20]	11.1 [5]	4.94 [2]
Tetrachloroethylene (PCE)	5	ND [18]	ND [5]	ND [2]
Thallium	2	ND [6]	0.12 [5]	ND [2]

a) MCL values are based on US EPA values available July 15, 2016.

b) Manganese has no MCL. The value used is the secondary standard published by US EPA in January 2016.

ND = Non-Detect.

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU

I. SITE INFORMATION

Site Name:	**R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU**	**Date of Inspection:**	**8/11/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #43**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**80°F** **Partly Cloudy**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Excavation/Consolidation

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: ________ (Name) ________ (Title) ________ (Date) ________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

4. **Other Interviews** *(Optional):* ☐ Report Attached ______________________

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☐ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☐ Maintenance Logs	☐ Readily Available	☐ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for R-Area Burning Rubble Pits and Rubble Pile OU, ER-IDS-019-036*

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS

☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A

Remarks: Signs-are in good condition.

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office
Contact: Phil Prater (Name) IACD Program Manager (Title) 11/15/2016 (Date) 803-952-9333 (Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks:

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A
Remarks:______________________________

B. Other Site Conditions

Remarks: Site inspections conducted annually from FY2012 through FY2016 identified active ant mounds, bare spots in the grass, and subsidence on cap. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident
Areal extent__________ Depth__________
Remarks:______________________________

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident
Lengths__________ Widths__________ Depths__________
Remarks:______________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent__________ Depth__________
Remarks:______________________________

4. Holes: ☐ Location shown on site map ☒ Holes not evident
Areal extent__________ Depth__________
Remarks:______________________________

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☒ No signs of stress
Areal extent__________ Depth__________
Remarks: Vegetation mowed routinely.

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

6. **Alternative Cover (armored rock, concrete, etc.):** ☒ N/A
Remarks:______________________________

7. **Bulges:** ☐ Location shown on site map ☒ Bulges not evident
Areal extent______________ Depth______________
Remarks:______________________________

8. **Wet Areas / Water Damage:** ☒ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent______________
☐ Ponding ☐ Location shown on site map Areal extent______________
☐ Seeps ☐ Location shown on site map Areal extent______________
☐ Soft subgrade ☐ Location shown on site map Areal extent______________
Remarks:______________________________

9. **Slope Instability:** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent______________
Remarks:______________________________

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected:** ☐ Functioning ☒ N/A
Remarks:______________________________

2. **Outlet Rock Inspected:** ☐ Functioning ☒ N/A
Remarks:______________________________

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Offsite Discharge ☐ Applicable ☒ N/A

Attachment P-1. Five-Year Review Site Inspection Checklist – R-Area Burning/Rubble Pits (131-R and 131-1R) (RBRP) and R-Area Rubble Pile (631-25G) (RRP) OU *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Excavation/Consolidation ☒ Applicable ☐ N/A

Excavation/Consolidation was performed at RBRP/RRP. The remedy is performing as designed.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

The selected remedy consists of excavation and offsite disposal of RCRA hazardous waste material and consolidation of RCRA non-hazardous waste under a low-permeability cover system. The remedy is effective and functioning as designed, as indicated by post construction well sampling data.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (verify no invasive activities have occurred and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining R-Area Burning/Rubble Pits and Rubble Pile Operable Unit (OU) and the condition of its warning signs is good. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A

T-AREA OPERABLE UNIT

I. Introduction

This report is the third five-year review for the T-Area Operable Unit (TAOU). This review was conducted from August 2016 through November 2016. Contaminants have been left in place at the TAOU at levels that do not allow for unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy in place at the TAOU is protective of human health and the environment. This report documents the results of the review.

II. OU Chronology

Table Q-1 lists the chronology of site events for the TAOU.

III. Background

The TAOU is listed as a Resource Conservation and Recovery Act (RCRA)/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for Savannah River Site (SRS) (FFA 1993). The media of concern is soil and concrete.

An area-based remedial strategy has been implemented in T Area. The TAOU incorporates all of the applicable OUs, Site Evaluation Areas, and the dismantled facilities of the T-Area footprint and the TNX Swamp except the remedial actions of the TNX Area Groundwater OU, which include the TNX Burying Ground (TBG) soil vapor extraction (SVE) and associated TNX-Area Groundwater air stripper.

Physical Characteristics

TAOU is located in the southwestern portion of SRS, approximately (0.4 km (0.25 mi) east of the Savannah River (Figure Q-1). TAOU incorporates most of the T-Area footprint (Figure Q-2) and the TNX Swamp. The TAOU is approximately 26.8 hectares (66 acres). T Area was used in the development and testing of processes, facilities, and equipment for various SRS programs. Constructed in 1950, T Area included three main buildings: Pilot

Plant Building (677-T), Chemical Semi-Works Building (678-T), and Engineering Text Facility (679-T). After 1978, the T Area was expanded to include over 30 buildings, comprising office administrative buildings, process buildings for large-scale experimental demonstrations, laboratories for research and analytical purposes, pilot-scale facilities, bulk tank storage, industrial wastewater processing facilities, and warehouse storage for a wide range of chemicals and specialty equipment. All of the facilities in T Area have been dismantled and removed (Figure Q-3) with the following exceptions: the Semiworks Waste Tank Mock-Up Facility (678-5T) and ancillary structures, the Telecommunications Building (702-T), and a SVE system. Operation of the 906-T Air Stripper was discontinued in 2007 and the air stripper was dismantled and removed in 2013. After completion of the engineered cap, the conventional mobile SVE system was replaced with five MicroBlowers™, which began operating in 2007. The T-Area Tile Fields 1, 2, and 3 were part of a sanitary sewer system previously closed under the TNX Septic System Closure Plan. Recent photographs showing the current condition of TAOU are included in Figure Q-4.

The TNX Swamp was not used in T-Area industrial processes; however, it was used routinely to manage surface runoff and stormwater. The TNX Swamp was divided into four subunits: the Outfall Delta (OD), the Inner Swamp, the High Ground Swamp, and the Outer Swamp. The TNX Swamp, and the Lower Discharge Gully (LDG) and Swamp Operable Unit (OU) are included as part of the TAOU.

Land and Resource Use

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of the SRS land should be prohibited. The *Land Use Control Assurance Plan for the Savannah River Site* (WSRC 1999) designates the TAOU as being within the site industrial support area. The future land use for TAOU is reasonably anticipated to remain industrial with the U.S. Department of Energy (USDOE) maintaining control of the land.

History of Contamination

The contamination requiring action at the TAOU is a result of T-Area industrial processes, waste management practices, and an industrial accident during facility operations. Within the industrial area, the contamination is related to leaks from industrial processes and disposal facilities such as tile fields, burying grounds, and seepage basins. In the TNX Swamp, the contamination resulted from a release of process water and entrained sediment from the Old TNX Seepage Basin down the topographic slope and into the swamp. The X001 Outfall received water from a sump located outside of Building 677-T that contained radiologically contaminated equipment.

Initial Response

Multiple actions have occurred within T Area and are summarized in Table Q-2. The TNX groundwater is being addressed under the TNX Area OU.

Three removal actions were performed in 2005 for waste consolidation under the TAOU cover system per the Removal Action Reports:

- Outfall Delta/Inner Swamp Soil was excavated to a 0.3-m (1-ft) depth (406 m^3 [531 yd^3]) to remove soil containing thorium-238 in excess of 35 ρCi/g and backfilled to grade (WSRC 2007);
- X001 Outfall Drainage Ditch was excavated to a 1.2-m (4-ft) depth over 0.4 hectare (0.1 acre) (191 m^3 [250 yd^3]) to remove soil containing uranium-238 and Aroclor 1260 in excess of 1.79 ρCi/g and 10 mg/kg, respectively (WSRC 2005a); and
- Tile Field 2 was excavated from 3 to 3.6 m (10 to 12 ft) in depth (574 m^3 [750 yd^3]) to remove a vitrified clay sewer line and soil containing mercury above the remedial goal (RG) of 0.078 mg/kg (WSRC 2007).

All contaminated material was stockpiled in the industrial portion of T Area waiting for final placement under the TAOU cover system.

Basis for Taking Action

A release of hazardous and radiological substances to the environment occurred at the TAOU, resulting in soil and sediment contamination (Table Q-3). Soil contaminants include mercury, tetrachloroethene (PCE), Aroclor 1260, cesium-137, and uranium/ thorium decay series radioisotopes (actinium-228, lead-212, radium-228, thorium-228, uranium-233/234, uranium-235, and uranium-238). Sediment contaminants include uranium/thorium decay series radioisotopes.

The following potential risks associated with unrestricted land use are the basis for taking action at the TAOU:

- Exposure and possible contaminant migration risks from soil and sediment with residual uranium/thorium decay series radioisotope contamination in the TNX Outfall Delta OU;
- Exposure and contaminant migration risks in the TBG from soils contaminated with mercury, PCE, and uranium/thorium decay series radioisotopes;
- Uncertainties associated with soils contaminated with uranium/thorium decay series radioisotopes that pose a potential contaminant migration threat from the TNX Area Process Sewer Lines;
- Soil contaminated with uranium/thorium decay series radioisotopes and stockpiles in the TAOU and present exposure or contaminant migration risks;
- Remaining building slabs that have metals or uranium/thorium decay series radioisotopes contamination on concrete slabs or in soils that may pose an exposure risk; and
- Uncertainty with potential under-slab soil contamination of metal or uranium/thorium decay series radioisotopes that may pose a future contaminant migration risk. This includes the residual soil contamination at Neutralization Sump 678-T.

IV. Remedial Actions

Remedy Selection

As stated in the Record of Decision (ROD) (WSRC 2005b), the remedial action objectives (RAOs) for the TAOU are as follows:

- Ensure that the future land use in the industrial portion of T Area is restricted to industrial land use and the future land use of the TNX Swamp is restricted to industrial buffer zone land use;
- Prevent exposure to contaminants that exceed target risk levels for receptors in the industrial portion of T Area;
- Prevent exposure to residual contamination in the Outfall Delta/Inner Swamp;
- Prevent contaminants in the industrial portion of T Area, the Outfall Delta/Inner Swamp from leaching to groundwater and impacting groundwater above maximum contaminant levels (MCLs); and
- Prevent exposure to ecological receptors.

As stated in the ROD (WSRC 2005b), the following remedies were selected for TAOU to meet the RAOs:

- Placement of a low permeability cap with an effective soil hydraulic conductivity of less than 1E-08 cm/s over contaminated soils, contaminated debris and building slabs that had been left in place, and contaminated soils excavated from T-Area facilities under previous removal actions and staged for placement beneath the cover.
- Treatment of contaminated soil in T-Area swamp with soil amendments to attenuate the leachability of radiological contaminants in the soils. Soil amendments will be reapplied if long-term monitoring indicates that they are losing their effectiveness.
- Implementing institutional controls (i.e., land use controls [LUCs]) to manage the TAOU. These controls include access control for on-site workers via the Site Use and Site Clearance Programs; access controls against trespassers at the SRS boundary

including entry control systems, and security procedures; signage posted and maintained at the TAOU; and deed restrictions.

Remedy Implementation

The selected remedy met the RAOs at TAOU by implementing the following activities:

- Consolidation of 1,171 m^3 (1,531 yd^3) of contaminated soils excavated from T-Area facilities under previous removal actions and placing beneath the cover for disposal.
- Placement of a 3.8-hectare (9.4-acre) low permeability cover system over contaminated soils, debris, and building slabs that had been left in place, and soils excavated from T-Area facilities. The cover system consists of the following layers: grading fill, 0.3-m (1-ft) thick structural fill, geosynthetic clay liner with an effective soil hydraulic conductivity of less than 1E-08 cm/s, geocomposite drainage layer, 0.45-m (18-in) thick common fill, 0.15-m (6-in) thick topsoil, and vegetation.
- In situ treatment of 2.4 hectares (5.8 acres) of the Outfall Delta/Inner Swamp by applying apatite at a rate of 3.75 tons/hectare (1.5 tons/acre) to the area where uranium exceeded its RG.
- Posted warning signs.
- Established institutional controls (i.e., LUCs) for 19.3 hectares (47.58 acres), which included installing access control warning signs along the perimeter (WSRC 2005c, WSRC 2007).

System Operations/Operation and Maintenance

There are no system operation requirements.

The following maintenance activities are ongoing as long as waste remains a threat to human health or environment:

- Annual site inspections to look for damage to the cover system due to erosion or intrusion by burrowing animals. The inspections also address upkeep of the vegetative cover and access control barriers (e.g., the warning signs).

- Necessary repairs (e.g., replacing eroded or disturbed soil, sign repair, etc.) and vegetation management (e.g., mowing, removal of larger vegetation, etc.) are performed when required.
- Institutional controls are enforced to preclude access through the SRS Site Use/Site Clearance program and SRS site security (WSRC 2006).

Table Q-4 compares the actual operation and maintenance (O&M) costs for the five-year remedy review period to the estimated direct O&M costs from the ROD (WSRC 2005b). The estimated O&M cost for Fiscal Year (FY) 2012 to FY2016 was $322,808 for inspections and maintenance and institutional controls (i.e., LUCs). The actual O&M cost for FY2012 to FY2016 is $360,934. The actual O&M costs are as expected.

V. Progress since Last Review

The previous protectiveness statement concluded that the remedial actions at TAOU are protective. Exposure pathways that could result in unacceptable risks are being controlled by institutional controls to prevent exposure to or ingestion of contaminated media. The final remedial actions of excavation, removal, and backfilling of excavated areas along with institutional controls and contaminated soil consolidation under a low-permeability geosynthetic cover system are functioning properly.

There were no recommendations or follow-up actions from the last five-year review.

VI. Five-Year Review Process

The following tasks were performed as part of the review:

- Reviewed the documents listed in Section XII. Documents Reviewed;
- Reviewed groundwater monitoring data to evaluate whether contaminants are leaching into groundwater above MCLs;
- Inspected the OU, interviewed maintenance personnel, and documented the results on the Inspection Checklist provided in Attachment Q-1 with the purpose of assessing the protectiveness of the remedy and the functionality of the access controls; and

- Reviewed changes in standards and to-be-considered guidance

Data Review

The effectiveness of both the low-permeability geosynthetic cover in the industrial portion of this OU and the soil amendments that were implemented in the Outfall Delta/ Inner Swamp to prevent contaminants from leaching to groundwater above MCLs is evaluated through the groundwater monitoring conducted for the TNX-Area Groundwater Operable Unit (TNX OU). The Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report, previously titled the Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report, for monitoring years 2012 through 2015 (SRNS 2013, SRNS 2014, SRNS 2015, and SRNS 2016) were reviewed. The TNX monitoring well network consists of three background wells, eight primary wells, 22 auxiliary wells, five secondary wells, and four recovery wells, as of September 2016. These wells are monitored semiannually with the exception of those wells that may be dry due to water levels being below the screen zones or wells that are inaccessible due to high river water levels. Elevated concentrations of contaminants are mainly observed in groundwater near historical disposal sites. The primary contaminant that is present as a defined plume in the TNX groundwater includes trichloroethylene. The distribution of cis-1,2-dichlrorethylene, 1,4-dioxane, nitrate-nitrite (as nitrogen), mercury, uranium, gross alpha, and radium is minimal with the highest concentrations observed primarily in the vicinity of historical sites but results in no discernable groundwater plume.

For the period 2012 through 2016, the groundwater contaminant data were reviewed as an analog for the TAOU refined constituent of concern (RCOCs) (Table Q-3). Mercury is the only TAOU RCOC sampled at the TNX OU monitoring wells. The radionuclide isotope RCOCs are not specifically sampled at TNX OU monitoring wells; however, gross alpha, total uranium, combined radium, and nonvolatile beta are collected and can be used as indicator parameters to determine the presence of the RCOCs. Aroclor 1260 is not sampled at the TNX OU monitoring wells and does not have an equivalent indicator parameter.

Table Q-5 provides a summary of the number of detections above the MCL, total number of detections, the wells with detections above the MCL and the number of instances for mercury, uranium, gross alpha, and combined radium. Seven TNX OU monitoring wells (i.e., TBG 4, TCM 5, TIR 1U, TNX 3D, TNX 30D, TNX 35D, and TRW 2) had concentrations of COCs greater than MCLs during the past 5 years. Four of these wells (i.e., TCM 5, TIR 1U, TNX 30D, and TNX 35D) are located in the Outfall Delta/Inner Swamp, outside of the industrial area for the TAOU (Figure Q-5). The COCs that have exceeded the MCL at TIR 1U, TNX 30D, and TNX 35D are sporadic. TCM 5 is the exception as it has exceeded the MCL for uranium and gross alpha consistently between 2012 and 2015. The exceedances that have occurred in the Outfall Delta/Inner Swamp are likely caused by a fluctuating water table surface through fluvial aquifer sediments and do not represent a discernable groundwater plume. The remaining three wells (i.e., TBG 4, TNX 3D, and TRW 2) in Table Q-5 are located within the industrial portion of this OU (Figure Q-5). Within the industrial portion of this OU nitric acid disposal has lowered the pH of the groundwater causing metals and radionuclides to leach out of the aquifer sediments. The concentrations exceeding an MCL within the industrial portion of the TAOU are typically sporadic in nature and do not represent a discernable plume.

Summary of Inspections and Interviews

Interviews were conducted with Richard Feagin, O&M staff member, and Steve Willingham, O&M Staff Member, on September 20, 2016 at the O&M organization offices. No issues were identified during these interviews.

The TAOU was inspected by Savannah River Nuclear Solutions, LLC (SRNS) and USDOE personnel on November 22, 2016. No issues were identified for the TAOU during this inspection. A site inspection was conducted by U.S. Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control personnel, accompanied by USDOE and SRNS personnel, on February 28, 2017. No significant problems regarding this OU were identified during the inspection.

Scheduled annual site inspections conducted from FY2012 through FY2016 identified minor erosion on slide slopes, active ant mounds, overgrown vegetation, bare spots, evidence of hog damage, cracked French drain clean out plug, and debris in drainage ditches. These findings were documented on the field inspection checklists and resolved soon after discovery.

VII. Technical Assessment

Is the Remedy Functioning as Intended by the Decision Document?

The review of documents, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and the results of the site inspection indicates that the remedy is functioning as intended by the ROD. The selected remedy of a low-permeability geosynthetic cover in the industrial portion of the TAOU is effective in preventing exposure of human and ecological receptors to contaminants that exceed target risk levels and contaminants from leaching to groundwater and impacting groundwater above MCLs. Likewise, the selected remedy of placing soil amendments in the Outfall Delta/ Inner Swamp is effective in preventing exposure of human and ecological receptor to contaminants that exceed target risk levels and contaminants from leaching to groundwater and impacting groundwater above MCLs.

The effective implementation of LUCs has prevented exposure to or ingestion of contaminated soils and ensuring the land use is restricted to industrial/industrial buffer zone use. LUCs include physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the TAOU for industrial use only, and warning signs and site use restrictions via the SRS Site Use/Site Clearance Program for the TAOU. The Land Use Control Implementation Plan for TAOU governs LUC implementation, maintenance, monitoring, reporting, and enforcement of LUCs (WSRC 2006). All LUC objectives are being met.

O&M of the cover system has been effective. Activities that have been documented on the annual inspection reports for the timeframe 2007 through 2016 and documented corrective actions include installation of a new drainage system on the western slope of the cover system, treating of active ant mounds on the cover system and repair of thin vegetation spots on the cover system.

There were no opportunities for system optimization determined during this review.

Are Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives still valid?

The exposure assumptions, toxicity data, and cleanup levels used at the time of remedy selection are still valid. There have been no changes in physical conditions of the TAOU that would affect the protectiveness of the remedy.

As the remedial work has been completed, most action-specific ARARS cited in the ROD have been met. Well Construction Standards (SC R.61-71) will remain applicable if monitoring wells are installed, modified, or abandoned. If future activities are deemed necessary in the Outfall Delta/Inner Swamp, the location-specific ARARS will remain applicable as they focus on protection of floodplains and wetlands. The chemical specific ARARs must still be met and have been evaluated.

The USEPA standards and toxicity values have been updated since the last five-year remedy review as shown in Appendix B. The changes to the values for COCs at the TAOU were not significant, and the RAOs continue to be met by the remedial action. No new standards or to-be-considered guidance have been identified that call into question the protectiveness of the remedy.

Fact sheets provided on the USEPA webpage regarding emerging contaminants were reviewed for applicability to this site. None of the listed emerging contaminants were identified as applicable to this OU.

Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No new information has come to light that could call into question the protectiveness of the remedy.

VIII. Issues

There are no issues related to current site conditions or activities that currently prevent the remedy for the TAOU from being protective.

IX. Recommendation and Follow-up Action

There are no recommendations or follow-up actions for the TAOU.

X. Protectiveness Statement(s)

The remedy at TAOU is protective of human health and the environment.

Exposure pathways that could result in unacceptable risks are being controlled by institutional controls (i.e., LUCs) to prevent exposure to or ingestion of contaminated media. All threats to contaminated soil at the TAOU have been addressed through excavation, removal, and the backfilling of excavated areas along with the installation of a final geosynthetic cover in the industrial section, addition of soil amendments to the Outfall Delta/Inner Swamp, physical access controls to prevent unauthorized entry to SRS (fences, guards, security patrols, etc.), administrative controls that maintain the TAOU for industrial use only, and warning signs and use restrictions via the SRS Site Use/Site Clearance Program.

XI. Next Review

The Fifth Five-Year Remedy Review Report and subsequent reports will be segregated into five phases. As shown in Appendix A, Table A-1, the next five-year review for SRS OUs with Geosynthetic or Stabilization/Solidification Cover Systems is scheduled for January 2023.

XII. Documents Reviewed

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

SRNS, 2013. *2012 Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report (U),* SRNS-RP-2013-00286, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

SRNS, 2014. *2013 Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report (U)*, SRNS-RP-2014-00469, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

SRNS, 2015. *2014 Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report (U)*, SRNS-RP-2015-00396, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

SRNS, 2016. *2015 Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report (U),* SRNS-RP-2016-00394, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC.

USDOE, 1996. *Savannah River Site Future Use Project Report*, U.S. Department of Energy, Savannah River Operations Office, Savannah River Site, Aiken, SC

WSRC, 1999. *Land Use Control Assurance Plan for the Savannah River Site,* WSRC-RP-98-4125, Revision 1.1, latest revision, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

WSRC, 2005a. *X-001 for Outfall Drainage Ditch OU, NBN (U) Removal Action Reports*, Revision 0, WSRC-RP-2005-4010, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005b. *Record of Decision Remedial Alternative Selection for the T-Area Operable Unit,* WSRC-RP-2004-4070, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2005c. *Corrective Measure Implementation/Remedial Action Implementation Plan (CMI/RAIP) for the T-Area Operable Unit (U)*, WSRC-RP-2005-4003, Revision1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 2006. *Land Use Control Implementation Plan (LUCIP) for T Area Operable Unit (U)*, WSRC-RP-2005-4029, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC.

WSRC, 2007. *Post-Construction Report for T-Area Operable Unit* (U), Revision 1, WSRC-RP-2006-4005, Washington Savannah River Company, Savannah River Site, Aiken, SC (includes the *Removal Action Report for TNX Outfall Delta, Lower Discharge Gully and Swamp OU* and *Removal Action Report for T-Area Tile Field #2, NBN*)

Various - *Inspection Data Sheets – Field Inspection Checklist, T-Area Operable Unit (TAOU) (U)*, ER-IDS-019-032, Inspection period: 2012 through 2016 (annually)

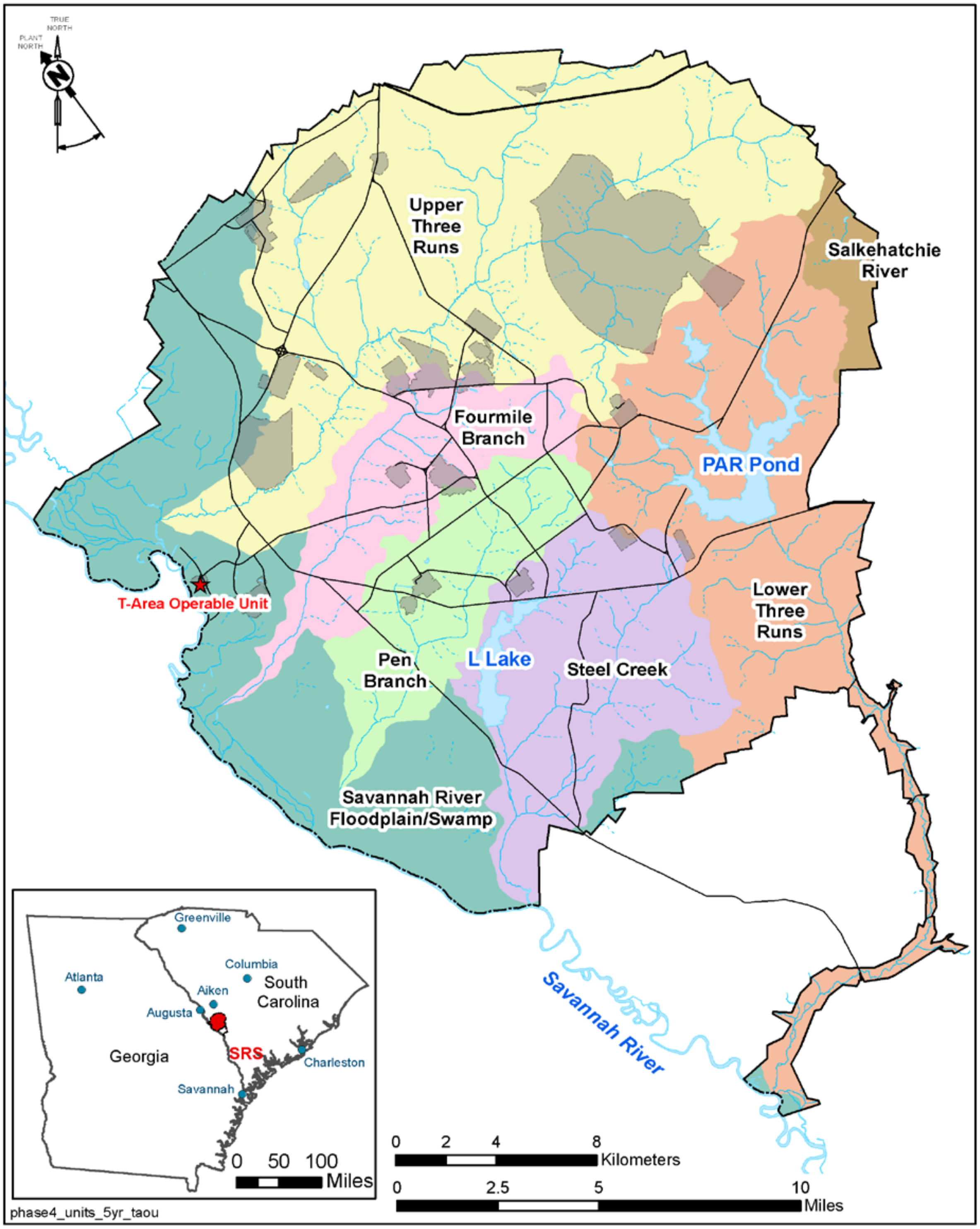


Figure Q-1. Location of T Area OU at SRS

This page is intentionally left blank.

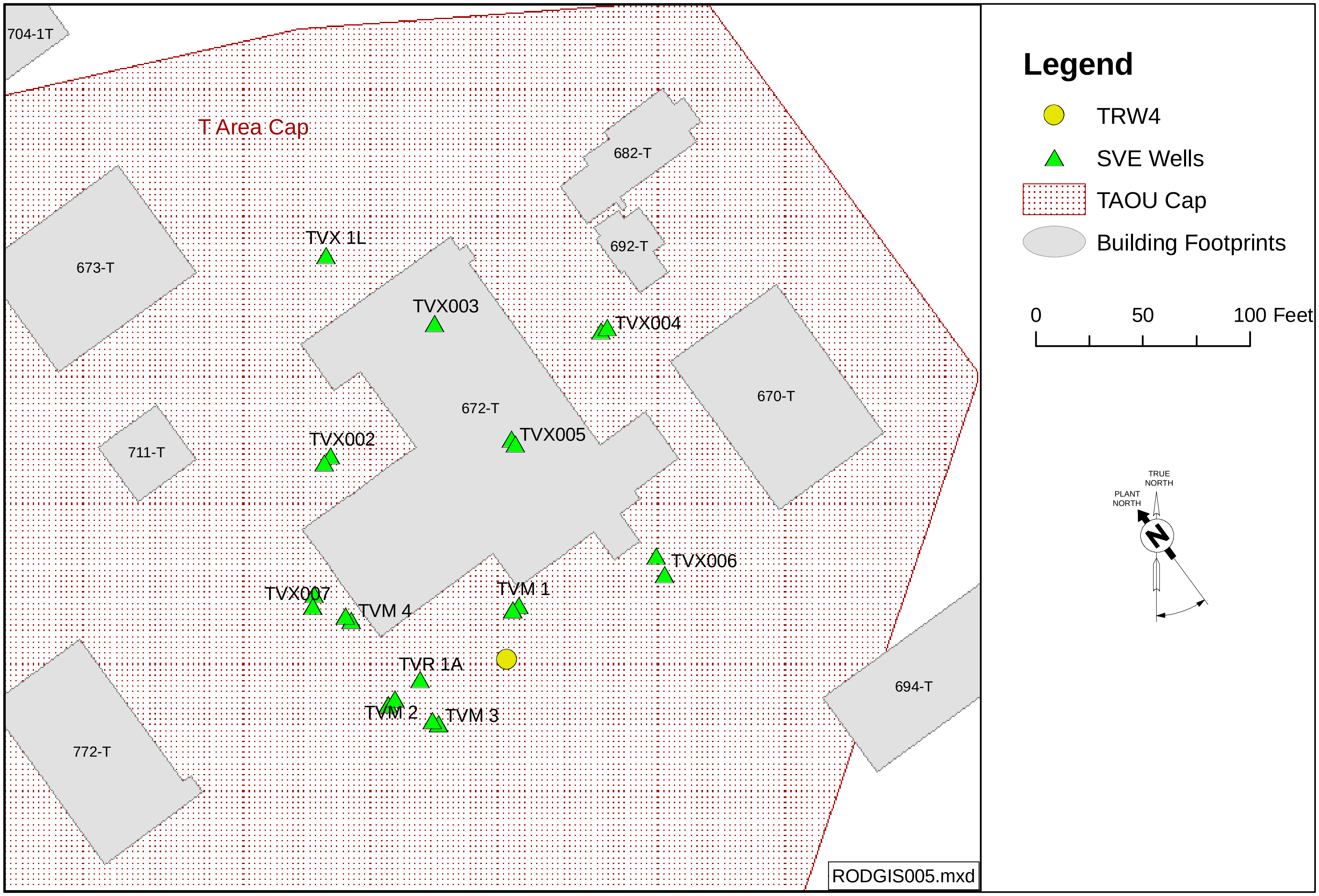


Figure Q-2. T-Area Operable Unit Pre-Remedial Action Site Plan

Figure Q-3. Aerial Photograph of T Area (TNX Swamp to the Right Side of the Photograph (2008))

Figure Q-4. Photographs of the TAOU (2016)

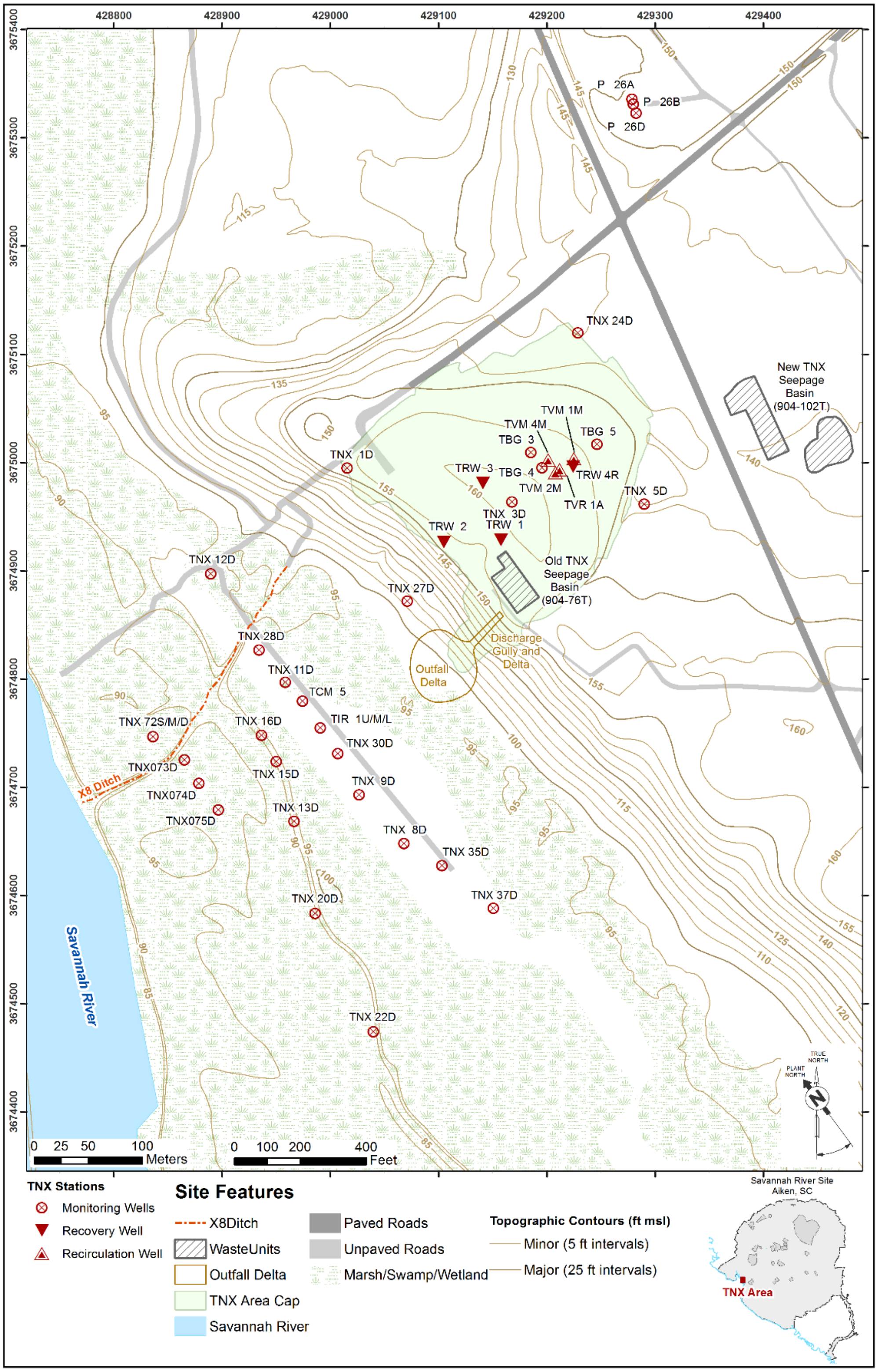


Figure Q-5. TNX Area Well Location Map (SRNS 2016)

Table Q-1. Chronology of OU Events

Event	Date
RFI/RI Field Start / Complete	February 7, 1996 / April 1, 2005
Removal Actions (3) Start / Complete	August 17, 2004 / September 15, 2005
Final ROD Issuance	January 4, 2006
Remedial Action Start/Complete	January 13, 2006 / November 15, 2006
Previous Five-Year Reviews Issuance	January 29, 2009 / February 4, 2014

Table Q-2. Summary of the Remedial Strategy for T Area (WSRC 2005b)

Areas	Risk[1]	Impacted Media[2]	Addressed Under Other Document	Addressed Under ROD[3]	Remedial or Removal Action Taken Under Other Documents[4]	Other Documents[5]
TNX Area OU						
NTSB/IPSL	ECO, HH	SW, S	•		Drained surface water and backfilled New TNX Seepage Basin (NTSB), Grouted Inactive Process Sewer Line (IPSL), LUCs	TNX Area ROD (WSRC-RP-2003-4017)
TBG/Vadose Zone	CM, PTSM	S	•		SVE	TNX Area ROD (WSRC-RP-2003-4017)
OTSB/IPSL	CM, PTSM	S	•		Excavation/Offsite Disposal of Old TNX Seepage Basin (OTSB)/IPSL PTSM, Grouted unexcavated portions of IPSL, Backfilled Excavated, Constructed an Engineered Cap, LUCs	TNX Area ROD (WSRC-RP-2003-4017)
LDG	CM, HH	S	•		Backfilled LDG, Constructed an Engineered Cap, LUCs	TNX Area ROD (WSRC-RP-2003-4017)
TNX GW	HH	GW	•		SVE and Air Stripping (Pump & Treat)	TNX Area ROD (WSRC-RP-2003-4017)
677-T/678-T Suspect Sumps	PTSM	S	•		Excavation/Offsite Disposal of PTSM	ESD to TNX Area OU ROD (WSRC-RP-2005-4030)
TNX OD OU						
Outfall Delta	CM, HH, PTSM	S	•	•	Soil Removal/Placement in Industrialized Portion of T Area, Amendments in Excavated Area, Backfilled, LUCs	TNX OD OU RSER/EE/CA (WSRC-RP-2004-4055)
Inner Swamp	CM, HH, PTSM	S	•	•	Soil Removal/Placement in Industrialized Portion of T Area, Amendments in Excavated Area, Backfilled, LUCs	TNX OD OU RSER/EE/CA (WSRC-RP-2004-4055)
Swamp High Ground	None	S		•	No problem warranting action[3]	RI/FFS/RA for TAOU (WSRC-RP-2004-4050)
Outer Sample	None	S		•	No problem warranting action[3]	RI/FFS/RA for TAOU (WSRC-RP-2004-4050)
X-001 Outfall Drainage Ditch OU	ARAR, HH	S	•	•	Soil Removal/Soil Placement in Industrialized Portion of T Area, LUCs. NFA after excavation	X-001 Outfall Drainage Ditch OU RSER/EE/CA (WSRC-RP-2004-4018)
Tile Field #1	None	S	•		No problem warranting action[3]	TAOU RI/FFS/RA (WSRC-RP-2004-4050)
Tile Field #2	CM	S	•	•	Soil Removal/Placement in Industrialized Portion of T Area, LUCs. NFA after excavation	Tile Field #2 RSER/EE/CA (WSRC-RP-2004-4027)

Table Q-2. Summary of the Remedial Strategy for T Area (WSRC 2005b) (*continued/end*)

Areas	Risk[1]	Impacted Media[2]	Media Addressed under Other Document	Media Addressed Under ROD[3]	Remedial or Removal Action Taken Under Other Documents[4]	Other Documents[5]
TNX OD OU (continued/end)						
Tile Field #3	None	S	•		No problem warranting action[3]	TAOU RI/FFS/RA (WSRC-RP-2004-4050)
TNX Area Process Sewer Lines	None	S	•		No problem warranting action[3]	TAOU RI/FFS/RA (WSRC-RP-2004-4050)
TBG (Previously Inaccessible Areas)	CM, HH, PTSM	S		•	None	TAOU RI/FFS/RA (WSRC-RP-2004-4050)
Former Building Slabs	HH	C	•	•	Removal of Buildings, Scabbling of Slabs to Remove PTSM, ICs	DPFRs, TAOU RI/FFS/RA (WSRC-RP-2004-4050)
	PTSM	S	•	•	None	TAOU RI/FFS/RA (WSRC-RP-2004-4050)

Note: the TAOU includes soil and associated materials (such as concrete and slabs); TNX groundwater is addressed under the TNX Area OU

1 ECO=Ecological, HH=Human Health, CM=Contaminant Migration, PTSM=Principal Threat Source Material, ARAR=Applicable or Relevant and Appropriate Requirements;

2 SW=Surface Water, S=Soil, GW=Groundwater, C=Concrete

3 WSRC 2005b - TAOU ROD (WSRC-RP-2004-4070)

4. LUCs=Land Use Controls, SVE=Soil Vapor Extraction, NFA=No Further Action

5 RI/FFS/RA = RI/Focused Feasibility Study/Risk Assessment, DPFR = Decommissioning Project Final Report

Table Q-3. RCOCs and RGs for Industrial Land Use at TAOU (WSRC 2005b)

RCOC	Type of RCOC	RG	Units
Outfall Delta (soil)			
Actinium-228	Human Health	3.34	ρCi/g
Lead-212	Human Health	35.34	ρCi/g
Radium-228	Human Health	3.21	ρCi/g
Thorium-228	Human Health	1.73	ρCi/g
Uranium-233/234	Contaminant Migration	6.54	ρCi/g
Uranium-235	Contaminant Migration	0.31	ρCi/g
Uranium-238	Contaminant Migration	6.58	ρCi/g
Inner Swamp (sediment)			
Actinium-228	Human Health	3.34	ρCi/g
Radium-228	Human Health	3.21	ρCi/g
Thorium-228	Human Health	1.73	ρCi/g
Uranium-233/234	Contaminant Migration	5.75	ρCi/g
Uranium-235	Contaminant Migration	0.27	ρCi/g
Uranium-238	Contaminant Migration	5.75	ρCi/g
TNX Burying Ground (soils)			
Uranium-238	Contaminant Migration	1.79	ρCi/g
Stockpiled Soils from X-001 Outfall (soil)			
Aroclor 1260	ARAR	10	mg/kg
Uranium-238	Human Health	1.79	ρCi/g
Stockpiled Soils from Tile Field 2 (soil)			
Mercury	Contaminant Migration	0.078	mg/kg

WSRC 2005b - TAOU ROD (WSRC-RP-2004-4070)

Table Q-4. Actual versus Estimated O&M Costs

	FY2012	**FY2013**	**FY2014**	**FY2015**	**FY2016**	**5-Year Total**
Total Actual O&M Costs ($)	64,697	61,625	71,148	73,168	90,296	360,934
Total ROD Estimated Direct O&M Costs*($)	73,608	62,300	62,300	62,300	62,300	322,808

* Costs for preparation of the Fourth Five-Year Remedy Review were accounted for in FY2012.

Table Q-5. Summary of TAOU COCs measured above MCLs in Groundwater

Contaminants (MCL)	Year (Results greater than MCL)									
	2012		2013		2014		2015		2016	
	# Detects (Tot Detects)	**Wells (#Events)**	**# Detects (Tot Detects)**	**Wells (#Events)**	**# Detects (Tot Detects)**	**Wells (#Events)**	**# Detects (Tot Detects)**	**Wells (#Events)**	**# Detects (Tot Detects)**	**Wells (#Events)**
Mercury (2.2 µg/L)	0 (25)	*	1(21)	TRW 2	0 (18)	*	0 (21)	*	0 (12)	*
Uranium (30 µg/L)	2 (13)	TCM 5 (2)	4 (14)	TBG 4 (2) TCM 5 (2)	4 (13)	TBG 4 (2) TCM 5 TNX 30D	1 (19)	TCM 5	1 (9)	TBG 4
Gross Alpha (15 ρCi/L)	2 (21)	TCM 5	5 (16)	TBG 4 (1) TCM 5 (2) TNX 3D TNX (30D)	3 (24)	TBG 4 TIR 1U TNX 30D	1 (22)	TCM 5	0 (7)	*
Combined Radium-226/ Radium-228 (5 ρCi/L)	0 (57)	*	0 (47)	*	3 (64)	TNX 30D TIR 1U TNX 35D	1 (53)	TRW 2	0 (39)	*

* - When no number is present, the number of events above the MCL is equal to the total number of detects above the MCL recorded in the column to the immediate left

This page is intentionally left blank.

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit

I. SITE INFORMATION

Site Name:	**T-Area Operable Unit**	**Date of Inspection:**	**9/08/2016**
Location and Region	**SRS, USEPA Region 4**	**EPA ID:**	**CERCLIS #96**
Agency, Office, or Company leading the Five-Year Review	**USDOE**	**Weather/ Temperature**	**84°F** **Sunny**

Remedy Includes: *(Click all that apply)*

☒ Landfill Cover/Containment
☒ Access Controls
☒ Institutional Controls
☐ Groundwater Pump and Treatment
☐ Surface Water Pump and Treatment
☐ Monitored Natural Attenuation
☐ Groundwater Containment
☐ Vertical Barriers

☒ Other Consolidation, soil amendments

Attachments: ☐ Inspection team roster attached ☐ Inspection team roster attached

II. INTERVIEWS *(Click all that apply)*

1. **O&M Staff:** Steve Willingham (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4145

Problems/Suggestions: ☐ Report Attached

2. **O&M Staff:** Richard Feagin (Name) EC&ACP Post Closure Waste Site Inspector/Maintenance Coord. (Title) 9/20/2016 (Date)

Interviewed: ☐ At Site ☒ At Office ☐ By Phone Phone No.: 803-952-4416

Problems/Suggestions: ☐ Report Attached

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

II. INTERVIEWS *(Click all that apply)(Continued)*

3. **Local Regulatory Authorities and Response Agencies** (i.e., State and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds or other city and county offices, etc.). Fill in all that apply.

Agency: ______________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

Agency: ______________________

Contact: __________ (Name) __________ (Title) __________ (Date) __________ (Phone No.)

Problems/Suggestions: ☐ Report Attached ______________________

____

4. **Other Interviews** *(Optional):* ☐ Report Attached

____

____

____

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Click all that apply)*

1. **O&M Documents:**

☐ O&M Manual	☐ Readily Available	☐ Up to Date	☒ N/A
☒ As-Built Drawings	☒ Readily Available	☒ Up to Date	☐ N/A
☒ Maintenance Logs	☒ Readily Available	☒ Up to Date	☐ N/A

Remarks: See *Waste Unit Inspection and Maintenance, ER-SOP-019, Field Inspection Checklist for T-Area Operable Unit*, ER-IDS-019-032.

____

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

III. ONSITE DOCUMENTS & RECORDS VERIFIED *(Continued)*

2. Health and Safety Plans (HASPs):

☐ Site-Specific Health and Safety Plans ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Contingency Plan/Emergency Response Plan ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks: Routine O&M activities do not require a SSHASP under 29 CFR 1910.1201, HAZWOPER.

3. O&M and OSHA Training Records: ☒ Readily Available ☒ Up to Date ☐ N/A

Remarks: Training Records are complete and up to date per EC&ACP training matrix.

4. Permits and Service Agreements:

☐ Air Discharge Permit ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Effluent Discharge ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Waste Disposal; POTW ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Other Permits ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

5. Gas Generation Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

6. Settlement Monument Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

7. Groundwater Monitoring Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

8. Leachate Extraction Records: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

9. Discharge Compliance Records:

☐ Air ☐ Readily Available ☐ Up to Date ☒ N/A
☐ Water (Effluent) ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

10. Daily Access/Security Logs: ☐ Readily Available ☐ Up to Date ☒ N/A

Remarks:

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

IV. O&M COSTS

1. O&M Organization:

☐ State In-House
☐ PRP In-House
☒ Other: SRS
☐ Contractor for State
☐ Contractor for PRP

2. O&M Cost Records:

☐ Readily Available ☐ Up to Date ☐ Funding mechanism/agreement in place
☒ Other: Project cost data is summarized in Section IV of this OU-specific review.

Total annual cost by year for review period, if available

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

From:______ To:______ ______ ☐ Breakdown attached
(Date) (Date) (Total Cost)

3. Unanticipated or Unusually High O&M Costs During Review Period

Describe costs and reasons: ______

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. Fencing Damage: ☐ Location shown on site map ☐ Gates secured ☒ N/A
Remarks: OU-specific perimeter fencing is not required by the remedial action.

B. Signs

1. Signs and Other Security Measures: ☐ Location shown on site map ☐ N/A
Remarks: Signs are in good condition.

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

V. ACCESS AND INSTITUTIONAL CONTROLS *(Continued)*

C. Institutional Controls

1. Implementation and Enforcement

Site conditions imply ICs are not properly implemented: ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs are not being fully enforced: ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive-by, etc.) Walkdown
Frequency: Once in 5 years
Responsible Party/Agent: USDOE Savannah River Field Office

Contact:	Brian Hennessey	FFA Program Manager	11/22/2016	803-952-8635
	(Name)	(Title)	(Date)	(Phone No.)

Reporting is up-to-date: ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency: ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met: ☒ Yes ☐ No ☐ N/A
Violations have been reported: ☐ Yes ☐ No ☒ N/A
Problems/Suggestions: ☐ Report Attached

2. Adequacy: ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks: Survey wooden stakes were located. Several had been damaged due to control burn in the area.

D. General

1. Vandalism/Trespassing: ☐ Location shown on site map ☒ No vandalism is evident
Remarks:

2. Land use changes onsite: ☒ N/A
Remarks:

3. Land use changes offsite: ☒ N/A
Remarks:

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. Roads damaged: ☒ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks:

B. Other Site Conditions

Remarks: Site inspections conducted annually from FY2012 through FY2016 identified minor erosion on slide slopes, active ant mounds, overgrown vegetation, bare spots from vehicle traffic, evidence of hog damage, cracked French drain clean out plug, and debris in drainage ditches. These findings were resolved soon after discovery.

VII. LANDFILL COVER/CONTAINMENT ☒ Applicable ☐ N/A

A. Landfill Surface

1. Settlement (Low spots)**:** ☐ Location shown on site map ☒ Settlement not evident

Areal extent________ Depth________

Remarks:

2. Cracks: ☐ Location shown on site map ☒ Cracking not evident

Lengths________ Widths________ Depths________

Remarks:

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident

Areal extent________ Depth________

Remarks:

4. Holes: ☐ Location shown on site map ☒ Holes not evident

Areal extent________ Depth________

Remarks:

5. Vegetative Cover: ☒ Grass ☒ Cover properly established ☐ No signs of stress

Areal extent________ Depth________

Remarks: Vegetation is mowed routinely.

6. Alternative Cover (armored rock, concrete, etc.): ☒ N/A

Remarks:

7. Bulges: ☐ Location shown on site map ☒ Bulges not evident

Areal extent________ Depth________

Remarks:

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

8. **Wet Areas / Water Damage:** ☒ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Areal extent________________
☐ Ponding ☐ Location shown on site map Areal extent________________
☐ Seeps ☐ Location shown on site map Areal extent________________
☐ Soft subgrade ☐ Location shown on site map Areal extent________________

Remarks:____

9. **Slope Instability:** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability

Areal extent________________

Remarks:____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mates, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents:** ☐ Active ☐ Passive

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks:____

2. **Gas Monitoring Probes:**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks:____

3. **Monitoring Wells:**

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks:____

4. **Leachate Extraction Wells:**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks:____

5. **Settlement Monuments:** ☐ Located ☐ Routinely Surveyed ☒ N/A

Remarks:____

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

E. Cover Penetrations ☒ Applicable ☐ N/A

6. Gas Vents: ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:____________________

7. Gas Monitoring Probes:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:____________________

8. Monitoring Wells:
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
Remarks:____________________

9. Leachate Extraction Wells:
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good Condition
☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A
Remarks:____________________

10. Settlement Monuments: ☐ Located ☐ Routinely Surveyed ☒ N/A
Remarks:____________________

F. Gas Collection and Treatment ☐ Applicable ☒ N/A

G. Cover Drainage Layer ☐ Applicable ☒ N/A

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

VII. LANDFILL COVER/CONTAINMENT *(Continued)*

H. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. Siltation:
Areal extent____________ Depth____________ ☐ N/A
☒ Siltation not evident
Remarks:________________________

2. Erosion:
Areal extent____________ Depth____________ ☐ N/A
☒ Erosion not evident
Remarks:________________________

3. Outlet Works: ☒ Functioning ☐ N/A
Remarks:________________________

4. Dam: ☐ Functioning ☒ N/A
Remarks:________________________

I. Retaining Walls ☐ Applicable ☒ N/A

J. Perimeter Ditches/Offsite Discharge ☒ Applicable ☐ N/A

1. Siltation: ☐ Location shown on site map ☐ Siltation not evident
Areal extent____________ Depth____________
Remarks:________________________

2. Vegetative Growth: ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent____________ Type____________
Remarks:________________________

3. Erosion: ☐ Location shown on site map ☒ Erosion not evident
Areal extent____________ Depth____________
Remarks:________________________

4. Discharge Structure: ☐ Location shown on site map ☒ N/A
Remarks:________________________

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

Attachment Q-1. Five-Year Review Site Inspection Checklist – T-Area Operable Unit *(continued)*

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

X. OTHER REMEDIES

If there are remedies applied at the site, which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

A. Consolidation and Soil Amendments ☒ Applicable ☐ N/A

Consolidation and soil amendment additions were performed at TAOU. The remedy is performing as designed. Consolidation and soil amendment additions were performed at TAOU.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emissions, etc.).

Remedy for this site is: low-permeability soil cover system; institutional controls, and application of soil amendments in the Outfall Delta/Inner Swamp to attenuate the leachability of radiological contaminants in soils. The cover system is intact, long term grasses have been fully established. Soil cover system remedy appears to be functioning as designed. Drainage channel function adequately. Soil amendments have been applied and results are monitored semi-annually through groundwater sampling and the results reported in the Annual Groundwater Monitoring and Remedial Action Effectiveness Interim Report (formerly known as the Annual Groundwater and Effectiveness Monitoring Strategy Report) for TNX Area OU.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The O&M procedures consisting of annual site inspections and site maintenance (repair of erosion damage, cover maintenance, and warning signs) and site controls (SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the OU) have been implemented. The O&M procedures are adequately maintaining the integrity of the engineered cover, which in turn will maintain the effectiveness of the cover to mitigate leaching. There are no issues requiring corrective actions.

C. Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

N/A