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APR 17 2019

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Federal Remediation Section
Division of Site Assessment, Remediation and Revitalization
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
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Mr. Jon Richards
Acting Savannah River Site Remedial Project Manager
Superfund Division
U. S. Environmental Protection Agency, Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303

Dear Ms. Fulmer and Mr. Richards:

SUBJECT: Focused Corrective Measures Study/Feasibility Study Letter in Support of the D-Area Operable Unit, SEMS Number: 63

In accordance with the terms of the Federal Facility Agreement, the U. S. Department of Energy (DOE) is submitting the Focused Corrective Measures Study/Feasibility Study Letter in Support of the D-Area Operable Unit for your review. Please review this letter and provide your comments within forty-five (45) days of receipt.

The effort and time that the South Carolina Department of Health and Environmental Control and the U. S. Environmental Protection Agency have given on the subject operable unit are greatly appreciated. Comments or questions from your staff may be directed to me at (803) 952-8365 or the DOE Federal Project Director, Ms. Karen Adams, at (803) 952-7871.

Sincerely,

Brian T. Hennessey
SRS Remedial Project Manager
Infrastructure and Area Completion Division

IACD-19-140

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FOCUSED CORRECTIVE MEASURES STUDY/FEASIBILITY STUDY LETTER IN SUPPORT OF THE D-AREA OPERABLE UNIT, SEMS NUMBER: 63

1.0 Introduction

This Focused Corrective Measures Study/Feasibility Study Letter provides information regarding the evaluation of remedial alternatives for portions of the D-Area Operable Unit (DAOU) at the Savannah River Site (SRS). The alternative evaluation will support the United States Department of Energy (USDOE), United States Environmental Protection Agency (USEPA), and the South Carolina Department of Health and Environmental Control (SCDHEC) agreement on the preferred remedy for four DAOU subunits.

The DAOU is comprised of multiple subunits and includes both deactivation and decommissioning facilities and facilities associated with the former operation of the 484-D Powerhouse (Figure 1). Following a series of removal actions, an Early Action Record of Decision (EA ROD) (SRNS 2011) was issued in 2011 that selected land use controls (LUCs) as the final remedial action to prevent unrestricted use for the DAOU Bubble Tower Subunit, Moderator Processing Subunit, 489-D Coal Pile Runoff Basin (CPRB) (Northern 25%), D-Area Asbestos Pit (including restrictions against land disturbance), and D-Area Process Sewer Lines as Abandoned inside the area fence.

This document supports a Second EA ROD for the following four DAOU subunits that were associated with the operation of the 484-D Powerhouse:

- 488-1D Ash Basin (including two Inlet Basins)
- 488-2D Ash Basin
- 488-4D Ash Landfill
- 489-D CPRB (Southern 75%)

A range of alternatives were evaluated for each of these subunits through a series of removal action documents that support an accelerated cleanup strategy for the DAOU. These documents include a Removal Site Evaluation Report (RSER) for the time-critical removal action (TCRA) at the 488-2D Ash Basin and a RSER/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for each of the non-time critical removal actions (NTCRAs) at the 488-1D Ash Basin, 488-4D Ash Landfill and the 489-D CPRB (Southern 75%). The removal actions included ash removal and installation of a geosynthetic cover system at the 488-1D Ash Basin; ash removal at the 488-2D Ash Basin; installation of a geosynthetic cover system at the 488-4D Ash Landfill; and excavation and disposal of coal residue for the 489-D CPRB (Southern 75%). The selected removal actions for these subunits were made available for public notice and comment, and corresponding Action Memorandums (AMs) were issued following the public comment periods.

In addition to these prior removal actions, remedial actions are required at the 488-1D Ash Basin, 488-2D Ash Basin and 488-4D Ash Landfill due to the presence of coal-related contaminants that pose a threat to human health and the environment. At the 489-D CPRB (Southern 75%) subunit, there are no human health, ecological or contaminant migration constituents of concern (COCs) following the removal action. In its current state, the 489-D CPRB (Southern 75%) subunit poses no risk to human health and the environment and supports unrestricted land use. Similarly, the 488-1D Inlet Basins pose no risk to human health and the environment and supports unrestricted land use.

This document outlines the range of remedial alternatives evaluated to prevent exposure to the contaminated media (coal and coal ash) and summarizes the removal action alternatives that were previously evaluated, documented and approved.

The future land use of the DAOU is reasonably anticipated to be industrial land use with USDOE maintaining control of the land.

Operable Unit Background

SRS produced special nuclear materials for the United States Department of Defense between 1952 and 1988. The reactors that were used to produce the nuclear materials required heavy water as a moderator to control the speed of neutrons in the reactor. The heavy water was produced at D Area on the SRS. D Area also contained the heavy water rework facility to purify the SRS inventory of used reactor moderator.

D Area is located in the southwest quadrant of the SRS, ~915-meters (m) (3,000-feet [ft]) east of the nearest site boundary, the Savannah River. The DAOU is ~85 hectares (ha) (210 acres [ac]) and contains surface units and source areas in D Area that are potentially responsible for contaminating groundwater. Previous groundwater investigations at D Area have identified relatively large, commingled, depleting plumes of tritium, volatile organic compounds (primarily trichloroethylene [TCE]), and metals. The tritium and TCE are a result of historical releases associated with operations at D Area, and the metals are attributed to the leaching of coal used at the 484-D Powerhouse. Groundwater is not part of the DAOU. Groundwater is currently being addressed separately under the D-Area Groundwater (DAG) OU.

D Area consists of three main facility areas: the 484-D Powerhouse, the D-Area Heavy Water Facility (i.e., bubble towers), and the Moderator Processing Facility. The facilities began operation in the early 1950s. The bubble towers were shut down in January 1982, the moderator processing facility remained operational until the late 1990s, and the 484-D Powerhouse (and associated support facilities) was shut down in April 2012.

An *Early Action Record of Decision Remedial Alternative Selection for the D-Area Operable Unit (DAOU) (U)* (SRNS 2011) integrated the outcomes of the completed removal actions and selected LUCs as the final action to prevent unrestricted use for the Bubble Tower Subunit,

Moderator Processing Subunit, 489-D CPRB (Northern 25%), D-Area Asbestos Pit (including restrictions against land disturbance), and D-Area Process Sewer Lines as Abandoned inside the area fence. The 2011 EA ROD documented that there were no problems warranting action for the 904-50G Outfall, electrical transformers, and miscellaneous buildings.

In 2013, the USDOE, USEPA, and SCDHEC agreed to add the 488-1D Ash Basin, 488-2D Ash Basin, and the 488-4D Ash Landfill as subunits of the DAOU. The ash basins were permitted and operated under the SCDHEC Industrial Wastewater Treatment (IWT) regulations (Permit #7295), and the ash landfill was permitted and operated as a Class Two Solid Waste Landfill (Permit #025800-1602). The USDOE, USEPA, and SCDHEC agreed to the submittal of three separate RSER/EE/CA documents and AMs to perform the cleanup. The Federal Facility Agreement (FFA) documentation satisfies the substantive technical objectives of the closure plan requirements for these units. The applicable IWT operating permits will be terminated upon approval of the Removal Action Reports. The Solid Waste Landfill permit will be managed consistent with the post closure phase of the SCDHEC permit as defined in the Applicable or Relevant and Appropriate Requirements (ARARs) until the remedial action described in the Second EA ROD is implemented.

In 2015, the USEPA, SCDHEC, and USDOE approved deletion of the submittal of the Revision 1 RSER/EE/CA from the FFA and agreed that only the submittal of the Revised AM and a Removal Action Start milestone were necessary for the remaining portion of the 489-D CPRB (Southern 75%). The 489-D CPRB was permitted under IWT Permit #7295 during operation.

Because of the extensive scope, cost, and duration, these removal actions were divided into two major phases. Phase 1 included removal actions at the 488-2D Ash Basin and the 488-4D Ash Landfill; Phase 2 included removal actions at the 488-1D Ash Basin and the 489-D CPRB (Southern 75%) (Figure 2).

488-1D Ash Basin

The 488-1D Ash Basin is an unlined, earthen containment structure that was built on existing grade (ground elevation). Powerhouse ash slurry flowed via an ash sluice line from the 484-D Powerhouse into one of two Inlet Basins identified as Inlet Basin #1 (northern) and Inlet Basin #2 (southern), each ~1.2 ha (3 ac) in size. The bulk of ash settled out of the slurry in the Inlet Basins and the slurry water flowed into the eastern end of the 488-1D Ash Basin (~14 ha [35 ac]). As the waste water level increased in the 488-1D Ash Basin, the waste water gravity flowed through a pipe located at the western end of the basin and discharged into the 488-2D Ash Basin for polish settling of any remaining finer solids.

When the 488-1D Inlet Basin(s) were filled to capacity, the ash was excavated, trucked and placed into the 488-4D Ash Landfill for final disposal. This operation ended when the 484-D Powerhouse was removed from service in 2012. Following cessation of the 484-D Powerhouse operations, only wash water was received in the Inlet Basins for ~6 months during the 484-D

Powerhouse deactivation activities. The area impacted by the presence of ash (including the 2.4 ha [6-ac] Inlet Basins) is ~16 ha (40 ac). Ash historically contains unacceptable levels of contaminants that require remediation to meet cleanup requirements.

The *Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for the D-Area Ash Basin (488-1D)* (SRNS 2016a) identified the objectives of the removal action for the 488-1D Ash Basin, described alternatives that address the potential threats from release of contaminants to the environment, and provided a vehicle for public involvement. The AM was submitted on August 17, 2016 (USDOE 2016a) with a Removal Action Start Date of August 25, 2016 (USDOE 2016b).

The removal action for the 488-1D Ash Basin was conducted in accordance with the *Removal Action Design Plan (RADP) for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2016b). After dewatering and vegetation removal, the ash in the 488-1D Ash Basin was consolidated into the eastern portion of the basin and a new berm installed along the western side interface. A geosynthetic cover was installed over the ash consolidation area ~7.9 ha (19.4 ac). A vegetative layer (sod) was placed over the geosynthetic cover. The cover system is compliant with the SCDHEC Class Three Solid Waste Landfill cover requirements. The western portion of the basin ~6.5 ha (16 ac) is covered with soil and graded to direct storm water away from the basin into an existing ditch at the southwest corner of the 488-1D Ash Basin.

The 488-1D Ash Basin subunit includes the ash sluicing lines. These above ground lines ran from the 484-D Powerhouse to the Inlet Basins at the 488-1D Ash Basin. Removal of these lines included 25.4-centimeters (cm) (10-inch [in.]) cast iron and fiberglass pipe, 20.3 cm (8-in.) carbon steel pipe, and a temporary 15.2-cm (6-in.) polyvinyl chloride pipe. These materials were disposed at an approved disposal facility (Three Rivers Landfill). The sluicing lines were removed during Phase 1 construction activities. Documentation is provided in the *Removal Action Report for the 488-2D Ash Basin and 488-4D Ash Landfill* (SRNS 2017a).

Ash was removed from the two Inlet Basins and placed into the eastern portion of the 488-1D Ash Basin. The Inlet Basin area was then graded to provide sheet flow drainage to an existing ditch located along the east side of the Inlet Basins. The *Removal Action Report for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2019a) documents the construction activities and as-built condition of the 488-1D Ash Basin and Inlet Basins.

The closure activities for the 488-1D Ash Basin required the abandonment of several monitoring wells and piezometers. Federal Energy Regulatory Commission wells/piezometers installed for monitoring berm stability that were abandoned include DA 4C, DB 5C, DA 7C, DB 6C, DA 11C, DB 10C, DA 12C, DB 13C, DA 14C, and DB 15C. In addition, piezometer P-06, installed as part of early basin closure activities, was abandoned. Two new wells (DCB081 and DCB082) were installed down gradient of the 488-1D Ash Basin geosynthetic cover system.

As required by the regulations (R.61-71, Well Standards), all well abandonments and installations were approved by SCDHEC. The USEPA was included on all correspondence concerning the well abandonments and installations. Figure 3 shows both the new and abandoned wells around the 488-1D Ash Basin. Well installation and abandonment records are provided in the *Removal Action Report for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2019a).

488-2D Ash Basin

The 488-2D Ash Basin served as the final settling stage for the treatment of the 484-D Powerhouse operation ash contaminated wastewater. This basin received the overflow waste water from the 488-1D Ash Basin and provided residence time for the final settling of the solids as the water flowed from the western end of the 488-2D Ash Basin to the discharge pipe located at the eastern end of the 488-2D Ash Basin. As the water flowed from west to east, the flow distance, along with the settling velocity of solids, provided sufficient removal of any remaining solids to ensure compliance with the National Pollution Discharge and Elimination System (NPDES) discharge permit at Outfall D-01C. The 488-2D Ash Basin discharged the treated water into the D-Area Discharge Canal at the D-01C Outfall which eventually flowed into Beaver Dam Creek.

A time critical *Removal Site Evaluation Report (RSER) for the D-Area Ash Basin (488-2D)* (SRNS 2014a) was submitted to the USEPA and SCDHEC to dewater and remove the bulk ash from the basin that was essential to reduce the risk to human health and the environment and to maintain the DAOU construction and closure schedule. The *Action Memorandum for the Time-Critical Removal Action for the D-Area Ash Basin (488-2D)* (USDOE 2014a) was submitted on October 28, 2014, with a Removal Action Start Date of October 14, 2014 (USDOE 2014b).

The removal action for the 488-2D Ash Basin was conducted in accordance with the *Removal Action Design Plan (RADP) for the 488-4D Ash Landfill and the 488-2D Ash Basin* (SRNS 2015a). After dewatering, the ash and contaminated sediment/soils from the basin bottom and embankment along the entire length of the northern berm were excavated and consolidated in the 488-4D Ash Landfill. Approximately 0.3-m (1-ft) average depth of ash fines and 0.3-m (1-ft) average depth of contaminated sediment/soils were removed from across the 488-2D Ash Basin bottom. Approximately 69,420 cubic meters (m^3) (90,800 cubic yards [yd^3]) of ash from the 488-2D Ash Basin was placed into the 488-4D Ash Landfill; this volume includes an area of ash excavated from the west (outer edge) of the 488-4D Ash Landfill.

Fill was placed in the 488-2D Ash Basin (~6 ha [15 ac]) and was re-graded, sloped appropriately and converted into a storm water detention structure. A detention structure is a permanent storm water management structure whose primary purpose is to temporarily store storm water runoff and release the stored runoff at controlled rates. This detention structure is designed and constructed to serve as a storm water conveyance system as part of the post-closure ARARs specific to the 488-4D Ash Landfill. The *Removal Action Report for the 488-2D Ash*

Basin and 488-4D Ash Landfill (SRNS 2017a) documents the construction activities and as-built condition of the 488-2D Ash Basin.

488-4D Ash Landfill

The 488-4D Ash Landfill is an 8.9-ha (22-ac) basin that was initially part of the SRS As-Built Construction Permit #7295 and the associated 1991 SRS permit-to-operate for existing SRS wastewater facilities. The basin ceased wet operations and has been dry since 1993. Per agreement with SCDHEC, the basin was re-permitted in November 2007 as a Class Two Solid Waste Landfill under Solid Waste Landfill Permit #025800-1602 to accept ash waste for disposal. All storm water drainage was directed into the infiltration basin located within the western end of the landfill which had an overflow channel that directed any excess contaminated water to the 488-2D Ash Basin for treatment (settling). The water was combined with the 488-1D Ash Basin waste water, treated per the 488-2D Ash Basin IWT permit, and released through NPDES Outfall D-01C.

An ash waste characterization report was approved by SCDHEC in 2004 requiring ash characterization to be completed every six years. In 2009, a one-time approval was granted by SCDHEC to dispose of dredge spoils from the 681-3G (Downstream Water Pump House for 100 Area) and 681-5G (Water Pump House for 400 Area) into the 488-4D Landfill. In 2010, characterization of the coal ash from the 484-D Powerhouse indicated that arsenic levels would exceed the regulatory threshold for a Class Two Solid Waste Landfill. In 2013, the USDOE, USEPA, and SCDHEC agreed to add the 488-4D Ash Landfill to the DAOU to satisfy substantive technical objectives of the Solid Waste Closure Plan requirements for the Class Two Solid Waste Landfill permit.

In 2012, coal from the D-Area Coal Storage Area (484-17D) was excavated and placed into the 488-4D Ash Landfill for disposal. This excavated material may have included coal-reject material that contained manganese and arsenic at concentrations exceeding the regulatory threshold for a Class Two Solid Waste Landfill. In May 2013, SCDHEC approved the disposal of non-hazardous solids from the nearby D-Area Surge Basin (483-6D) into the 488-4D Ash Landfill. Characterization of the surge basin solids indicated that manganese, aluminum, and iron exceeded the regulatory threshold for a Class Two Solid Waste Landfill. As a result, SCDHEC reiterated in 2013 their requirement that the 488-4D Landfill be closed with a SCDHEC Class Three Landfill cover.

The *Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for the D-Area Ash Landfill (488-4D)* (SRNS 2014b) was submitted in June 2014. The removal action for the 488-4D Ash Landfill was conducted in accordance with the *Removal Action Design Plan (RADP) for the 488-4D Ash Landfill and the 488-2D Ash Basin* (SRNS 2015a). The AM and Responsiveness Summary for the Non-Time Critical Removal Action for the D-Area Ash Landfill (488-4D) was submitted on August 11, 2014 (USDOE 2014c). The Removal Action Start Date was September 2, 2014 (USDOE 2014d).

Under the removal action, excavated ash from the 488-2D Ash Basin was placed in the 488-4D Ash Landfill. The landfill was graded to achieve proper slope elevations and the infiltration basin located at the western end of 488-4D Ash Landfill was dewatered and filled in. Side slopes were graded to obtain proper slopes for drainage and stabilization (where necessary). A geosynthetic cover was applied over the entire 488-4D Ash Landfill (~8.9 ha [22 ac] including the infiltration basin). A vegetative layer (sod) was placed over the geosynthetic cover. The cover system is compliant with the SCDHEC Class Three Solid Waste Landfill cover requirements. The *Removal Action Report for the 488-2D Ash Basin and 488-4D Ash Landfill* (SRNS 2017a) documents the construction activities and as-built condition of the 488-4D Ash Landfill.

A total of five (5) wells (DCB 16R, DCB 47C, DCB075, DCB076 and DCB 13R) were abandoned for the construction activities related to the Phase 1 (488-4D Ash Landfill and 488-2D Ash Basin) removal activities. Four replacement wells (DCB077, DCB078, DCB079 and DCB080) were installed around the 488-4D Ash Landfill. As required by SCDHEC regulations (R.61-71, Well Standards), all well abandonments and installations were approved by SCDHEC. The EPA was included on all correspondence concerning the well abandonments and installations. Figure 3 shows both new and abandoned wells around the 488-4D Ash Landfill. Well installation and abandonment records are provided in the *Removal Action Report for the 488-2D Ash Basin and 488-4D Ash Landfill* (SRNS 2017a).

489-D CPRB (Southern 75%)

The 489-D CPRB is located in the southern portion of the DAOU and is ~5.7 ha (14 ac) in size. During operation of the 484-D Powerhouse, runoff storm water from the 484-17D Coal Storage Area was collected through a network of drainage ditches and flowed to the 489-D CPRB via storm sewers for settling. The *RCRA Facility Investigation/ Remedial Investigation (RFI/RI) Work Plan and RFI/RI Report with Baseline Risk Assessment for the D-Area Operable Unit* (SRNS 2009) concluded that arsenic in 489-D CPRB sediment posed an unacceptable risk for future industrial workers, and arsenic and 2-methylnapthalene posed a risk for ecological receptors. In addition, metals and low pH presented an ecological risk for aquatic receptors in surface water. On December 21, 2009, an AM was issued to document the preferred removal action for the 489-D CPRB to include consolidation of contaminated sediments, placement of a soil cover, and LUCs (USDOE 2009).

Because the 484-D Powerhouse would still be active when the removal action began in April 2011, a revised AM was issued on August 26, 2010 to segment the 489-D CPRB into a northern and southern section (USDOE 2010). The Northern 25% section of the 489-D CPRB was addressed by the removal action, and the Southern 75% section remained active during 484-D Powerhouse operations. As documented in the August 2010 Revised AM, the second phase for remediation of the Southern 75% section would be implemented after the operations of the 484-D Powerhouse ceased, and storm water runoff was no longer received from the active 484-17D Coal Storage Area. In 2013, the storm water sewer line was diverted to prevent storm water

runoff originating from the 484-17D Coal Storage Area from entering the Southern 75% section of the 489-D CPRB.

The Revision 3 AM for the Non-Time Critical Removal Action for the D-Area CPRB (489-D), dated August 11, 2015, identified the removal action of excavation and disposal with unrestricted land use for the Southern 75% section (USDOE 2015a), and a Removal Action Start Date of September 10, 2015 was achieved (USDOE 2015b).

The removal action for the Southern 75% of the 489-D CPRB was completed in accordance with the *Removal Action Design Plan (RADP) for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2016b). After dewatering, ~17,620 m^3 (23,050 yd^3) of coal fines and contaminated sediments from the basin were excavated, transferred and consolidated within the eastern end of the 488-1D Ash Basin. The *Removal Action Report for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2019a) documents the construction activities and as-built condition of the Southern 75% of the 489-D CPRB. The remediated basin is defined as a storm water retention structure in the end-state condition. A retention structure is a permanent structure whose primary purpose is to permanently store a given volume of storm water runoff; release of the given volume is by infiltration and/or evaporation.

2.0 Operable Unit Characteristics, Data Evaluation and Risk Assessment

Previous remedial investigations and baseline risk assessments performed by SRS concluded that coal and/or ash typically contains toxic metals such as arsenic and naturally-occurring radionuclides. Based on this historical information, the USDOE, USEPA and SCDHEC concluded that the 488-1D Ash Basin, 488-2D Ash Basin, and the 488-4D Ash Landfill likely contained unacceptable levels of contaminants (i.e., metals and naturally occurring radionuclides) that required remediation to meet Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) cleanup requirements. This section describes the characterization sampling prior to the removal actions and the post removal confirmation sampling.

Characterization Sampling

Characterization sampling information for each subunit, as appropriate, is summarized below.

Inlet Basins Ash Sampling

The 2010 characterization of the D-Area Powerhouse ash collected from the 488-1D Inlet Basins indicated that arsenic levels exceeded the regulatory threshold for a Class Two Solid Waste Landfill. The data indicates arsenic toxicity characteristic leaching procedure (TCLP) values of 0.11, 0.12 and 0.13 mg/L were detected and exceeded the ten times (10X) maximum contaminant level (MCL) threshold value (the South Carolina regulatory threshold for Class Two Landfills). No other constituents exceeded the 10X MCL threshold. No constituents exceed the Resource Conservation and Recovery Act (RCRA) thresholds for toxicity characteristic hazardous waste. Excerpts from the Waste Characterization Report are provided in the

RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a).

488-1D and 488-2D Ash Basin Sampling

Additional characterization of the 488-1D and 488-2D Ash Basins was performed in 2012. No constituents had a TCLP value that exceeded the 10X MCL threshold at the 488-1D Basin, but arsenic concentrations of 0.112 mg/L and 0.106 mg/L exceeded the 10X MCL threshold at the 488-2D Ash Basin. In addition, a total metals analysis was performed for the RCRA metals at both basins. Arsenic (maximum concentration = 64.3 mg/kg) was the only constituent that exceeded SRS maximum background concentrations in both the 488-1D and 488-2D Ash Basins. No constituents exceed the RCRA thresholds for toxicity characteristic hazardous waste. This information is provided in the RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a).

488-1D Ash Basin and Inlet Basin Surface Water Sampling

In December 2015, two surface water samples from the Inlet Basins (one sample per basin) and two surface water samples from the 488-1D Ash Basin were collected. A portion of each of these samples was filtered in the field in an effort to evaluate potential issues related to turbidity. The samples were analyzed for target analyte list inorganics and target compound list volatile organic compounds (VOCs), semi-VOCs and pesticides/polychlorinated biphenyls. Only the metal constituents were detected in the surface water samples. The concentrations of beryllium (0.010 mg/L) and cadmium (0.0129 mg/L) exceeded the MCL in Inlet Basin #1. Cobalt (0.337 mg/L) and manganese (7.08 mg/L) also exceeded the regional screening level (RSL) in this basin. There were no MCL/RSL exceedances from Inlet Basin #2 or either of the surface water samples from the 488-1D Ash Basin. This information is provided in the RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a).

488-2D Ash Basin Surface Water Sampling

In May 2014, two surface water samples were obtained from the 488-2D Ash Basin. The samples were analyzed for target analyte list inorganics and target compound list VOCs, semi-VOCs and pesticides/polychlorinated biphenyls. Only the metal constituents were detected in the surface water samples. A comparison of the maximum detected results to MCLs/ RSLs is provided in the RSER for the 488-2D Ash Basin (SRNS 2014a). None of the maximum detected concentrations exceeded the MCL/RSL threshold levels.

488-4D Ash Landfill

In 2009, a one-time approval was granted by SCDHEC to dispose of dredge spoils from the 681-3G (Downstream Water Pump House for 100 Area) and 681-5G (Water Pump House for 400 Area) into the 488-4D Landfill. Savannah River sediment data from locations upstream (River Marker [RM] 160 and RM 157.2) of these intakes were included as part of the 2008 approval request package. It was concluded that the radiological levels at the upstream sample locations

were insignificant and representative of background levels. All data are readily available in the SRS Environmental Report for 2007.

The 2010 characterization of the D-Area Powerhouse ash indicated that arsenic levels exceeded the regulatory threshold for a Class Two Solid Waste Landfill. In 2013, approval was granted by SCDHEC to dispose of material from the D-Area Coal Storage Area (484-17D) and D-Area Surge Basin (483-6D) into the 488-4D Ash Landfill. Coal from the D-Area Coal Storage Area (484-17D) likely contained coal reject material. Characterization of this material indicated manganese in the coal/coal reject material from the D-Area Coal Storage Area (484-17D) exceeded the regulatory threshold for a Class Two Solid Waste Landfill. The D-Area Surge Basin (483-6D) characterization indicates that manganese, aluminum and iron exceed the regulatory threshold for a Class Two Solid Waste Landfill. The waste material from these locations was placed in the 488-4D Ash Landfill.

Excerpts from the Waste Characterization Reports, including the results of the TCLP analysis, for the D-Area Powerhouse, D-Area Coal Storage Area (484-17D), and the D-Area Surge Basin (483-6D) are provided in the RSER/EE/CA for the 488-4D Ash Landfill (SRNS 2014b).

Ash Located Exterior to the 488-4D Ash Landfill Sampling

Two samples were collected from ash located exterior to the east end of the 488-4D Ash Landfill in December 2016. Results of the TCLP analysis are presented in the RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a). Detected constituents include arsenic, barium, boron, cadmium, chromium, selenium and thallium. No constituents exceed the RCRA thresholds for toxicity characteristic hazardous waste. This material was placed into the eastern portion of the 488-1D Ash Basin with a geosynthetic cover.

489-D Coal Pile Runoff Basin Sampling

The *RCRA Facility Investigation/Remedial Investigation (RFI/RI) Work Plan and RFI/RI Report with Baseline Risk Assessment for the D-Area Operable Unit* (SRNS 2009) concluded that the 489-D CPRB sediment posed an arsenic risk for future industrial workers and arsenic and 2-methylnaphthalene posed a risk for ecological receptors (sediment dwelling organisms). Arsenic was detected at concentrations ranging from 2.02 to 158 mg/kg with an average of 22.6 mg/kg. 2-Methylnaphthalene was detected at concentrations ranging from non-detect to 2.4 mg/kg with an average of 0.68 mg/kg. Sample results from locations that correspond to the 75% southern section of the 489-D CPRB that were placed in the eastern portion of the 488-1D Ash Basin (under the geosynthetic cover system) are presented in RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a).

The RFI/RI/Baseline Risk Assessment (BRA) also concluded that surface water was impacted with aluminum (maximum = 70.5 mg/L), beryllium (maximum = 0.0243 mg/L), cobalt (maximum = 0.4 mg/L), copper (maximum = 0.495 mg/L), iron (maximum = 152 mg/L), manganese (maximum = 5.0 mg/L) and zinc (maximum = 1.66 mg/L) at concentrations

that posed a risk to aquatic organisms. In addition, the low pH conditions posed a risk to aquatic organisms, mammals and birds.

A portion of the 489-D CPRB was sampled in 2000 for TCLP analysis as part of a maintenance action. This information is provided in the RSER/EE/CA for the 488-1D Ash Basin (SRNS 2016a). Barium (0.096 mg/L), chromium (0.0111 mg/L), and silver (0.0084 mg/L) were the only constituents detected; none of these exceeded the RCRA thresholds for toxicity characteristic hazardous waste.

In November 2016, soil/coal fines were staged for TCLP sampling prior to placement in 488-1D Ash Basin. Material from each of the staged piles was composited into three separate samples and submitted to the laboratory for TCLP analysis. Only one constituent, barium, was detected. The maximum detected concentration of 0.159 mg/L is below the regulatory threshold of 100 mg/L for toxicity characteristic hazardous waste. These sample results confirm the process knowledge determination that material from the 489-D CPRB is not a RCRA hazardous waste. The TCLP results from the 489-D CPRB are presented in the *Removal Action Report for the 488-1D Ash Basin and 489-D Coal Pile Runoff Basin* (SRNS 2019a).

Confirmation Sampling and Evaluation

The removal actions for three of the DAOU subunits (488-1D Ash Basin, 488-2D Ash Basin and 489-D CPRB) involved excavation of ash or coal media. Confirmation sampling was performed at the completion of the excavation/removal activities. The *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site* (SRNS 2014c) outlines the project data quality objectives and human health risk-based threshold levels for the historical COCs in SRS coal and/or ash as well as potential COCs that may be associated with coal ash media from the draft document *Human and Ecological Risk Assessment of Coal Combustion Wastes* (USEPA 2010). In addition to arsenic, these potential COCs included aluminum, antimony, barium, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, vanadium and zinc. Human health risk-based threshold levels for an unrestricted land use scenario (i.e., residential) were developed for each of these 30 (total) constituents (24 metals and 6 radionuclides). Ecological risk-based thresholds were also developed for these constituents and are presented in each technical evaluation document (SRNS 2016c, SRNS 2017b, SRNS 2019b).

488-1D Ash Basin Confirmation Sampling

The *Field Sampling Plan for the 488-1D Ash Basin* (SRNS 2015b) identified a total of 19 confirmation sampling locations in the western end (16 within the basin and 3 in the basin berm) of the 488-1D Ash Basin. The samples were collected from September 2017 through January 2018. Also, two confirmation samples on the east side of the 488-4D Ash Landfill were collected in December 2016 and are included in the 488-1D Ash Basin confirmation sample dataset. The confirmation sample results were evaluated to demonstrate successful ash removal

in *Human Health and Ecological Evaluation for Confirmation Sampling at the 488-1D Ash Basin and Inlet Basins* (SRNS 2019b). The residual concentrations of all analytes, with the exception of hexavalent chromium, met the pre-established cleanup levels documented in the *Confirmation Sampling and Analysis Plan for Coal and/or Ash Removal at the Savannah River Site* (SRNS 2014c) for unrestricted land use (i.e., residential). The concentration of hexavalent chromium (maximum = 1.94 mg/kg) does not exceed the threshold level for an industrial use scenario (RSL = 6.3 mg/kg).

The *Field Sampling Plan for the 488-1D Inlet Basins* (SRNS 2014d) identified a total of eight sample locations (four per Inlet Basin) for confirmation sampling. The samples were collected in September 2017 and July 2018. The confirmation sample results were evaluated to demonstrate successful ash removal in *Human Health and Ecological Evaluation for Confirmation Sampling at the 488-1D Ash Basin and Inlet Basins* (SRNS 2019b). The residual concentrations of all analytes met the pre-established cleanup levels for unrestricted land use.

488-2D Ash Basin Confirmation Sampling

The confirmation sampling data for the 488-2D Ash Basin are presented in the *Human Health and Ecological Evaluation for Confirmation Sampling at the 488-2D Ash Basin* (SRNS 2016c). Fifteen confirmation samples were collected between July 2015 and September 2015 as outlined in the *Field Sampling Plan for the 488-2D Ash Basin* (SRNS 2015c). In addition, an area of ash located on the west side of the 488-4D Ash Landfill was sampled (after ash removal) and the results included in the confirmation sampling dataset for the formal evaluation. The technical evaluation concluded that the basin soil results were indeterminate with regard to meeting the acceptance criteria for unrestricted land use because the residential threshold level (RSL = 0.29 mg/kg) is at (or very near) the method detection limit and there is a potential for analytical interferences resulting in false positives at these trace levels. Consequently, statistical hypothesis testing results and residual risks varied, depending on the analytical method used. The concentration of hexavalent chromium (maximum = 3.78 mg/kg) does not exceed the threshold level for an industrial use scenario (RSL = 6.3 mg/kg).

489-D CPRB (Southern 75%) Confirmation Sampling

The confirmation sampling data used in this evaluation are provided in the *Human Health and Ecological Evaluation for Confirmation Sampling at the 489-D Coal Pile Runoff Basin* (SRNS 2017b). A total of 11 samples as outlined in the *Field Sampling Plan for the 489-D Coal Pile Runoff Basin* (SRNS 2015d) were collected between September 2016 and November 2016. In addition to the 11 confirmation sampling locations collected per the Field Sampling Plan, 12 samples were collected in November 2016 at locations where soil/coal fines were previously staged for TCLP sampling prior to placement in 488-1D Ash Basin. Therefore, a total of 23 confirmation sample results were evaluated to demonstrate that the coal has been successfully removed from the 489-D CPRB and the remaining soils are below human health and ecological risk-based threshold levels. In addition to the 24 metals and six radionuclide analytes, one

organic compound (2-methylnaphthalene) was included in the analytical suite because it was identified as a refined COC in sediment media in the RFI/RI/BRA (SRNS 2009). The technical evaluation concluded that the residual concentrations of these analytes met the pre-established cleanup levels for unrestricted land use (SRNS 2017b).

Risk Assessment

488-1D Ash Basin (and Inlet Basins)

Summary of Human Health Risk Assessment

Prior to implementation of the NTCRA, arsenic and coal-related radionuclides were identified as historic COCs in SRS surface ash that may pose a risk to human receptors (future industrial worker risk >1E-06).

Completion of the removal action (i.e., excavate ash and contaminated sediment from the western section of the 488-1D Ash Basin and the Inlet Basins and placement of a geosynthetic cover system in the eastern section of the 488-1D Basin) addressed the surface ash problems warranting action to human receptors that were identified prior to construction activities. Coal-related contaminants beneath the geosynthetic cover (eastern end) pose a risk to human receptors (future industrial worker risk >1E-06) if direct exposure were to occur. In addition, coal-related constituents remain in soil in the western end of the basin that pose a risk to human receptors (hypothetical future resident risk >1E-06).

At the Inlet Basins, the residual concentrations of all analytes met the pre-established cleanup levels for unrestricted land use (i.e., residential).

Summary of Ecological Risk Assessment

Prior to implementation of the NTCRA, arsenic was identified as a historic COC in SRS surface ash that may pose a risk to ecological receptors (hazard quotient [HQ] >1).

Completion of the removal action addressed the surface ash problems warranting action to ecological receptors that were identified prior to construction activities. Coal-related contaminants beneath the geosynthetic cover (eastern end) pose a risk to ecological receptors (HQ >1) if direct exposure were to occur.

No ecological problems warranting action were identified for the Inlet Basins following the NTCRA.

Summary of the Fate and Transport Analysis

Prior to completion of the NTCRA, there was a potential for migration of contaminants to groundwater above groundwater protection standards due to the uncertainty in groundwater elevation and flow path changes over time.

Completion of the removal action addressed the potential contaminant migration problems warranting action that were identified prior to construction activities. Coal-related contaminants beneath the engineered cover system pose a potential for migration of contaminants to groundwater above protection standards if leaching of the source material were to occur.

Discussion of Principal Threat Source Material

No principal threat source material (PTSM) was identified at the 488-1D Ash Basin or Inlet Basins.

488-2D Ash Basin

Summary of Human Health Risk Assessment

Prior to implementation of the TCRA, arsenic and coal-related radionuclides were identified as historic COCs in SRS surface ash that may pose a risk to human receptors (future industrial worker risk >1E-06).

Completion of the removal action (i.e., excavation of ash and contaminated sediment) addressed the surface sediment problems warranting action to human receptors that were identified prior to construction activities. Coal-related contaminants remain in basin soils that pose a risk to human receptors (hypothetical future resident risk >1E-06).

Summary of Ecological Risk Assessment

Prior to implementation of the TCRA, arsenic was identified as a historic COC in SRS surface ash that may pose a risk to ecological receptors (HQ >1).

Completion of the removal action (i.e., excavation of ash and contaminated sediment) addressed the surface ash problem warranting action to ecological receptors identified prior to construction activities. There are no problems warranting action from an ecological risk perspective.

Summary of the Fate and Transport Analysis

There were no contaminant migration problems warranting action identified prior to the TCRA.

Completion of the removal action further prevents migration of potential mobile contaminants to groundwater that could exceed groundwater protection standards.

Discussion of PTSM

No PTSM was identified at the 488-2D Ash Basin.

488-4D Ash Landfill

Summary of Human Health Risk Assessment

Prior to implementation of the NTCRA, arsenic and coal-related radionuclides were identified as historic COCs in SRS surface ash that may pose a risk to human receptors (future industrial worker risk >1E-06).

Completion of the removal action (i.e., placement of a geosynthetic cover system) addressed the surface ash problem warranting action to human receptors identified prior to any construction activities. Currently, there is waste consisting primarily of coal and coal combustion ash beneath the engineered cover system that poses a risk to human receptors (future industrial worker risk >1E-06) if direct exposure were to occur.

Summary of Ecological Risk Assessment

Prior to implementation of the NTCRA, arsenic was identified as a historic COC in SRS surface ash that may pose a risk to ecological receptors (HQ >1).

Completion of the removal action (i.e., placement of a geosynthetic cover system) addressed the surface ash problems warranting action to ecological receptors identified prior to construction activities. Currently, there is waste consisting primarily of coal and coal combustion ash beneath the engineered cover system that poses a risk to ecological receptors (HQ >1) if direct exposure were to occur.

Summary of the Fate and Transport Analysis

Prior to completion of the NTCRA, there was a potential for migration of contaminants to groundwater for constituents (aluminum, arsenic, iron and manganese) that exceed the regulatory thresholds for a Class Two Solid Waste Landfill.

Completion of the removal action (i.e., placement of a geosynthetic cover system) addressed the potential contaminant migration problem warranting action identified prior to construction activities. Coal-related contaminants beneath the engineered cover system pose a potential for migration of contaminants to groundwater above protection standards if leaching of the source material were to occur.

Discussion of PTSM

No PTSM was identified at the 488-4D Ash Landfill.

489-D CPRB (Southern 75%)

Summary of Human Health Risk Assessment

Prior to implementation of the NTCRA, arsenic was identified as a human health COC in surface sediment at concentrations that pose an unacceptable exposure risk to a future industrial worker (risk = 1.9E-05) and hypothetical future resident (risk = 5.0E-05).

Completion of the removal action (i.e., excavation of coal fines and contaminated sediment) addressed the surface sediment problems warranting action to human receptors identified prior to construction activities. The residual concentrations of coal-related constituents met the pre-established cleanup levels for unrestricted land use, and there are no human health problems warranting action.

Summary of Ecological Risk Assessment

Prior to implementation of the NTCRA, arsenic (HQ = 2.8) and 2-methynaphthalene (HQ = 9.7) were identified as COCs to benthic organisms; and surface water was impacted with aluminum (HQ = 791), beryllium (HQ = 45), cobalt (HQ = 17), copper (HQ = 13), iron (HQ = 127), manganese (HQ = 41) and zinc (HQ = 5) at concentrations exceeding an HQ of one that posed a risk to aquatic organisms. In addition, the low pH conditions posed a risk to aquatic organisms, mammals and birds.

Completion of the removal action (i.e., water removal and excavation of coal fines and contaminated sediment) addressed both the surface sediment and surface water problems warranting action to ecological receptors identified prior to construction activities. The remaining soils did not pose an unacceptable risk to ecological receptors.

Summary of the Fate and Transport Analysis

There were no contaminant migration COCs identified prior to the NTCRA.

Completion of the removal action (i.e., excavation of coal fines and contaminated sediment) further prevents migration of potential mobile contaminants to groundwater that could exceed groundwater protection standards.

Discussion of PTSM

No PTSM was identified at the 489-D CPRB (Southern 75%).

Risk Assessment Conclusions

Following the removal actions, coal-related contaminants remain at the 488-1D Ash Basin, 488-2D Ash Basin, and 488-4D Ash Landfill that pose a risk to human receptors. Coal-related contaminants beneath the cover systems at the 488-1D Ash Basin and 488-4D Ash Landfill pose a risk to ecological receptors if direct exposure were to occur. There is also the potential for migration of contaminants at the 488-1D Ash Basin and 488-4D Ash Landfill above groundwater protection standards if leaching of the source material were to occur. Figure 4 is a photograph that was taken in October 2013, prior to project initiation. Figure 5 is a photograph that was taken in October 2018, after completion of the removal actions.

For the 489-D CPRB (Southern 75%), there are no human health, ecological or contaminant migration problems warranting action following the removal action. The 489-D CPRB (Southern 75%) meets the criteria for unrestricted land use. In addition, the residual concentrations of all analytes at the 488-1D Inlet Basins met the pre-established cleanup levels for unrestricted land use.

3.0 Remedial Action Objectives (RAOs)

The following RAOs are identified for the DAOU after completion of removal actions:

488-1D Ash Basin

- Maintain the engineered cover system (eastern end) to eliminate or control all routes of exposure to contaminants beneath the cover that pose a risk to future industrial workers and ecological receptors and/or present a contaminant migration concern.

- Protect hypothetical future residents from exposure to residual contamination in soil in the western end of the basin exceeding 1E-06 risk.

488-2D Ash Basin

- Protect hypothetical future residents from exposure to residual contamination in basin soils exceeding 1E-06 risk.

488-4D Ash Landfill

- Maintain the engineered cover system to eliminate or control all routes of exposure to contaminants beneath the cover that pose a risk to future industrial workers and ecological receptors.

- Maintain the engineered cover system to prevent migration of contaminants to groundwater that could exceed groundwater protection standards.

489-D CPRB (Southern 75%)

- None

4.0 Remedial Alternatives

General Response Actions

This section presents the remedial alternatives that apply to post-removal action conditions at the 488-1D Ash Basin, 488-2D Ash Basin, and 488-4D Ash Landfill subunits of the DAOU. In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), it is desirable, when practical, to offer a range of diverse alternatives to compare during the detailed analyses. The range of alternatives includes an option that involves little or no treatment yet provides protection to human health and the environment by preventing or controlling exposure through LUCs. Due to the focused effort in this document, two alternatives including No Action and LUCs were developed for the 488-1D Ash Basin, 488-2D Ash Basin and 488-4D Ash Landfill to address contamination in the surface and subsurface. No remedial action is required for the 489-D CPRB (Southern 75%) and the 488-1D Inlet Basins.

Alternative 1. No Action

The No Action alternative is required by the NCP to serve as a baseline for comparison to other alternatives. Under this alternative, no efforts would be made to control access, limit exposure, or reduce contaminant toxicity, mobility, or volume. This alternative would leave the DAOU subunits in their current condition with no additional controls. This alternative is not effective in achieving the RAOs, and there are no capital construction or system operation and maintenance costs. The No Action alternative is not sufficient in meeting neither the threshold criteria of protection of human health and environment nor compliance with ARARs. This alternative does not include five-year remedy reviews.

Summary of Costs

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

Alternative 2. Land Use Controls

LUCs (i.e., engineering controls [ECs] and institutional controls [ICs]) will be implemented for the 488-1D Ash Basin, 488-2D Ash Basin, and 488-4D Ash Landfill subunits of the DAOU to limit access (e.g., land use and disturbance activities) in the area. ECs (i.e., warning signs) and ICs (i.e., excavation permit restrictions and deed restrictions) will be used to restrict access to or activities that can be performed at the impacted areas. Site maintenance (site inspections, mowing, general housekeeping, repair of erosion damage, and other routine maintenance as needed) would be required to maintain the cover systems at the 488-1D Ash Basin and 488-4D Ash Landfill. Because this alternative results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unrestricted use, five-year remedy reviews would be performed to ensure that the remedy is and will continue to be protective of human health and the environment. LUCs meet the threshold and balancing criteria requirements. Only LUC costs for the subunits associated with the removal actions are a part of this alternative. Estimated costs include the capital cost, O&M cost, and present worth cost (for 200 years).

Groundwater monitoring will be performed to evaluate the long-term effectiveness of the cover systems and the results will be documented in the *Groundwater Monitoring Report for the D-Area Groundwater Operable Unit* (which is a full report issued in the even years), and the *D-Area Groundwater Operable Unit Letter Report* (which is an abbreviated report issued in the odd years). The groundwater sampling and monitoring requirements will be addressed by the DAG OU; therefore, costs associated with groundwater monitoring and reporting are not included in this estimate.

Summary of Costs

Capital Cost:	$47,520
O&M:	$9,846,699
Total Present-Worth Cost:	$9,894,219

Remedial Alternatives Screening and Evaluation

According to USEPA guidance, if there is no current or potential threat to human health and the environment and no action is warranted, the CERCLA 121 requirements are not triggered. If the requirements are not triggered, there is no need to evaluate other cleanup alternatives or to evaluate the No Further Action alternative against the nine remedy selection criteria under CERCLA. These nine criteria are used as a basis for selecting cleanup remedies that are protective of human health and the environment, implementable, cost-effective, and acceptable to the state regulatory agency.

No further evaluation of alternatives is needed for the 489-D CPRB (Southern 75%) subunit or the 488-1D Inlet Basins. This alternative is protective of human health and the environment at the 489-D CPRB (Southern 75%) and 488-1D Inlet Basins.

For the final remedial action at the 488-1D Ash Basin, 488-2D Ash Basin and 488-4D Ash Landfill, the potential remedial alternatives have been evaluated against the CERCLA threshold and primary balancing criteria. Provided below is a summary of the comparison of the alternatives against the CERCLA evaluation criteria. Key advantages and disadvantages for each alternative relative to one another and in relation to the two threshold criteria and five primary balancing criteria are discussed below.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) is not protective of human health and the environment. Alternative 2 (LUCs) is protective of human health and the environment and addresses the buried coal-related contamination and residual contamination at the 488-1D Ash Basin, 488-2D Ash Basin, and 488-4D Ash Landfill subunits by preventing potential exposure through land use restrictions.

Compliance with ARARs

Chemical-Specific ARARs. There are no chemical-specific ARARs.

Action-Specific ARARs. There are no action-specific ARARs applicable to Alternative 1 (No Action). Alternative 2 (LUCs) would be effective in complying with the action specific ARARs pertaining to the relevant and appropriate closure and monitoring of landfills (i.e., 488-1D Ash Basin and 488-4D Ash Landfill, Table 1).

Location-Specific ARARs. There are no location-specific ARARs.

Short-Term Effectiveness

The remedial alternatives are assessed considering factors relevant to implementation of the remedial action, including risks to the community during implementation, impacts to workers, potential environmental impacts and the time until protection is achieved. Alternative 1 (No Action) does not provide short-term effectiveness since there are no controls in place to prevent potential exposure to contaminated media. Alternative 2 (LUCs) achieves RAOs in a short period of time with essentially no risk to workers or the public.

Long-Term Effectiveness and Permanence

The remedial alternatives are assessed based on their ability to maintain reliable protection of human health and the environment after implementation. Alternative 1 (No Action) does not provide long-term effectiveness and permanence since there are no controls in place to prevent the potential exposure to contaminated media. Alternative 2 (LUCs) is protective and provides

long-term effectiveness and permanence as long as LUCs are maintained. Alternative 2 also provides additional assurance regarding the protection of groundwater by inclusion of a monitoring program to evaluate the long-term effectiveness of the cover systems.

Reduction of Toxicity, Mobility, or Volume through Treatment

None of the alternatives reduce toxicity, mobility, or volume through treatment.

Implementability

The remedial alternatives are assessed by considering the difficulty of implementing the alternative, including technical feasibility, constructability, reliability of technology, ease of undertaking remedial actions (if required), monitoring considerations, administrative feasibility (regulatory requirements), and availability of services and materials. Both alternatives are easily implementable.

Cost

Alternative 1 (No Action) is the least expensive alternative of the two alternatives as compared to Alternative 2 (LUCs) at $9,894,219. The cost for five-year remedy reviews are included in the estimate for Alternative 2 (LUCs). The groundwater sampling and monitoring requirements will be addressed by the DAG OU; therefore, costs associated with groundwater monitoring and reporting are not included in the estimate for Alternative 2.

5.0 Recommendation

It is recommended that Alternative 2, Land Use Controls is the preferred alternative for the 488-1D Ash Basin, 488-2D Ash Basin and 488-4D Ash Landfill subunits of the DAOU. The removal actions reduced the human health and ecological risks by eliminating the exposure pathways and minimizing the potential for contaminants to migrate to groundwater. Alternative 2 would implement LUCs as the final remedial action and also provides additional assurance regarding the protection of the groundwater by inclusion of a monitoring program.

It is recommended that the No Further Action alternative is the preferred alternative for the 489-D CPRB (Southern 75%) and the 488-1D Inlet Basins. There is no waste to treat, no LUCs are required, and there are no ARARs after completion of the NTCR actions. The 489-D CPRB subunit and the 488-1D Inlet Basins pose no risk to human health and the environment and support unrestricted land use. For these reasons, no further screening or evaluation of remedial alternatives is warranted.

6.0 References

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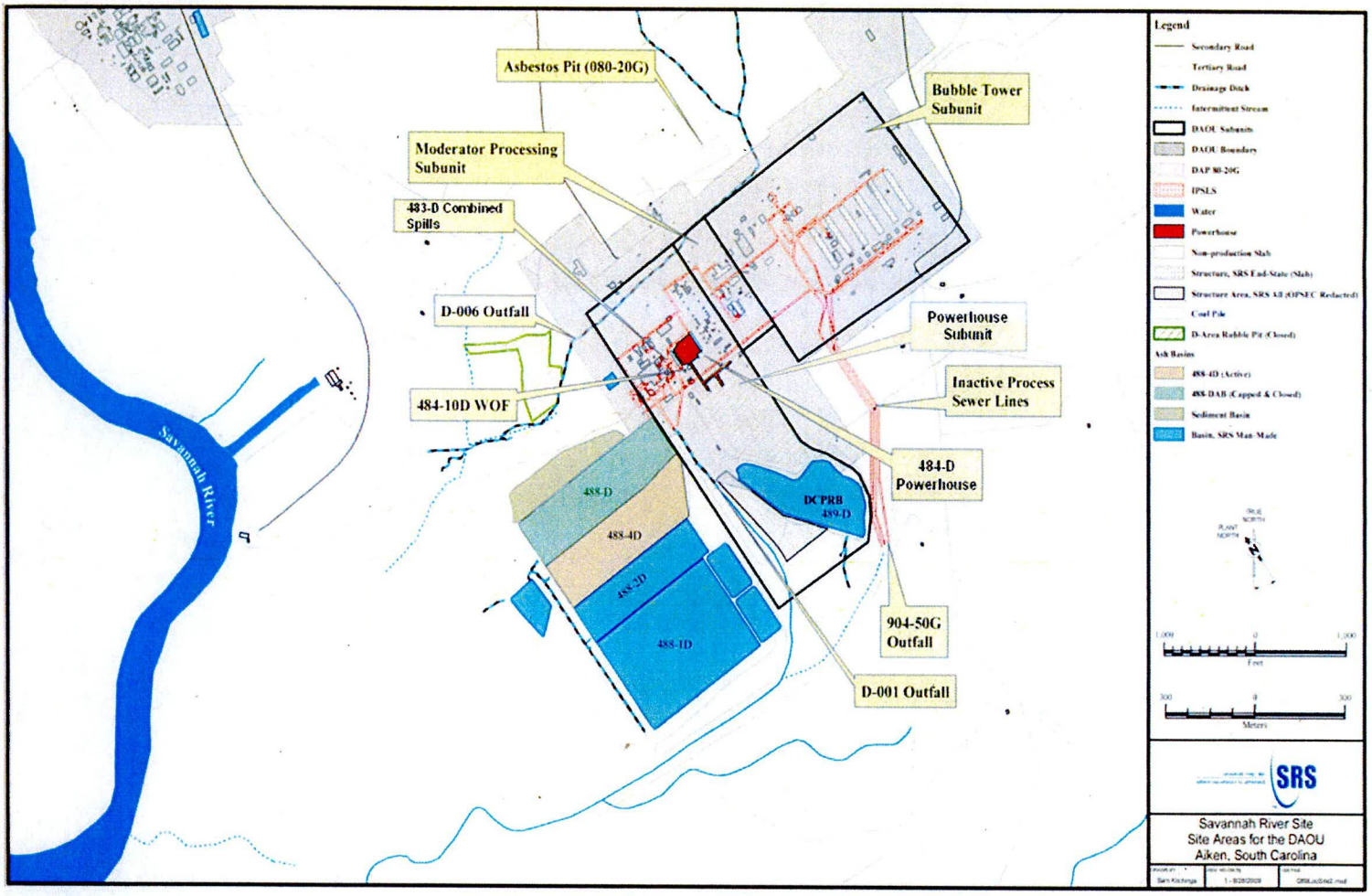

Figure 1. Layout of the DAOU

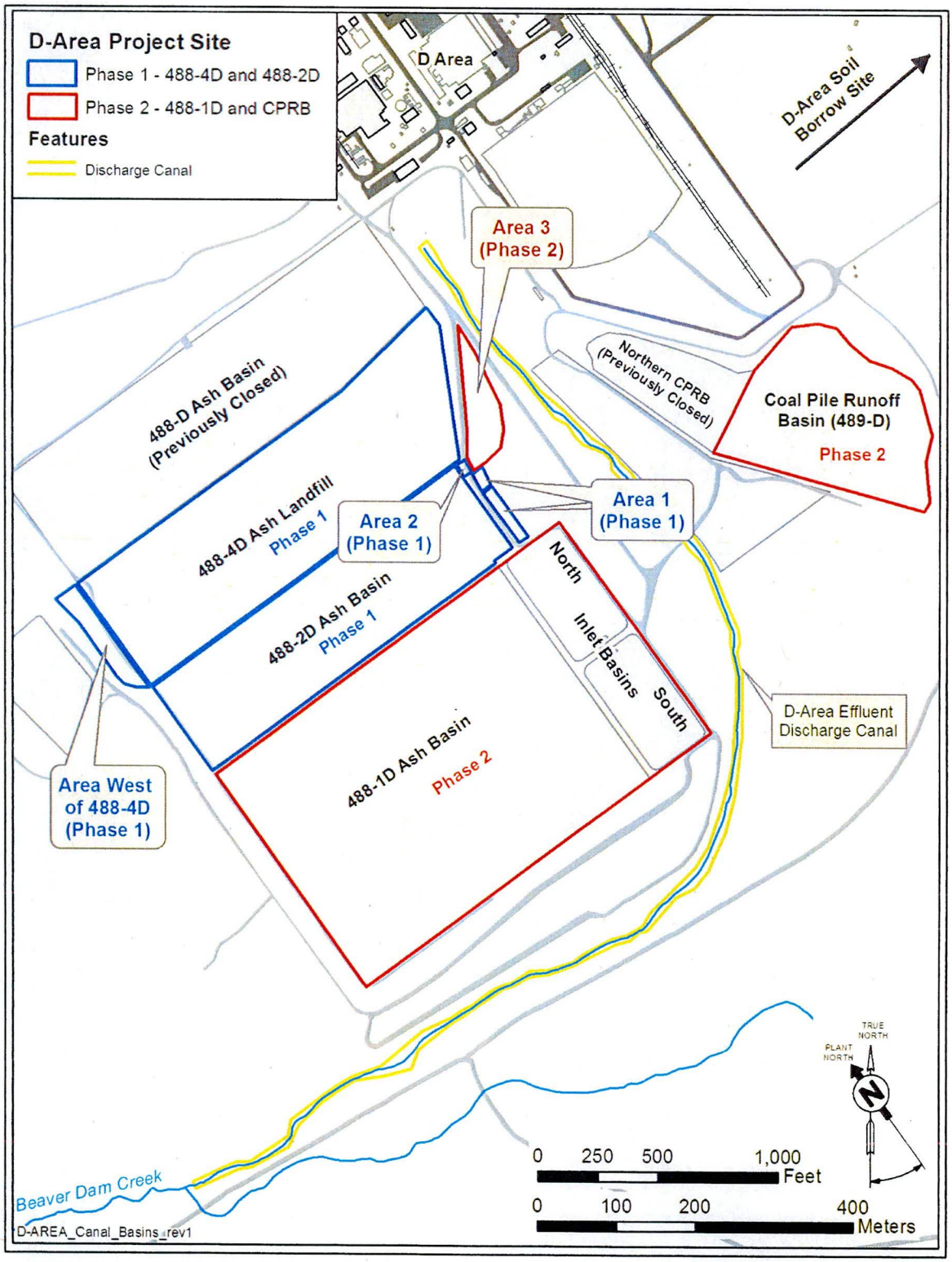

Figure 2. D-Area Project Site, Phase 1 and Phase 2

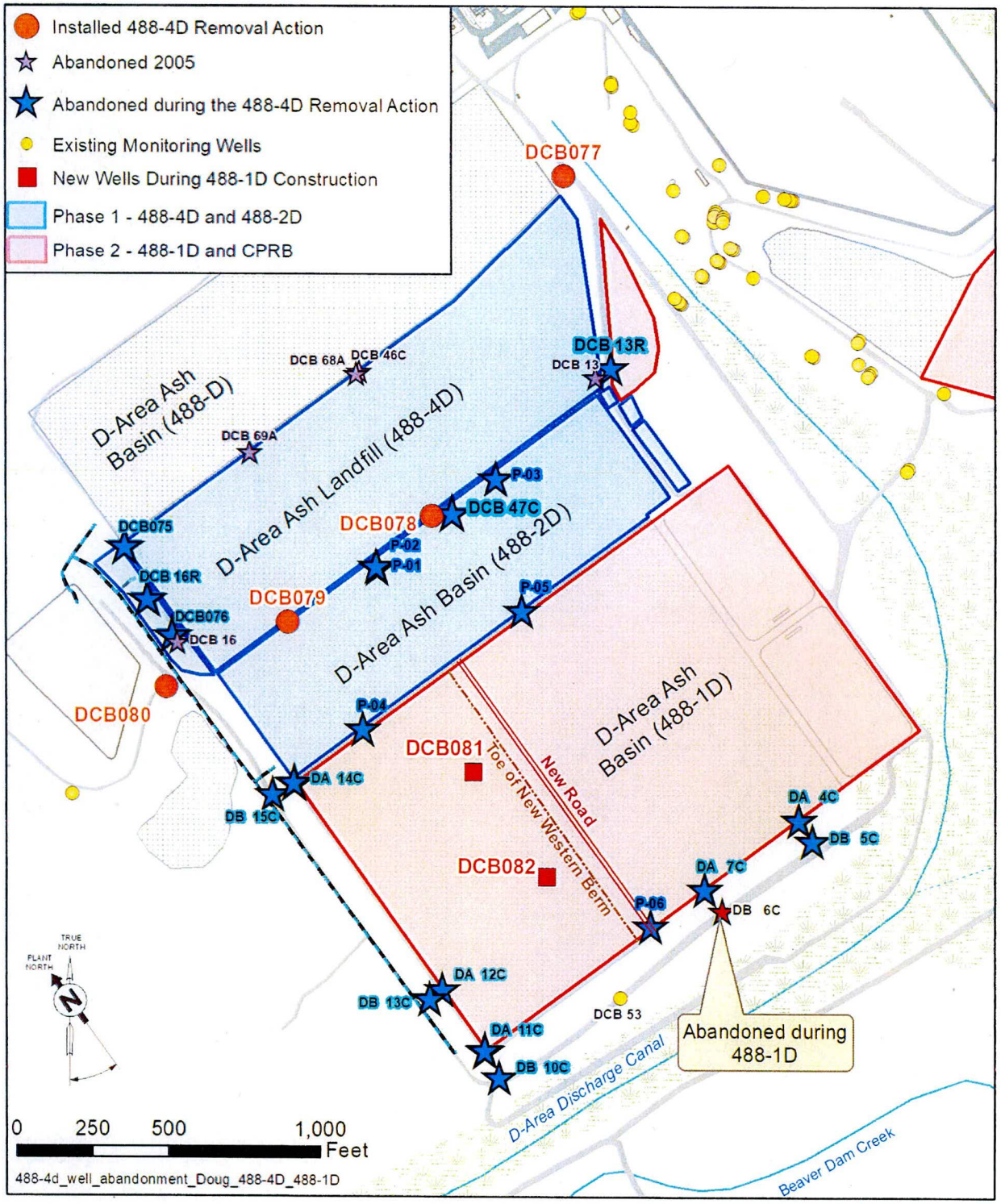

Figure 3. Well Modifications

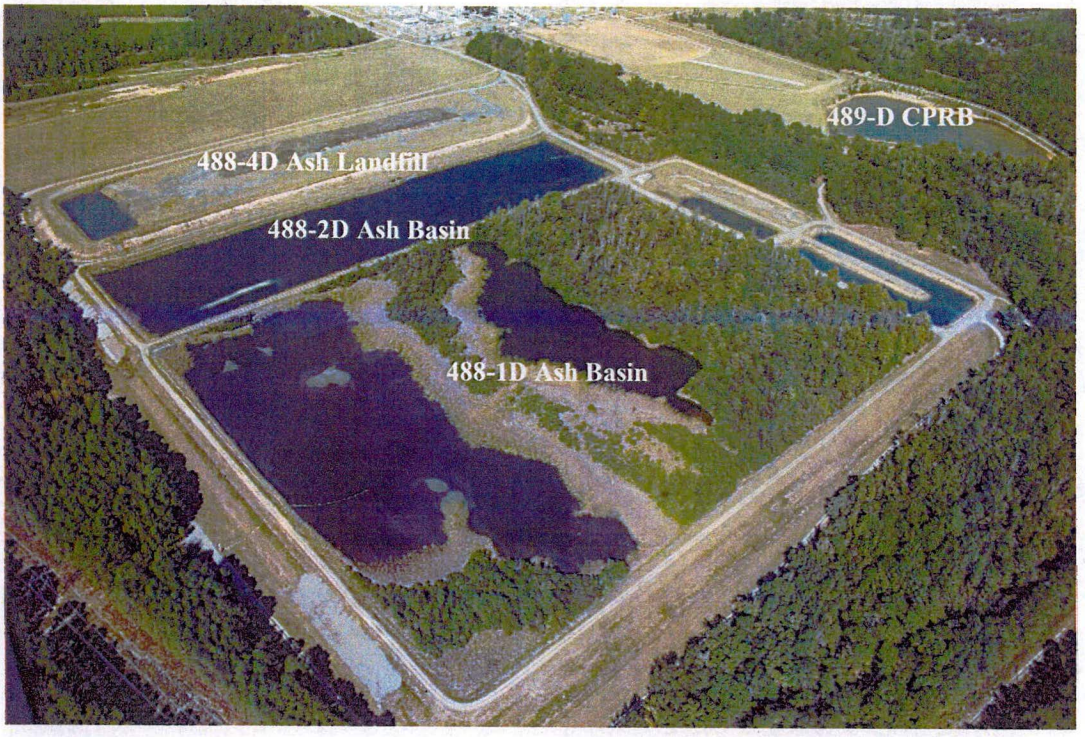

Figure 4. D-Area Project in October 2013 (Before Project Initiation)

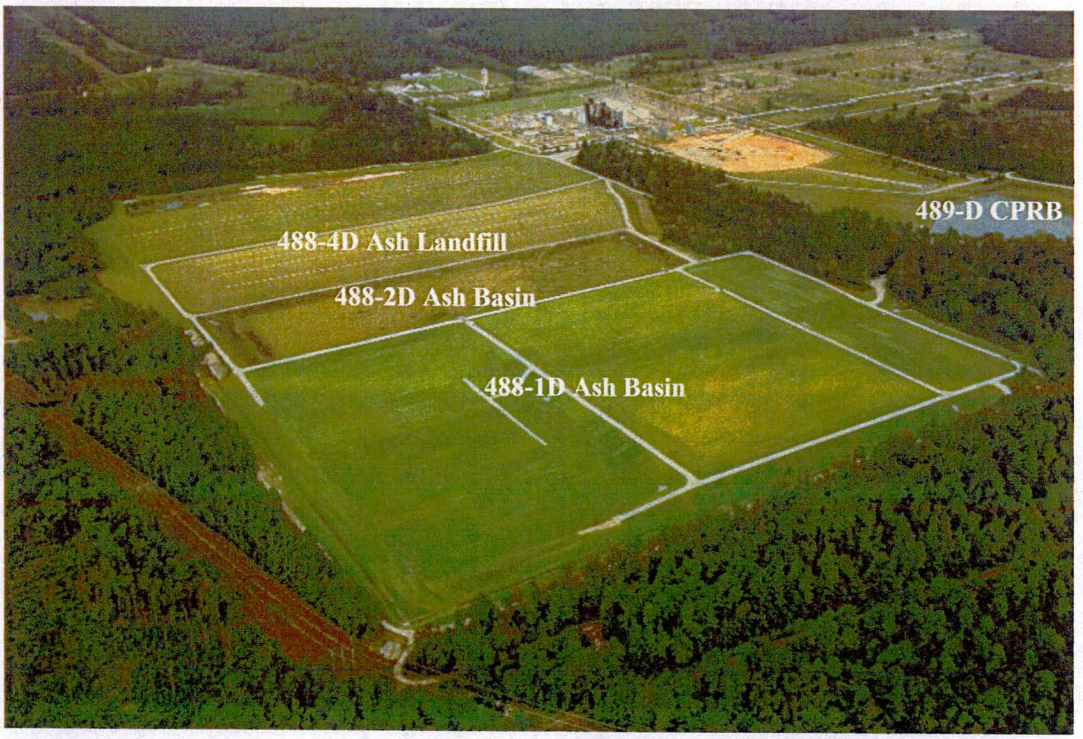

Figure 5. D-Area Project in October 2018 (After Project Completion)

Table 1. ARARs for the LUCs Alternative for the DAOU

Action	Requirements	Prerequisite	Citation
Onsite Closure/Capping of the 488-1D Ash Basin and the 488-4D Ash Landfill			
Run-on/Run-off control Systems for Landfill Cover	The final cover system shall be designed and constructed to have a storm water conveyance system for the landfill cap designed to ensure that the hydraulic head at any point does not exceed one foot for a 24-hour period as the result of a 24-hour, 25-year storm event on all areas that have received final cover.	Closure of solid waste disposal facility (SC Class III landfill) – **applicable**	SCDHEC R. 61-107.19 Part V Subpart F 258.60(a)(4)
Post-Closure of 488-1D Ash Basin and the 488-4D Ash Landfill			
Post-Closure Care Requirements	Following closure, owner/operator must conduct post-closure care for a minimum of 30 years, except as provided in paragraph b. below, and consistent of at least the following: Maintain the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover	Post-closure care of solid waste disposal facility (SC Class III landfill) – **488-1D: relevant and appropriate** **488-4D: applicable**	40 CFR 258.61(a)(1),(3) SC R.61-107.19 Part V Subpart F 258.61(a)
Post-Closure Groundwater Monitoring	Monitoring the groundwater in accordance with the requirements of subpart E of this Part and maintaining the groundwater monitoring system. *Note:* USDOE will conduct post-closure groundwater monitoring and reporting under the D-Area Groundwater Operable Unit to document the effectiveness of the cover system. The length of the post-closure care period may be decreased if the permittee can provide technical rationale that the decreased post-closure care period is sufficient to protect human health and the environment. *Note:* USDOE as part of the CERCLA remedy review process (including Five-Year Review under Section 121(c)), must seek SCDHEC and USEPA approval of a modification to the monitoring period.	Post-closure care of solid waste disposal facility (SC Class III landfill) – **488-1D: relevant and appropriate** **488-4D: applicable**	SC R.61-107.19 Part V Subpart F 258.61(a)(3) 40 CFR 258.61(b)(2) SC R.61-107.19 Part V Subpart F 258.61(b)(2)
Post-closure use of Property	Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other components of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this Part. *Note:* USDOE is responsible for ensuring LUCs (as part of the CERCLA remedy) to prevent unauthorized activities including disturbance of landfill cover integrity. LUCs will be implemented as part of the final remedial action for the DAOU.	Post-closure care of solid waste disposal facility (SC Class III landfill) – **488-1D: relevant and appropriate** **488-4D: applicable**	SC R.61-107.19 Part V Subpart F 258.61(c)(3)