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

Removal Site Evaluation Report / Engineering Evaluation / Cost Analysis (RSER/EE/CA) for the D-Area Coal Storage Area (484-17D) (U)

SEMS Number: 63

SRNS-RP-2018-00813

Revision 0

November 2018

DISCLAIMER

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy.

This work was prepared under an agreement with and funded by the U.S. Government. Neither the U.S. Government or its employees, nor any of its contractors, subcontractors or their employees, makes any express or implied: 1. warranty or assumes any legal liability for the accuracy, completeness, or for the use or results of such use of any information, product, or process disclosed; or 2. representation that such use or results of such use would not infringe privately owned rights; or 3. endorsement or recommendation of any specifically identified commercial product, process, or service. Any views and opinions of authors expressed in this work do not necessarily state or reflect those of the United States Government, or its contractors, or subcontractors.

Printed in the United States of America

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

EXECUTIVE SUMMARY

The United States Department of Energy (USDOE) is proposing to perform a non-time critical removal action at the D-Area Coal Storage Area (DCSA) (484-17D), which is part of the D-Area Powerhouse subunit of the D-Area Operable Unit (DAOU) located at the Savannah River Site (SRS), in Aiken, South Carolina. Closure of the DAOU will be implemented in phases utilizing a series of removal actions and early final actions to accommodate response implementation commensurate with changing missions and evolving budgets. The final remedial action for the DCSA will be selected with the ROD for the DAOU scheduled for submittal in 2046. Final remedial action for the groundwater media is addressed by the D-Area Groundwater (DAG) Operable Unit (OU).

This Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis identifies the objectives of the non-time critical removal action to address the acidified vadose zone soils at the DCSA to improve groundwater conditions in D-Area. This document provides a comparison of non-time critical removal action strategies for the DCSA vadose zone soils with respect to cost, implementability, and effectiveness. This document provides a vehicle for public comment in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 Code of Federal Regulations 300.415.

The DCSA was an approximately 6 hectare (15-acre) temporary storage area for coal prior to its use in the 484-D Powerhouse. Coal was stored at the DCSA for 59 years which allowed infiltration of rainwater through the coal and degradation of iron sulfide (pyrite) commonly found in coal to sulfuric acid when mixed with rainwater. Although a maintenance action in 2012 and 2013 removed essentially all of the visible coal from the DCSA, the long-term coal storage has caused the underlying vadose zone soil and groundwater to become acidified (i.e., low pH). Groundwater is shallow in D-Area; the depth to the water table below the DCSA is approximately 3 to 4.6 meters (10 to 15 feet) below ground surface. Groundwater in D-Area has been shown to be contaminated with various metals, and many of the metal plumes coincide with the low-pH area in groundwater and/or nearby source areas including the DCSA and the 489-D Coal Pile Runoff Basin (CPRB). As was previously suspected, soil sampling conducted in June 2018 indicated that the vadose zone

soils underneath the DCSA are acidified at levels similar to the underlying and downgradient groundwater. The vadose zone soils are expected to be a source of acidity to groundwater in D-Area if not addressed.

The preferred non-time critical removal action is Alternative 2 - Addition of Soil Neutralization Amendments (15 acres), which will reduce the acidity in the upper portion of the vadose zone and subsequently reduce the amount of acidic leachate to groundwater. Addressing the acidic vadose zone soils will eventually improve groundwater conditions. This can be achieved by mixing neutralization amendments (lime/calcium carbonate) into the vadose zone soils at the DCSA. This removal action is specific for the DCSA vadose zone soils and will complement a treatability study for the treatment of acidic groundwater and surface water in the vicinity of the DCSA and the 489-D CPRB (SRNS 2018b).

Based on information currently available, SRS believes that Alternative 2 – Addition of Soil Neutralization Amendments (15 acres), provides the best balance of tradeoffs with respect to the evaluation criteria. The preferred action will satisfy the statutory requirements in CERCLA Section 121(b) to 1) be protective of human health and the environment, 2) comply with applicable or relevant and appropriate requirements, and 3) be cost-effective. This alternative will not preclude any additional remediation of the DAOU or DAG OU and is consistent with the current and future land use.

The United States Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control (SCDHEC), and USDOE have agreed that the DCSA subunit of the DAOU is a candidate for an early action to reduce risk to human health and the environment. The acidic conditions within the DCSA vadose zone meet the criteria in 40 CFR Section 300.415(b) (2) (iv.): *High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that might migrate*.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ac	acre
ARAR	applicable or relevant and appropriate requirement
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
DAOU	D-Area Operable Unit
DAG	D-Area Groundwater
DCSA	D-Area Coal Storage Area
EE/CA	Engineering Evaluation/Cost Analysis
FFA	Federal Facility Agreement
ft	feet
ha	hectare
in	inch
km	kilometer
km^2	square kilometer
LLC	Limited Liability Company
m	meter
m^3	cubic meter
mi	mile
mi^2	square mile
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NTC	non-time critical
OU	operable unit
RAO	removal action objectives
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
RSER	Removal Site Evaluation Report
SCDHEC	South Carolina Department of Health and Environmental Control
SEMS	Superfund Enterprise Management System
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
TBC	to be considered
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
WSRC	Washington Savannah River Company LLC (October 2005-present)
WSRC	Westinghouse Savannah River Company LLC (before October 2005)
yd	yard
yd^3	cubic yard

This page is intentionally left blank.

1.0 INTRODUCTION

The U.S. Department of Energy (USDOE) is proposing to perform a non-time critical (NTC) removal action at the 484-17D D-Area Coal Storage Area (DCSA). The DCSA is associated with the 484-D Powerhouse and is listed in the Federal Facility Agreement (FFA) Appendix K.1 as a Deactivation and Decommissioning (D&D) Facility to be decommissioned (FFA 1993). This Removal Site Evaluation Report (RSER)/Engineering Evaluation/Cost Analysis (EE/CA) does not address D&D activities but instead pertains to a NTC removal action in the vadose zone soils at the DSCA to improve conditions in groundwater. This RSER/EE/CA describes removal alternatives that address the potential threats from release of contaminants to the environment and provides a vehicle for public comment in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) 300.415. The remedial action for groundwater will be addressed in the D-Area Groundwater (DAG) Operable Unit (OU). The final remedial action for the DCSA will be selected in a Record of Decision (ROD) for the D-Area OU (DAOU), scheduled for submittal in 2046.

The Savannah River Site (SRS) encompasses 803 square kilometers (km^2) (310 square miles [mi^2]) of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina. SRS is located approximately 40 kilometers (km) (25 miles [mi]) southeast of Augusta, Georgia, and 32 km (20 mi) south of Aiken, SC (Figure 1). SRS is owned by USDOE while Savannah River Nuclear Solutions, LLC (SRNS) provides management and operating services. SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are by-products of nuclear material production processes. Hazardous substances, as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), are present in the SRS environment as a result of SRS operations.

The public is encouraged to comment on the alternatives presented in this RSER/EE/CA. Following the public comment period, an Action Memorandum will be prepared by USDOE and added to the SRS Administrative Record, which is accessible by the public. All responses to the public comments will be included in an Action Memorandum.

Copies of this RSER/EE/CA and the Administrative Record for SRS are available at the following locations:

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

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

Hard copies of this RSER/EE/CA are available at the following locations:

Reese Library
Government Information Department
Augusta University
2500 Walton Way
Augusta, GA 30904
(706) 737–1744

Asa H. Gordon Library
Savannah State University
2200 Tompkins Road
Savannah, GA 31404
(912) 358–4324

To submit comments or request a public meeting during the public comment period, contact:

Janet Griffin
Savannah River Nuclear Solutions, LLC
Public Involvement
Savannah River Site
Building 730–1B
Aiken, South Carolina 29808
(803) 952-8467
janet.griffin@srs.gov

2.0 SITE CHARACTERIZATION

2.1 Site Description and Background

The DAOU is one of the area operable units identified at SRS. The DAOU is located approximately 914 meters (m) (3,000 feet [ft]) east of the nearest site boundary, the Savannah River (Figure 2). The DAOU is approximately 85 hectares (ha) (210 acres [ac]) and comprises the geographic area that includes surface units and source areas in D-Area that pose a threat to human health and the environment. The DCSA is part of the Powerhouse subunit of the DAOU.

The D-Area Powerhouse (484-D) was built in 1953 and removed from service in 2012 after 59 years of operation. The facility burned ~160,000 tons of coal per year during this period. The DCSA was an approximately 6 ha (15 ac) temporary storage area for coal prior to its use in the 484-D Powerhouse. The location of the DCSA within the DAOU is shown in Figure 3. Deactivation of the 484-D Powerhouse and associated facilities began following the shutdown. As a result of the shutdown of the powerhouse, continued storage of coal in the DCSA was no longer needed.

During the 484-D Powerhouse operational period, rainwater leached through the stored coal, resulting in a degradation of the iron sulfide (pyrite) commonly found in coal to sulfuric acid when mixed with rainwater. Although a maintenance action in 2012 and 2013 removed most of the coal from the DCSA, infiltration of rainwater over the years through the stored coal caused the underlying vadose zone soil and groundwater to become acidified, with pH levels ranging from 3.5 – 4.0 (Table 1 and Figure 6). Groundwater is shallow in D-Area; the depth to the water table below the DCSA is approximately 3 to 4.6 m (10 to 15 ft) below ground surface. Groundwater in D-Area has been shown to be elevated in concentrations of various metals, and many of the metal plumes coincide with the low-pH area in groundwater and/or nearby source areas including the DCSA and the 489-D Coal Pile Runoff Basin (CPRB) (SRNS 2018a). As was previously suspected, soil sampling in June 2018 (see Section 2.5, *Nature and Extent of Contamination*) has indicated that the soils underneath the DCSA are acidified at levels similar to the underlying and downgradient groundwater. Rainwater and groundwater in contact with the DCSA low-pH vadose zone soils continue to contribute to the low-pH groundwater within the area and the resulting metal

plumes (Figure 4). The low-pH groundwater is the subject of a recently submitted Treatability Study (SRNS 2018b) for treatment of groundwater and surface water. As part of the Treatability Study, potable groundwater from nearby production wells in D-Area will be injected in the upper water table upgradient of the DCSA and the 489-D CPRB to raise the water table approximately 1.5 m (5 ft) to flush and raise the pH levels in the upper water table. Also, as part of the Treatability Study, acidic surface water in the D-Area Discharge Canal will be treated with calcium carbonate reactive structures to raise the pH of the surface water prior to discharge into Beaver Dam Creek and the Savannah River floodplain and river.

The final remedial action for the DCSA will be addressed by the ROD for the DAOU scheduled for issuance in January 2046. Addressing the low-pH issues in the DCSA vadose zone soils early is expected to improve groundwater and surface water conditions in the future in D-Area. During an interactive scoping process in which the USDOE, United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Services (SCDHEC) participated, soil neutralization at the DCSA was identified as a candidate for a NTC removal action to improve groundwater conditions and minimize future impacts to groundwater.

2.2 Previous Action

During the closure of the northern 25% section of the 489-D CPRB in 2011 (SRNS 2011), a drainage ditch was constructed in the southern 2-ha (5-ac) section of the DCSA to direct surface runoff to the southern 75% section of the 489-D CPRB, and the area was groomed with topsoil and a grass cover (Figure 4). No actions have occurred in the northern 4-ha (10-ac) section of the DCSA other than a visual coal removal maintenance action in 2012 and 2013. Recent (June 2018) sampling of the DCSA vadose zone soils was conducted to ascertain soil pH conditions as well as depth to groundwater and soil types. Sampling results confirmed low-pH soil conditions in the DCSA. No soil sampling or testing of pH was previously performed on soils at the DCSA. Additionally, a relatively thin (15 - 20-centimeter [cm]) (6-8-inch [in]) layer of coal fragments was found at all the sample locations in the southern 2 ha (5 ac) section of the DCSA.

2.3 Land Use

The DCSA is in an area currently designated for industrial use. No current or projected future development of the DCSA is planned. Future industrial land use will be controlled in accordance with the SRS Land Use Control Assurance Plan to prevent unrestricted land use if residential remedial goals are not attained through final remediation, as well as the use of groundwater that exceeds groundwater protection standards (WSRC 1999). The Upper Three Runs Aquifer, which is the zone where the pH and metal plumes are located, is not currently used as a drinking water source and its future use is not reasonably anticipated (USDOE 1996).

Portions of the DAOU are industrialized areas, while other portions are wooded or wetlands, or have been recently closed and remediated as grassy areas. The DCSA is located within the industrial area of DAOU (Figure 3).

2.4 Environmental Setting

The DAOU lies entirely within the Savannah River Watershed and represents a drainage area of ~115 ha (285 ac). 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 2009a) provide details about the environmental setting of the DAOU.

The entire DCSA area is approximately 6 ha (15 ac) within the footprint of the DAOU. The southern 2 ha (5 ac) portion is groomed with topsoil and a grass cover that is maintained. The remaining northern 4 ha (10 ac) has no vegetative cover, and decades of coal storage and heavy operating and construction equipment use have compacted the soil. The DCSA vadose zone consists of compacted sands, silts, and clays. Groundwater beneath the DCSA is approximately 3 – 4.6 m (10 - 15 ft) below ground surface (~36.6 – 38.1 m [~120 – 125 ft] mean sea level) and the ground surface is fairly level. Groundwater flows towards the southwest and a portion of the upper water table aquifer discharges into the D-Area Discharge Canal located southwest of the DCSA (Figure 3).

2.5 Nature and Extent of Contamination

There has not been a baseline risk assessment (BRA) performed at the DCSA. The final remedial action for the DCSA will be selected with the ROD for the DAOU, scheduled for issuance in 2046. However, low pH in the groundwater downgradient of the DCSA and 489-D CPRB, acidic groundwater discharge into the D-Area Discharge Canal, associated dissolved metals plumes emanating from the DCSA and 489-D CPRB, and previous acidic (pH ~2.0) surface water conditions in the 489-D CPRB created from rainwater runoff from the coal pile are consistent with the presence of low-pH vadose zone soils at the DCSA. More detail of the potential contributors to groundwater are documented in the annual groundwater monitoring reports and data summary letters for the DAG OU (SRNS 2018a).

Although ample data on the groundwater and surface water are available, quantification of the extent and degree of acidification in the DCSA vadose zone soils was needed to support the development of this RSER/EE/CA and for cost estimates for neutralization amendments. In June 2018, soil samples were collected from eight locations throughout the DCSA at six depth intervals down to the water table. Figure 5 shows locations of the collected soil samples. Due to the expected soil compaction, a direct push technology Geoprobe® rig was utilized to collect soil cores for the sample collection.

A total of 54 samples were collected. The pH of all soil samples was measured both in the field and the laboratory. Both the field and lab pH results displayed an overall acidification of the DCSA vadose zone soils (Table 1 and Figure 6). Normal pH levels in native soils are generally above 5.0. Most of the sampled locations and depths at the DCSA had pH levels between 3 and 4.5 indicating that the entire 6 ha (15 ac) of vadose zone soils has been affected by the coal leachate. These results are similar to the pH levels seen in the groundwater and surface water downgradient of the DCSA and 489-D CPRB, indicating that the acidified vadose zone soil poses a contaminant migration concern to groundwater.

The presence of a low-pH plume in groundwater demonstrates that the buffering capacity of the vadose zone soils and the aquifer has been consumed by sulfuric acid and aluminum acidity in the leachate. The sulfuric acid and aluminum acidity have saturated the cation exchange capacity

(CEC) of the soil with proton (H^+) acidity, dissolved iron, aluminum, and manganese oxide surface coatings, and changed the net surface charge of the soil from negative to positive such that dissolved metals present in the groundwater remain in solution. The saturation of the sediment CEC with H^+ ions will cause the continued presence of an acid plume, and the resulting impact on downgradient groundwater and the D-Area Discharge Canal is estimated to persist for decades. Precipitation infiltrating through the vadose zone and upgradient groundwater becomes strongly acidic when it encounters proton and aluminum acidity in the soils, until such time that most of the reserve acidity is depleted. If the reserve acidity of the soil can be largely neutralized and the pH of the aquifer ultimately raised to less acidic background conditions, the metals plume in and around the DCSA can eventually be reduced or eliminated.

3.0 REMOVAL ACTION SCOPE AND OBJECTIVES

The DCSA covers an area of approximately 6 ha (15 ac). The entire area and depth to the water table is assumed to be acidified based on sampling results obtained in June 2018 (See Section 2.5, *Nature and Extent of Contamination*) and the DCSA vadose zone soils will continue to be an acidic source to groundwater in D-Area if not addressed. Leaching of acidic vadose zone soil results in low pH and dissolved metals in groundwater that exceed groundwater protection standards. Remedial actions for the groundwater will be addressed in the DAG OU with a Remedial Investigation Field Start scheduled for June 2020.

A sampling plan to confirm the results of the NTC removal action on the vadose zone soils is provided in Appendix A.

3.1 Justification for the Proposed Removal Action

USDOE, as lead agency, is mandated to take action to reduce the adverse effects of man-made contamination on human health and the environment. The NCP states that if the lead agency determines a release or potential release poses a threat to public health or welfare or the environment, the lead agency may take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release. This determination should be based on the factors identified in 40 CFR Section 300.415(b) (2).

The August 2018 scoping meeting between USEPA, SCDHEC and USDOE identified the DCSA subunit of the DAOU as a candidate for a NTC removal action to reduce risk to human health and the environment. The acidic conditions of the DCSA vadose zone soil meet the criteria in 40 CFR Section 300.415(b) (2) *(iv.): High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that might migrate*.

3.2 Removal Action Objective

The removal action objective to protect human health and the environment is to increase the pH in the DCSA vadose zone soils to more natural conditions to minimize future impacts to groundwater.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

In accordance with CERCLA, the following alternatives for the DCSA removal action were evaluated.

- **Alternative 1 – No Action**

  The No Action alternative is required to be evaluated by the NCP to serve as a baseline for comparison to other alternatives. Under the No Action alternative, no efforts would be made to control access, limit exposure, or reduce contaminant toxicity, mobility, or volume. This alternative would leave the DCSA in its current condition with no additional controls. This alternative will not be effective in achieving the RAO.

- **Alternative 2 - Addition of Soil Neutralization Amendments (15 acres)**

  Under Alternative 2, soil neutralization amendments would be used to "lime" the DCSA vadose zone soil by the addition of agricultural limestone (calcium carbonate) or effective calcium carbonate equivalent (e.g., quick lime, hydrated lime, etc.) mixed within the upper portion of the DCSA vadose zone soils to a targeted depth of 1.2 m (4 ft) below ground surface. The addition of soil neutralization amendments will assist in the return of vadose zone soil to more natural conditions and eventually allow groundwater pH to return to natural background levels over time. Large construction and/or agricultural equipment will be utilized to break up the compacted soils and allow thorough mixing in of the neutralization amendments. It is

expected the total depth of treatment will be able to reach approximately 1.2 m (4 ft) below ground surface. Although the entire 3-4.6 m (10-15 ft) of the vadose zone is acidified, the greatest acidity is shown in shallower depths (Figure 6). Agricultural equipment to reach the total depth is not available or feasible, and alternate means of reaching lower depths (e.g., complete excavation of all vadose zone soils) are cost-prohibitive. Additionally, the DAG OU Treatability Study with water injection is expected to raise the water table into the lower portions of the DCSA vadose zone soils.

Construction activities for implementation of Alternative 2 include construction of a temporary sedimentation basin, removal of gravel from portions of the surface of the DCSA, ripping/breaking up of the dense soils, addition and mixing of soil neutralization amendments, final grading and reconstruction of surface water drainages to the 489-D CPRB, and placement of a vegetative cover.

The 15-20 cm (6-8-in) layer of coal fragments in the southern 2-ha (5-ac) section has similar pH measurements to the vadose zone soils, is likely weathered/oxidized, and poses no greater leaching threat than the affected vadose zone soils; therefore, the layer of coal fragments will not be removed under Alternative 2 prior to the addition of soil amendments.

- **Alternative 3 - Partial Excavation of Coal Fragments (5 acres) and Addition of Soil Neutralization Amendments (15 acres)**

  Under Alternative 3, the 15-20 cm (6-8 in) layer of coal fragments in the southern 2-ha (5-ac) section of the DCSA will be excavated along with the overlying topsoil to a depth of approximately 1.5 ft (0.5 m). An estimated 9,251 cubic meters (m^3) (12,100 cubic yards [yd^3]) of material will be removed and disposed of in the Three Rivers Landfill. Soil neutralization amendments would be used to "lime" the DCSA vadose zone soil by the addition of agricultural limestone (calcium carbonate) or effective calcium carbonate equivalent (e.g., quick lime, hydrated lime, etc.) mixed within the upper portion of the DCSA vadose zone soils to a targeted depth of 1.2 m (4 ft) below ground surface. The addition of soil neutralization amendments will assist the return of vadose zone soil to more natural conditions and eventually allow groundwater pH to return to natural background levels over time. Large construction

and/or agricultural equipment will be utilized to break up the compacted soils and allow thorough mixing in of the neutralization amendments. It is expected the total depth of treatment will be able to reach approximately 1.2 m (4 ft) below the current ground surface. Although the entire 3-4.6 m (10-15 ft) of the vadose zone is acidified, the greatest acidity is shown in shallower depths. Agricultural equipment to reach the total depth is not available or feasible, and alternate means of reaching lower depths (e.g., complete excavation of all vadose zone soils) are cost-prohibitive. Additionally, the DAG OU Treatability Study with water injection is expected to raise the water table into the lower portions of the DCSA vadose zone soils.

Construction activities for implementation of Alternative 3 include construction of a temporary sedimentation basin, excavation, transportation, and off-site disposal of topsoil and coal fragments, removal of gravel from portions of the surface of the DCSA, ripping/breaking up of the dense soils, addition and mixing of soil neutralization amendments, final grading and reconstruction of surface water drainages to the 489-D CPRB, and placement of a vegetative cover.

5.0 ANALYSIS AND COMPARISON OF REMOVAL ACTION ALTERNATIVES

Three alternatives are presented in this RSER/EE/CA for evaluation. According to the NCP, the No Action Alternative, Alternative 1, must be evaluated as a baseline. Alternative 2 proposes to add soil neutralization amendments such as lime/calcium carbonate to raise the pH of the DCSA acidified vadose zone soils and allow groundwater pH to return to natural background levels over time. Alternative 3 proposes to excavate the 15-20 cm (6-8 in) layer of coal fragments in the southern 2 ha (5 ac) section of the DCSA along with the overlying topsoil. The remaining upper 1.2 m (4 ft) of acidified vadose zone soils will be amended with materials such as lime/calcium carbonate to raise the pH to more natural conditions to prevent future impacts to groundwater.

Guidance on conducting NTC removal actions under CERCLA recommends that each alternative be reviewed against three broad criteria: effectiveness, implementability, and cost. Regulatory acceptance and community acceptance are usually not known until after the comment period. However, during the alternative analysis, a judgment as to acceptance may be included based on

previous regulatory decisions or on public comment to other related documents. The final impact of these modifying criteria can be assessed only after the comment period and after subsequent responses are developed.

5.1 Effectiveness

Alternative 1, No Action, does not meet the effectiveness criteria. Leaving the DCSA in place does not reduce the risk to groundwater. This alternative does not contribute to a reduction of toxicity, mobility, or volume through treatment. The short-term and long-term effectiveness are not applicable since no action is being implemented.

Alternative 2, Addition of Soil Neutralization Amendments (15 acres), meets the effectiveness criteria to improve vadose zone conditions. The 15-20 cm (6-8-in) layer of coal fragments in the southern 2 ha (5 ac) section will remain in place and has similar pH measurements to the vadose zone soils (See Figure 6 and Table 1) and is likely weathered/oxidized and poses no greater leaching threat than the affected vadose zone soils. The addition of soil neutralization amendments to raise the pH of the vadose zone soils (including the 15-20 cm [6-8 in] layer of coal fragments) will reduce the acidic leachate that contributes to low pH and metals plumes in groundwater. This alternative will employ treatment by the addition of soil amendments and meets the criteria to reduce toxicity by raising the pH of the leachate prior to discharge to groundwater. Through treatment of the vadose zone soils and reduction in acidic leachate, groundwater pH is expected to return to more natural background levels over time. Reducing the leaching of metals and returning the groundwater to more natural conditions over time is more protective of human health and the environment as compared to no action.

Alternative 3, Partial excavation of coal fragments (5 acres) and addition of soil neutralization amendments (15 acres), meets the effectiveness criteria to improve vadose zone conditions. Excavation of the 15-20 cm (6-8 in) layer of coal fragments and overlying topsoil in the southern 2 ha (5 ac) section of the DCSA, followed by soil neutralization to raise the pH of the vadose zone soils to more natural levels will reduce acidic leachate that contributes to low-pH and metals plumes in groundwater. The groundwater pH is expected to return to natural background levels over time. This alternative will employ treatment by the addition of soil amendments and

meets the criteria to reduce toxicity by raising the pH of the leachate prior to discharge to groundwater. Through treatment of the vadose zone soils and reduction in acidic leachate, groundwater pH is expected to return to more natural background levels over time. Reducing the leaching of metals and returning the groundwater to more natural conditions over time is more protective of human health and the environment as compared to no action.

5.2 Identification of ARARs

In accordance with 40 Code of Federal Regulations (C.F.R.) § 300.415(j) of the NCP, on-site removal actions conducted under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, are required to attain applicable or relevant and appropriate requirements (ARARs) to the extent practicable, considering the exigencies of the situation. In determining whether compliance with ARARs is practicable, the lead agency may consider appropriate factors, including 1) the urgency of the situation; and 2) the scope of the removal action. ARARs include only federal and state environmental or facility siting laws/regulations; they do not include occupational safety or worker protection requirements. Compliance with OSHA standards is required by 40 C.F.R. § 300.150. For purposes of ease of identification, the USEPA has created three categories of ARARs: Chemical-, Location- and Action-Specific. Additionally, per 40 C.F.R. § 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies [to-be-considered (TBC) category]. USDOE, the lead agency at the SRS, is expected to comply with ARARs and TBC guidance as set forth in the EE/CA when conducting this NTC removal action.

Applicable requirements, as defined in 40 C.F.R. § 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements, as defined in 40 C.F.R. § 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently

similar to those encountered at a CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

Under Section 121 of CERCLA, any material remaining on site must reach a level or standard of control equal to that of any other applicable or relevant and appropriate standard or requirement promulgated under any federal or more stringent state environmental statute. The term "promulgated" means that the requirement generally is applicable and legally enforceable. The ARAR concept is pertinent only to onsite actions; offsite actions must comply with all applicable federal and state requirements. A requirement under other environmental laws may be either "applicable" or "relevant and appropriate," but not both. The first step in identifying ARARs is to determine if a requirement is applicable.

ARARs are identified for the DCSA NTC removal action in Table 2 for Alternatives 2 and 3. This RSER/EE/CA does not propose to waive any ARARs. As previously stated, the final disposition of the entire DCSA will be addressed as part of the DAOU closure. Completion activities are identified in the FFA, a legally binding and enforceable tri-party agreement between USDOE and the two regulatory agencies, USEPA and SCDHEC.

Consideration of NEPA Values

This RSER/EE/CA conforms to USDOE policy (i.e., DOE Order 451.1B, "National Environmental Policy Act Compliance Program") to incorporate National Environmental Policy Act (NEPA) values in USDOE CERCLA documents. NEPA values include consideration of socioeconomic, demographic, environmental justice, archaeological, historical, cultural, natural resources, protected species, floodplains, wetlands, and cumulative impacts of the proposed action.

The DCSA represents no cultural or historical significance. It has not been identified as a structure which qualifies as historically significant as documented in the SRS's Cold War Built Environmental Cultural Resource Management Plan (CRMP) (USDOE 2005). The site of the proposed removal action is located within an established industrial landscape. Any previously existing archaeological, cultural, or historical resource(s) in the project area would have been destroyed by extensive land alterations and modern construction-related activities associated with

development of the DAOU. Implementation of the proposed removal action would have a negligible impact on SRS archaeological, cultural, or historical resources.

5.3 Implementability

Implementability of each alternative was assessed against the criteria below:

- Technical feasibility with regard to available techniques and demonstrated methods for accomplishing the proposed alternative
- Administrative feasibility with regard to operations personnel and other resources to complete the alternative's implementation; also the availability of specific equipment and technical specialists
- Regulatory acceptance of the preferred alternative
- Community acceptance of the preferred alternative. USDOE–Savannah River will provide for a public comment period, and comments concerning the proposed remedy will be incorporated into the comment responses and included with the action memorandum.

Alternative 1, No Action, is the current condition and would not require any additional resources to implement. The pH levels of the vadose zone soils at the DCSA will continue to leach acidity to groundwater and be a continuing source for the low-pH and metals groundwater plumes.

Alternative 2, Addition of Soil Neutralization Amendments (15 acres), could be implemented without major technical or administrative concerns. Personnel are readily available and technologies for the addition of soil amendments to neutralize (raise the pH of) the vadose zone soils are well defined and available. The heavy equipment (i.e., tractors, rippers, diskers, etc) are available at SRS and/or are available through off-site vendors. Soil neutralization amendments are readily available from off-site vendors.

Alternative 3, Partial Excavation of Coal Fragments (5 acres) and Addition of Soil Neutralization Amendments (15 acres), could be implemented without major technical or administrative concerns. Personnel are readily available and technologies for the excavation of

coal and topsoil and the addition of soil amendments to neutralize (raise the pH of) the vadose zone soils are well defined. The heavy equipment (i.e., tractors, rippers, diskers, excavators, etc) are available at SRS and/or are available through off-site vendors. Because Alternative 3 includes the excavation and disposal of the 15-20 cm (6-8 in) layer of coal fragments prior to the addition of soil amendments, Alternative 3 would require more construction activities to implement as compared to Alternative 2. Excavated coal and topsoil would be disposed of at a solid waste landfill (i.e., Three Rivers Landfill). Soil neutralization amendments are readily available from off-site vendors.

5.4 Cost

Detailed cost estimates provided in Tables 3 and 4 are derived from current information, including vendor quotes, conventional cost-estimating guides, and costs associated with similar projects.

- **Alternative 1, No Action**

  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 DCSA in its current condition with no additional controls. The no action alternative does not include any costs.

- **Alternative 2, Addition of soil neutralization amendments (15 acres)**

  Alternative 2 will mix in soil neutralization amendments such as lime or calcium carbonate material to a targeted depth of 1.2 m (4 ft) below ground surface across the entire 6 ha (15 ac) DCSA, including the 15-20 cm (6-8 in) layer of coal fragments. The cost estimate includes construction costs associated with removing gravel in the northern 4-ha (10-ac) section, ripping of the dense soils, neutralization amendments, final grading and construction of surface water drainages back to the 489-D CPRB, vegetative cover, one-time follow-up soil pH sampling, and costs to reflect maintenance of the vegetative cover. The 15-20-cm (6-8 in) layer of coal fragments in the southern 2-ha (5-ac) section has similar pH measurements to the vadose zone soils. A detailed cost analysis for Alternative 2 is provided in Table 3. A summary of costs is provided below:

Summary of Costs	
Capital Cost	$2,494,622
O&M Cost	$1,404,671
Total Estimated Cost	$3,899,293

- **Alternative 3, Partial excavation of coal fragments (5 acres) and addition of soil neutralization amendments (15 acres)**

  Alternative 2 will excavate approximately 0.5 m (1.5 ft) from the top of the southern 2-ha (5-ac) section of the DCSA. This would include the 15-20 cm (6-8 in) layer of coal fragments along with the overlying topsoil layer, with a combined estimated volume of 9,251 m^3 (12,100 yd^3). It is anticipated that the material will be sent to Three Rivers Landfill. Following excavation, soil neutralization amendments such as lime or calcium carbonate material will be mixed to a targeted depth of 1.2 m (4 ft) below ground surface across the entire 6 ha (15 ac) DCSA. The cost estimate includes construction costs associated with removing gravel in the northern 4-ha (10-ac) section, removal and disposal of 0.5 m (1.5 ft) layer of coal fragments and topsoil from the southern 2-ha (5-ac) section of the DCSA, ripping of the dense soils, neutralization amendments, final grading and construction of surface water drainages back to the DCPRB, vegetative cover, and costs to reflect maintenance of the vegetative cover. A detailed cost analysis for Alternative 3 is provided in Table 4. A summary of costs is provided below:

Summary of Costs	
Capital Cost	$4,423,625
O&M Cost	$1,404,671
Total Estimated Cost	$5,828,296

5.5 Comparison of Removal Action Alternatives

A comparative analysis[1] of the alternatives is presented below.

	Effectiveness	Implementability	Cost	Acceptance
Alternative 1 No Action	Low	High	$0	Low
Alternative 2 Addition of soil neutralization amendments (15 acres)	High	Medium	$ 3.9 M	High
Alternative 3 Partial excavation of coal fragments (5 acres) and addition of soil neutralization amendments (15 acres)	High	Low	$ 5.8 M	Medium

[1] Comparative analysis rankings for each alternative are relative to one another. For example, a No Action alternative is less difficult to implement (i.e., highly implementable) as compared to Alternatives 2 and 3.

6.0 PREFERRED REMOVAL ACTION ALTERNATIVE

The preferred action is **Alternative 2, Addition of Soil Neutralization Amendments (15 acres),** which meets the effectiveness criteria and is more protective of human health and the environment than a no action alternative. Based on information currently available, SRS believes that Alternative 2 provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The preferred action will satisfy the statutory requirements in CERCLA Section 121(b) to: 1) be protective of human health and the environment, 2) comply with ARARs, and 3) be cost-effective.

Current and future infiltration of rainwater through the DCSA acidic vadose zone creates an acidic leachate that continues to contribute to low-pH and metal plumes in groundwater. The preferred removal action to return the pH in the DCSA vadose zone soils to more natural conditions by means of adding soil neutralization amendments (i.e., calcium carbonate, quick lime, hydrated lime, etc.) is expected to improve groundwater conditions over time.

The 15-20-cm (6-8-in) layer of coal fragments in the southern 2-ha (5-ac) section has similar pH measurements as compared to the rest of the vadose zone soils and is likely weathered/oxidized

and poses no greater leaching threat than the affected vadose zone soils. Alternative 2 and Alternative 3 are equally effective. Alternative 2 is also somewhat easier to implement as there is no excavation and disposal component. In addition, the cost is much less to leave the relatively thin layer of coal fragments in place as compared to the amount required to excavate and dispose of the layer of coal fragments. For this reason, Alternative 2 that treats the layer of coal fragments in place is preferred over Alternative 3. Reducing the acidity of the DCSA by utilization of a NTC removal action is an effective strategy for cost-effectively reducing future negative impacts to groundwater.

Alternative 2 will not preclude any additional remediation of the DAOU if needed, and is consistent with the current and future land use.

7.0 IMPLEMENTATION SCHEDULE

This RSER/EE/CA will be submitted to USEPA and SCDHEC for review and comment. The RSER/EE/CA will be available for public comment following this review. The removal action schedule is presented below:

Submit RSER/EE/CA for Regulatory Comment	November 30, 2018
Issue RSER/EE/CA for Public Comment	January 23, 2019
Submit Action Memorandum to USEPA and SCDHEC	March 28, 2019
Removal action start of RSER/EE/CA activity	April 30, 2020
Anticipated completion of RSER/EE/CA activity	October 30, 2020
Anticipated post-action pH soil sampling	March 29, 2021
Anticipated closeout letter issued	May 1, 2021

8.0 REFERENCES

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

SRNS, 2011. *Project Close Out Report For D-Area Coal pile Runoff Basin Soil Cover, 489-D, Waste Oil Facility, 484-10D, and D-006 Outfall Removal Action*, SRNS-RP-2011-01500, Rev. 1, July, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC

SRNS, 2018a. *D-Area Groundwater Operable Unit Letter Report for Calendar Year 2017 Data*, IACD-18-170, Rev. 0, July, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC

SRNS, 2018b. *Treatability Study Work Plan for Groundwater Injection and Discharge Canal Treatment at the D-Area Groundwater (OU) (U)*, SRNS-TR-2018-00128, Rev. 0, July, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC

USDOE, 1996. *Savannah River Site Future Use Project Report*, Stakeholder-Preferred Recommendations for SRS Land and Facilities, USDOE Savannah River Operations Office

USDOE, 2005. *Savannah River Site's Cold War Building Environment Cultural Resources Management Plan (CRMP)*, United States 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, Rev. 1.1, August 1999, latest update, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

9.0 GLOSSARY

Applicable or Relevant and Appropriate Requirement (ARAR): The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requires compliance with any promulgated standard requirements, criteria, or limitation under Federal and more stringent State environmental laws. Examples include the Clean Water Act, Endangered Species Act, etc.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A Federal law, known as Superfund passed in 1980 and reauthorized by the Superfund Amendments and Reauthorization Act (SARA) in 1986. The law authorizes the Federal government to respond directly to releases of hazardous substances that may endanger public health or the environment.

Deactivation: The process of placing a facility in a stable and known condition including the removal of hazardous and radioactive materials to ensure adequate protection of the worker, public health and safety, and the environment, thereby limiting the long-term cost of surveillance and maintenance. Actions include the removal of fuel, draining and/or de-energizing nonessential systems, removal of stored radioactive and hazardous materials, and related actions. Deactivation does not include all decontamination necessary for the dismantlement and demolition phase of decommissioning, e.g., removal of contamination remaining in the fixed structures and equipment after deactivation.

Decommissioning: Decommissioning is inclusive of activities that take place after a facility has been deactivated and placed in an ongoing surveillance and maintenance program. Decommissioning can include decontamination and dismantlement. Decontamination encompasses the removal or reduction of radioactive or hazardous contamination from facilities. Dismantlement involves the disassembly or demolition, and removal, of any structure, system, or component and the interim or long-term disposal of waste materials in compliance with applicable requirements.

Decontamination: The removal or reduction of residual radioactive and hazardous materials by mechanical, chemical or other techniques to achieve a stated objective or end condition.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of our country's efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

Non-Time Critical Removal Action: This is a type of response action recognized by the EPA as appropriate for addressing hazardous substance threats where a planning horizon of six months or more is appropriate. Under an EPA/DOE agreement, DOE uses a non-time critical removal action approach tailored for decommissioning DOE facilities. That approach is comprised of: a threat assessment; identification, analysis, and documentation of decommissioning alternatives; opportunities for public participation in the decommissioning decision; and planning and performance of decommissioning activities.

Removal Action: When DOE identifies a threat of exposure to, or migration of, hazardous substances that poses a risk to health, welfare, or the environment, DOE is authorized by CERCLA to exercise removal action authority to implement an appropriate response to the risks posed. Activities that may be taken under CERCLA removal action authority include any activity that reduces risks or potential risks in a relatively short time frame and can be identified as appropriate with a relatively limited analysis of alternatives. Removal actions are not limited to immediate action, or action in response to an emergency. (See non-time critical removal action.)

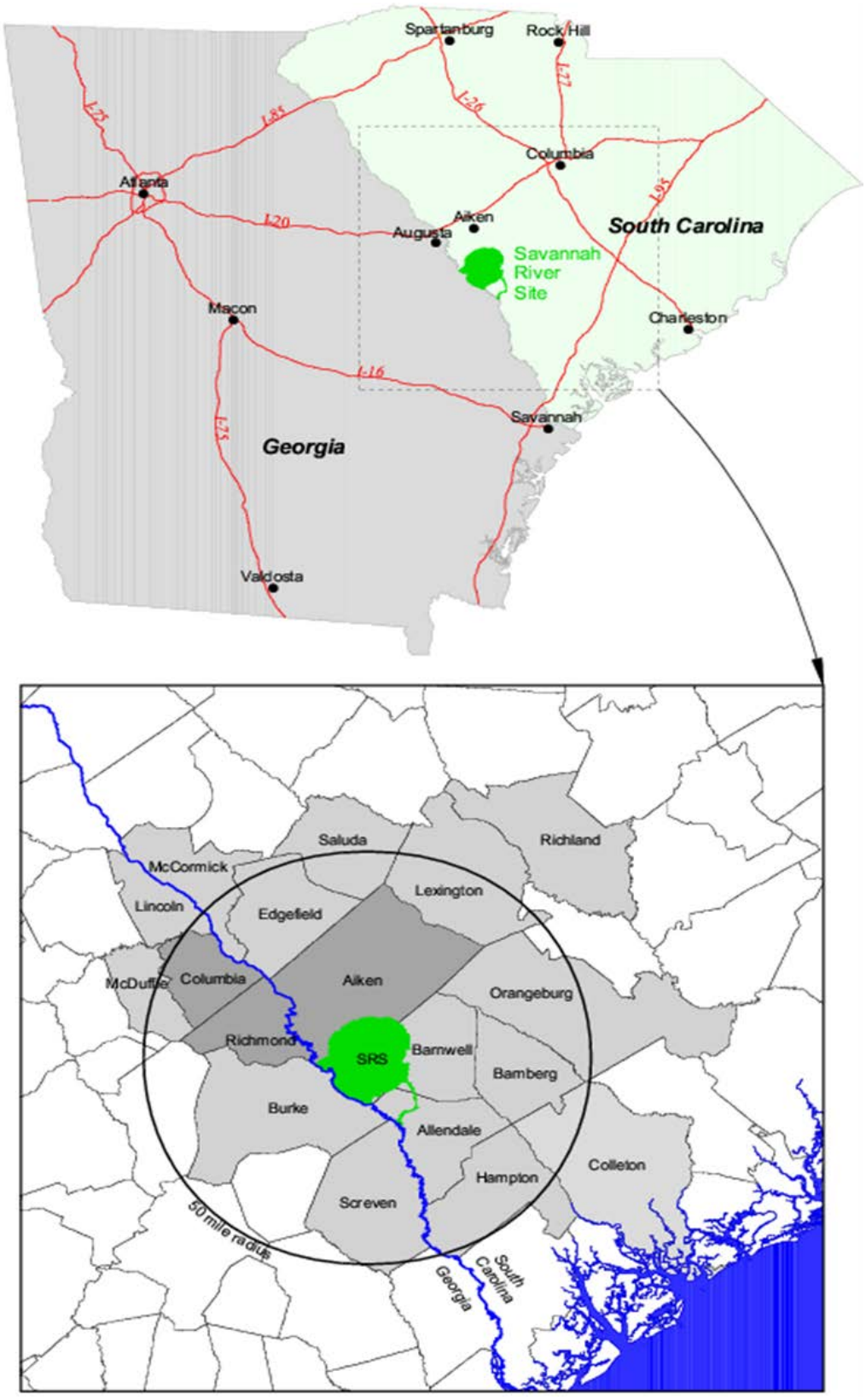

Figure 1. Geographic Proximity of the Savannah River Site

This page is intentionally left blank.

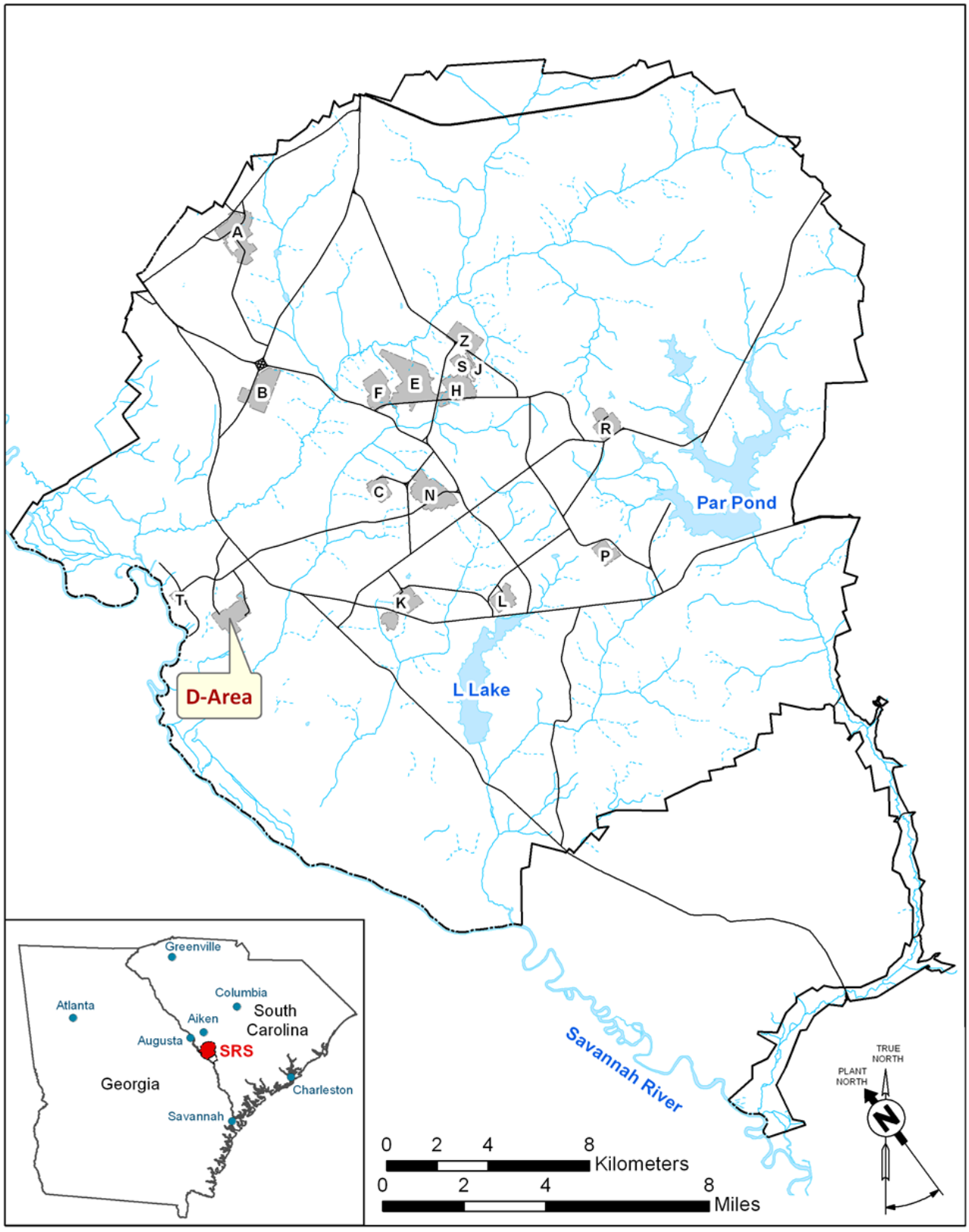

Figure 2. SRS Site Map Showing the Relative Location of the DAOU

This page is intentionally left blank.

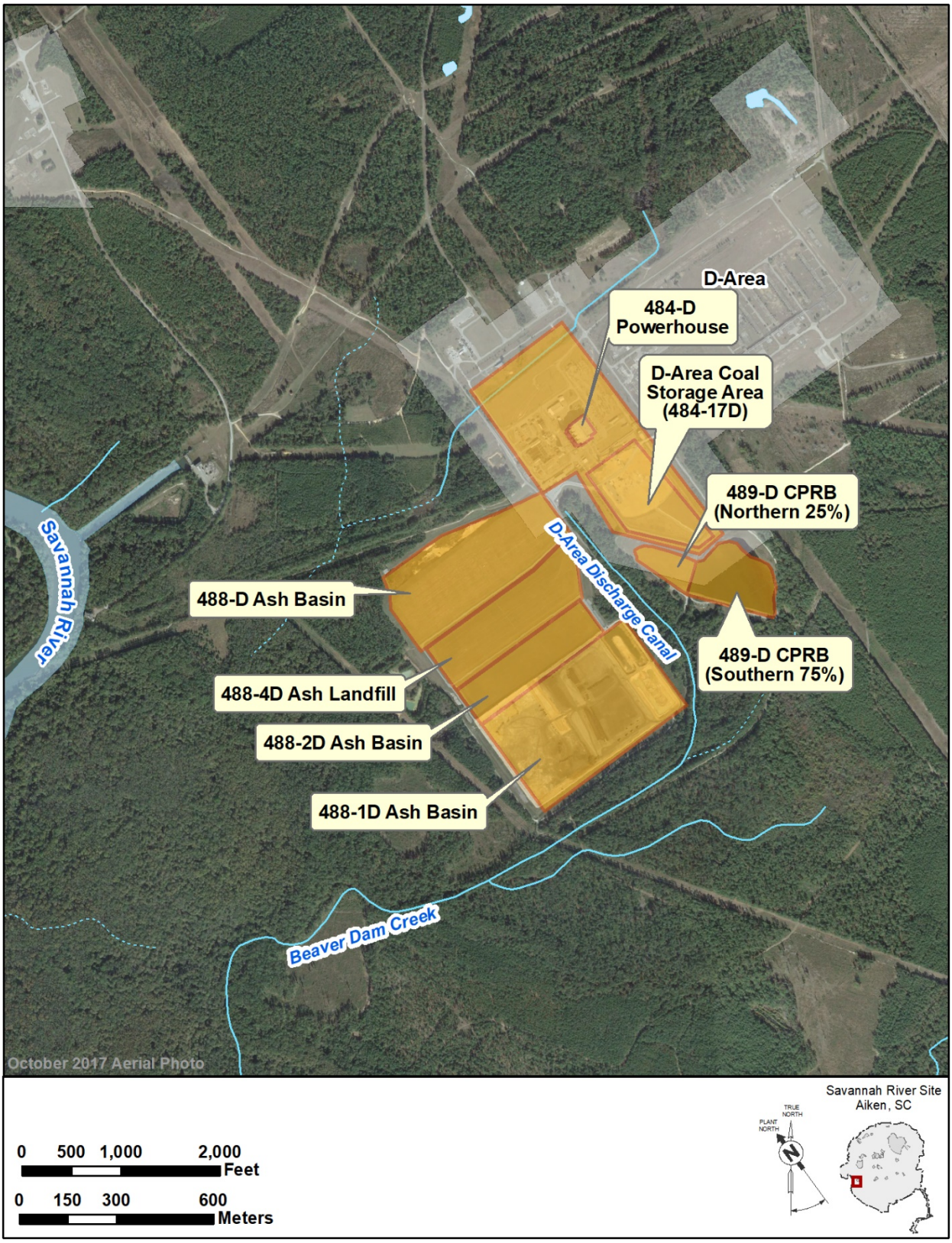

Figure 3. Location of 484-17D D-Area Coal Storage Area Within the DAOU

This page is intentionally left blank.

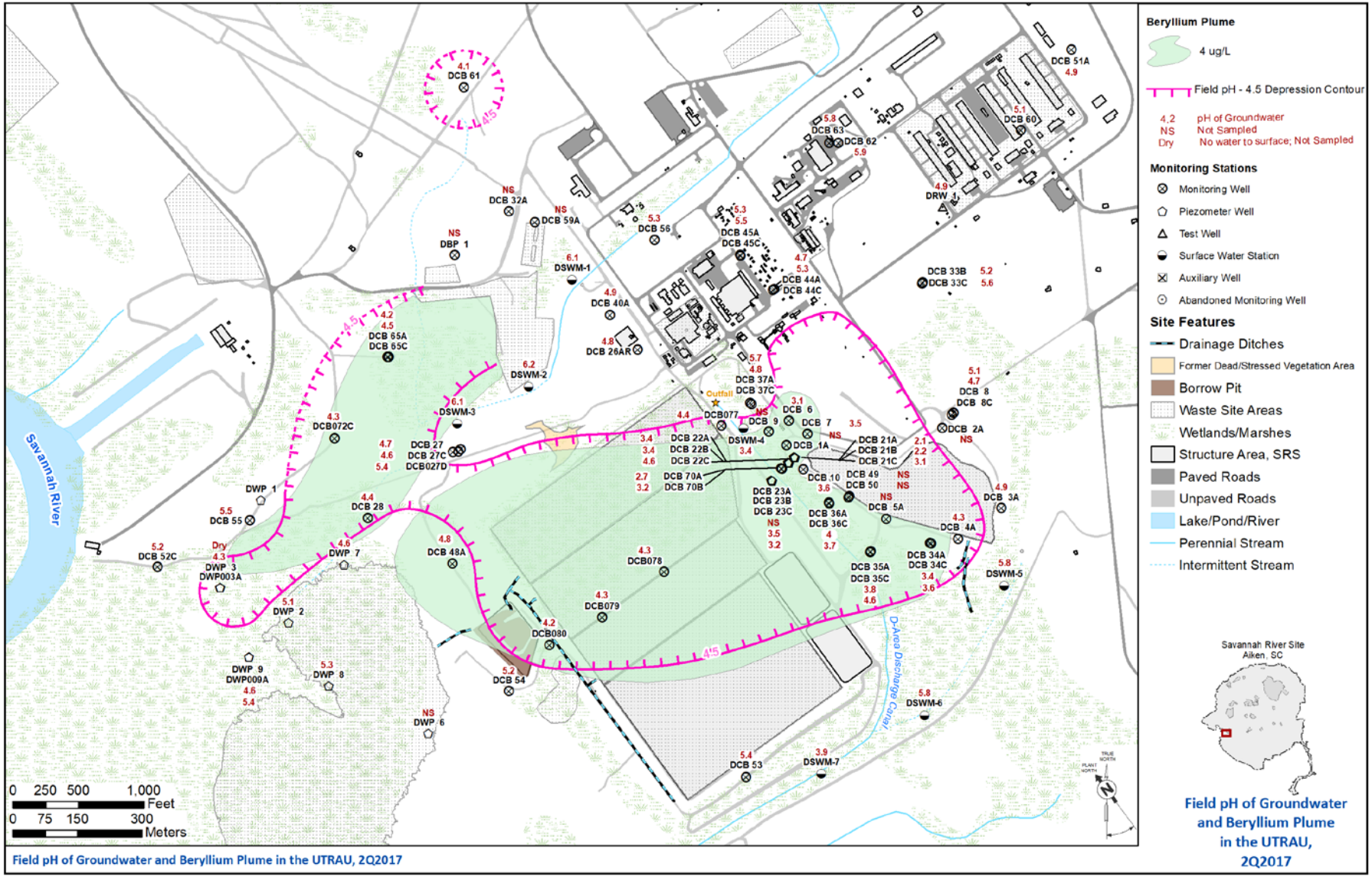

Figure 4. Field pH of Groundwater and Beryllium Plume in D-Area, 2Q2017

This page is intentionally left blank.

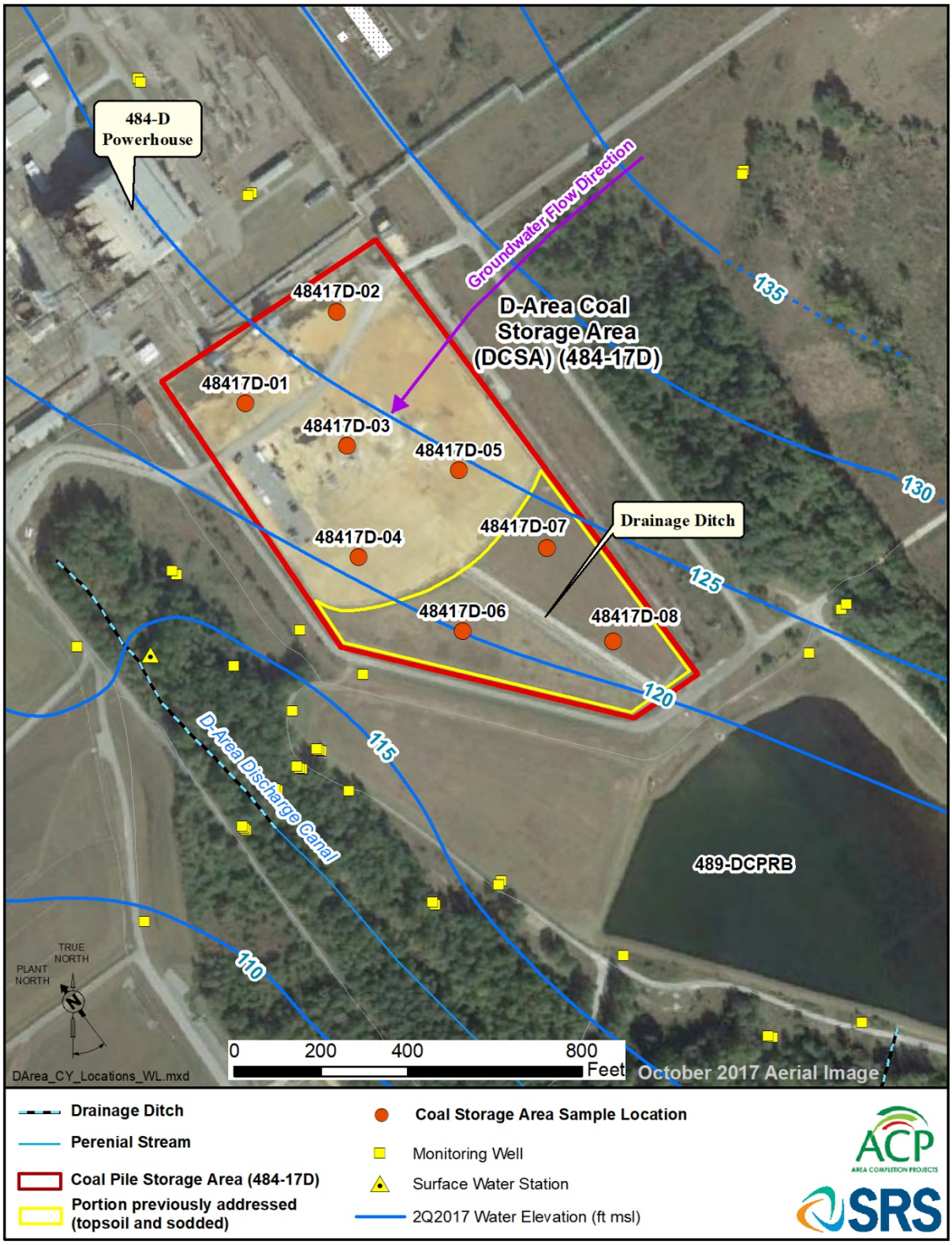

Figure 5. June 2018 Soil Sampling Locations within the DCSA

This page is intentionally left blank.

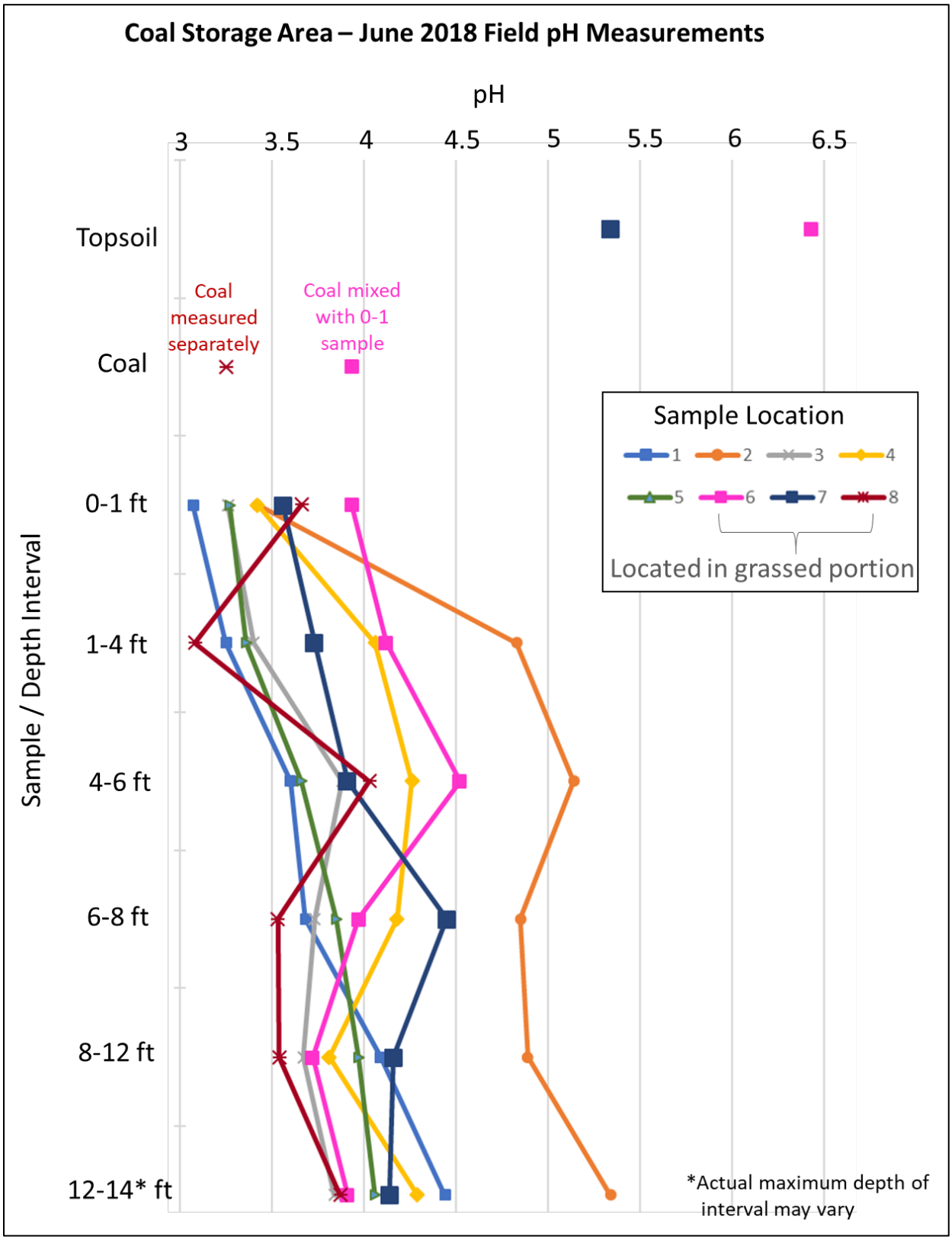

Figure 6. June 2018 DCSA Soil Sampling pH Field Measurements

This page is intentionally left blank.

Table 1. June 2018 Soil Sample Field pH and Lab pH Measurements

Location	1		2		3		4		5		6		7		8	
Sample/Depth	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab	Field	Lab
Topsoil	--	--	--	--	--	--	--	--	--	--	6.43	--	5.34	--	--	--
Coal	--	--	--	--	--	--	--	--	--	--	3.93[1]	--	--	--	3.25	--
0-1	3.07	3.28	3.42	3.72	3.26	3.27	3.42	3.55	3.27	3.31	3.93	4.23	3.56	3.68	3.66	4.1
1-4	3.25	3.32	4.83	4.74	3.4	3.73	4.06	3.97	3.36	3.4	4.12	4.45	3.73	3.82	3.08	3.4
4-6	3.6	3.66	5.14	5.03	3.88	3.74	4.26	4.19	3.66	3.64	4.52	4.67	3.91	4.02	4.03	4.07
6-8	3.68	3.8	4.85	5.34	3.73	3.67	4.18	4.26	3.85	3.74	3.97	4.16	4.45	4.67	3.53	4.19
8-12	4.09	4.36	4.89	5.11	3.67	3.64	3.81	4.07	3.97	3.96	3.72	3.98	4.16	4.38	3.54	4.02
12-14*	4.44	4.58	5.34	5.51	3.84	3.92	4.29	4.18	4.06	4.11	3.91	4.04	4.14	4.5	3.87	4.11

* Actual maximum depth of interval may vary

[1] Coal was mixed with the 0-1 ft sample and a field pH measurement was taken after homogenization. Actual pH measurement using just the coal may be slightly lower than the soil mixture (as was seen at location 8).

Table 2. Potential ARARs and TBC Criteria for the D-Area Coal Storage Area (484-17D)

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)					
Managing storm water run-off from land-disturbing activities	Must comply with the substantive requirements for storm water management and sediment control of *NPDES General Permit No. SCR100000*.	Large and small construction activities (as defined in R.61-9) of more than 1 acre of land – **applicable**	SC R.61-9.122.26(c) NPDES General Permit No. SCR100000	✓	✓
	The requirements of R.72-305 and R.72-307 will apply.	For land disturbing activities disturbing more than five (5) acres – **applicable**	SC R.72-305.B.(3)	✓	✓
	The storm water management and sediment control plan shall contain at a minimum the information provided in the following subsections:	Activities involving more than two (2) acres and less than five (5) acres of actual land disturbance which are not part of a larger common plan of development or sale – **applicable**	SC R.72-307 I. – *South Carolina Storm Water Management and Sediment Reduction Regulations*	✓	✓
	A plan for temporary and permanent vegetative and structural erosion and sediment control measures which specify the erosion and sediment control measures to be used during all phases of the land disturbing activity and a description of their proposed operation.		SC R.72-307 I.(3)(d)	✓	✓
	Provisions for storm water runoff control during the land disturbing activity and during the life of the facility meeting the following requirements: 1. Post-development peak discharge rates shall not exceed pre-development discharge rates for the 2- and 10-year frequency 24-hour duration storm event. Implementing agencies may utilize a less frequent storm event (e.g. 25-year, 24-hour) to address existing or future storm water quantity or quality problems. 2. Discharge velocities shall be reduced to provide a non-erosive velocity flow from a structure, channel, or other control measure or the velocity of the 10-year, 24-hour storm runoff in the receiving waterway prior to the land disturbing activity, whichever is greater.		SC R.72-307 I.(3)(e)	✓	✓

Table 2. Potential ARARs and TBC Criteria for the D-Area Coal Storage Area (484-17D) (*continued)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.*(cont'd)*					
Managing fugitive dust emissions from land disturbing activities	Emissions of fugitive particulate matter shall be controlled in such a manner and to the degree that it does not create an undesirable level of air pollution. Volatile organic compounds shall not be used for dust control purposes. Oil treatment is also prohibited.	Activities that will generate fugitive particulate matter (Statewide) – **applicable**	SC R.61-62.6 Section III(a)- *Control of Fugitive Particulate Matter Statewide* SC R.61-62.6 Section III(d)	✓	✓
Waste Characterization and Storage — (e.g., excavated coal, coal fines, contaminated soils/sediments, vegetation, debris)					
Characterization of *solid* waste	Must determine if solid waste is a hazardous waste using the following method: Should first determine if waste is excluded from regulation under 40 CFR 261.4; and	Generation of solid waste as defined in 40 CFR 261.2 – **applicable**	40 CFR 262.11(a) SC R.61-79 262.11*(a)*		✓
	Must determine if waste is listed as hazardous waste under 40 CFR Part 261.	Generation of solid waste which is not excluded under 40 CFR 261.4(a) – **applicable**	40 CFR 262.11(b) SC R.61-79 262.11*(b)*		✓
	Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR Part 261 by either: 1. Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or 2. Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.	Generation of solid waste which is not excluded under 40 CFR 261.4(a) – **applicable**	40 CFR 262.11(c) SC R.61-79 262.11*(c)*		✓
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be *hazardous* waste – **applicable**	40 CFR 262.11(d) SC R.61-79 262.11*(d)*		✓

Table 2. Potential ARARs and TBC Criteria for the D-Area Coal Storage Area (484-17D) (*continued)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Waste Characterization and Storage — (e.g., excavated coal, coal fines, contaminated soils/sediments, vegetation, debris) *(cont'd)*					
Determinations for management of *hazardous* waste [1]	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq.* *Note:* This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.	Generation of hazardous waste for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) SC R.61-79 268.9*(a)*		✓
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable**	40 CFR 268.9(a) SC R.61-79 268.9*(a)*		✓
	Must determine if the hazardous waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. *Note:* This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11.	Generation of hazardous waste for storage, treatment or disposal – **applicable**	40 CFR 268.7(a) SC R.61-79 268.7 *(a)* (1)		✓
Temporary Storage of Solid Waste	Shall be conducted in a manner to: a. Inhibit the harborage of flies, rodents, and other vectors; b. Prevent conditions for transmission of diseases to man or animals; c. Prevent blowing debris and particulates so as not to be injurious to human health and the environment; d. Prevent water pollution and prevent the escape of solid waste or leachate to waters of the State; and Minimize objectionable odors, dust, unsightliness, and aesthetically objectionable conditions, and prevent the accumulation of materials in an untidy and unsafe manner so as to become a fire and safety hazard.	Generation of solid waste for temporary storage prior to processing, disposal of that waste – **relevant and appropriate**	SC R.61-107.5(C)(1)		✓

Table 2. Potential ARARs and TBC Criteria for the D-Area Coal Storage Area (484-17D) (*continued)*

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Disposal of Wastes Off-Site (e.g., coal, coal fines, contaminated soils/sediments, vegetation, debris)					
Off-Site Disposal of Solid Waste	Shall ultimately dispose of solid waste at facilities and/or sites permitted or registered by the Department for processing or disposal of that waste stream.	Generation of solid waste intended for off-site disposal – **relevant and appropriate**	SC R.61-107.5(D)(3)		✓
Off-site Disposal of RCRA-*Hazardous* Waste in a Land-Based Unit [1]	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste – **applicable**	40 CFR §268.40(a) SC R.61-79 268.40*(a)*		✓
	All underlying hazardous constituents [as defined in 40 CFR 268.2(i)] must meet the Universal Treatment Standards (UTSs), found in 40 CFR 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001-D043) not managed in a wastewater treatment system regulated under the Clean Water Act (CWA), that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – **applicable**	40 CFR §268.40(e) SC R.61-79 268.40*(e)*		✓
	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or Must be treated according to the UTSs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils –**applicable**	40 CFR §268.49(b) SC R.61-79 268.49*(b)*		✓
	To determine whether a hazardous waste identified in this section exceeds the applicable treatment standards of 40 CFR 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste. If the waste contains constituents (including underlying hazardous constituents [UHCs] in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR 268.48, the waste is prohibited from land disposal, and all requirements of Part 268 are applicable, except as otherwise specified.	Land disposal of RCRA toxicity characteristic wastes (D004-D011) that are newly identified – **applicable**	40 CFR 268.34(f) SC R.61-79 268.34*(f)*		✓

Table 2. Potential ARARs and TBC Criteria for the D-Area Coal Storage Area (484-17D) (*continued; end*)

Action	Requirements	Prerequisite	Citation	Alt-2	Alt-3
Transportation of Wastes					
Transportation of Samples (i.e. Solid Waste and Soils)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: • the sample is being transported to a laboratory for the purpose of testing; or • the sample is being transported back to the sample collector after testing. • the sample is being stored by sample collector before transport to a lab for testing.	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition – **applicable**	40 CFR 261.4(d)(1)(i)-(iii) SC R.61-79 261.4*(d)* (1)		✓
General Requirements					
Protection of Migratory Birds	No person may take, possess, import, export, transport, sell, purchaser, barter or offer for sale, purchase or barter, any migratory bird, or the parts, nests, or eggs of such bird except as under the terms of a valid permit.	Migratory bird populations may be present in the vicinity – **applicable**	16 *USC* 703-704 – Migratory Bird Treaty Act	✓	✓

1- The requirements from 40 CFR Part 268 contained in this table will be triggered if any generated wastes, including coal ash, coal fines, soil, sediments, and/or groundwater are characterized as RCRA *hazardous* wastes.

Alt	=	Alternative	NPDES	=	National Pollutant Discharge Elimination System
ARAR	=	applicable or relevant and appropriate requirement	POLYM	=	Polymerization
CFR	=	*Code of Federal Regulations*	RCRA	=	Resource Conservation and Recovery Act of 1976
CMBST	=	Combustion	RORGS	=	Recovery of organics
CWA	=	Clean Water Act of 1972	SCDHEC	=	South Carolina Department of Health and Environmental Control
DEACT	=	deactivation	TCLP	=	Toxicity Characteristic Leaching Procedure
DOT	=	U.S. Department of Transportation	UHC	=	underlying hazardous constituents
EPA	=	U.S. Environmental Protection Agency	UTS	=	Universal Treatment Standard
LDR	=	Land Disposal Restrictions	WWTU	=	Waste Water Treatment Unit

Table 3. Detailed Cost Analysis for the D-Area Coal Storage Area

Alternative 2

Addition of Soil Neutralization Amendments (15 acres)

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Coal Yard				
Mobilization/Demobilization	2	EA	$ 5,000	$ 10,000
Initial Submittals/Work Packages	1	LS	$ 50,000	$ 50,000
General Requirements	10	WKS	$ 30,000	$ 300,000
Construction Facilities/Temporary Utilities	10	WKS	$ 4,000	$ 40,000
Site Surveys (Initial & As-Built)	2	EA	$ 10,000	$ 20,000
Site Surveys (Interim/Progress)	4	EA	$ 5,000	$ 20,000
Sedimentation Basin				
Storm Water/Erosion Control (Exterior Perimeter)	1	LS	$ 15,000	$ 15,000
Excavate, Load, and Haul	10000	BCY	$ 7	$ 70,000
Spread Excavated Materials within Project Limits	12000	CY	$ 2	$ 24,000
Fine Grade Sedimentation Basin / Light Compaction	1	LS	$ 5,000	$ 5,000
Sedimentation Basin Stormwater Pipe & Spillway	1	LS	$ 15,000	$ 15,000
Place Install Riprap	160	CY	$ 63	$ 10,080
Gravel Removal from Work Area				
Excavate and Load Gravel	20,000	CY	$ 3	$ 60,000
Haul	20,000	CY	$ 3	$ 60,000
Specialty Lower-Tier Subcontractor				
Excavate and Till Total Depth - (12 Weeks)				
Mobilization (4 Over Size Loads @ 1200 Miles Each)	1	LS	$ 35,000	$ 35,000
Rip with a 48" Parabolic Ripper	15	AC	$ 2,400	$ 36,000
Cross Rip with a 48" Parabolic Ripper	15	AC	$ 2,400	$ 36,000
Rip/Cross Rip with a 48" Parabolic Ripper (Assume 2 Add. Passes)	2	EA	$ 9,000	$ 18,000
Speading of Lime	15	AC	$ 1,200	$ 18,000
Offset Disc and Roll (Lime Incorporation)	15	AC	$ 6,000	$ 90,000
Offset Disc and Roll (Lime incorporation) (Assume 2 Add. Passes)	2	EA	$ 18,000	$ 36,000
Demobilization (4 Over Size Loads @ 1200 Miles Each)	1	LS	$ 35,000	$ 35,000
Material (Lime Cost)				
Liming Agent to be Spread on Acreage	1200	TONS	$ 150	$ 180,000
Dust Control				
Water Truck, (5000 Gallons)	10	WKS	$ 2,420	$ 24,200
Labor - Teamster	10	WKS	$ 700	$ 7,000
Site Stabilization				
Stabilization of Area (Vegetation i.e., Hydroseeding)	653	MSF	$ 43	$ 27,753
Subtotal - Direct Capital Cost				$ 1,242,033
Weekly Interface/Performance Margin	3%	of Subtotal Direct Capital		$ 37,261
Total Direct Capital Cost		(Sum of * Items)		**$ 1,279,293**
Indirect Capital Costs				
Engineering & Design	15%	of Direct Capital		$ 191,894
Project/Construction Management	25%	of Direct Capital		$ 319,823
Health & Safety	5%	of Direct Capital		$ 63,965
Overhead	30%	of Direct Capital		$ 383,788
Contingency	20%	of Direct Capital		$ 255,859
Total Indirect Capital Cost				**$ 1,215,329**
Total Estimated Capital Cost				**$ 2,494,622**
Direct O&M Costs				
Annual Costs (During Implementation)	0.7%	Discount Rate for Costs > 30 Years Duration[1]		
Subtotal - Annual Costs				$ -
Present Worth Annual Costs (-0.5% Discount Rate)				**$ -**
One-Time Costs (Sampling)	1	year O&M		
Follow-Up Sampling (8 Samples)	8	EA	$ 10,000	$ 80,000
Subtotal - One-Time Costs				$ 80,000
Present Worth Annual Costs (-0.5% Discount Rate)				**$ 80,402**
Annual Costs (Land Use Controls)	30	years O&M		
Annual Inspections / Maintenance	1	EA	$ 5,000	$ 5,000
Subtotal - Annual Costs				$ 5,000
Present Worth Annual Costs (0.7% Discount Rate)				**$ 134,873**
Total Present Worth Direct O&M Cost				**$ 215,275**
Indirect O&M Costs				
Project/Admin Management	290%	of direct O&M		$ 624,298
Health & Safety	218%	of direct O&M		$ 468,224
Overhead	30%	of direct O&M		$ 64,583
Contingency	15%	of direct O&M		$ 32,291
Total Estimated Present Worth Indirect O&M Cost				**$ 1,189,396**
Total Estimated Present Worth O&M Cost				**$ 1,404,671**
TOTAL ESTIMATED COST				**$ 3,899,293**

This page is intentionally left blank.

Table 4. Detailed Cost Analysis for the D-Area Coal Storage Area

Alternative 3

Partial Excavation of Coal Fragments (5 Acres) and Addition of Soil Neutralization Amendments (15 Acres)

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Coal Yard				
Mobilization/Demobilization	2	EA	$ 5,000	$ 10,000
Initial Submittals/Work Packages	1	LS	$ 50,000	$ 50,000
General Requirements/Construction Management	10	WKS	$ 30,000	$ 300,000
Construction Facilities/Temporary Utilities	10	WKS	$ 4,000	$ 40,000
Site Surveys (Initial & As-Built)	2	EA	$ 10,000	$ 20,000
Site Surveys (Interim/Progress)	4	EA	$ 5,000	$ 20,000
Sedimentation Basin				
Storm Water/Erosion Control (Exterior Perimeter)	1	LS	$ 15,000	$ 15,000
Excavate, Load, and Haul	10000	BCY	$ 7	$ 70,000
Spread Excavated Materials within Project Limits	12000	CY	$ 2	$ 24,000
Fine Grade Sedimentation Basin / Light Compaction	1	LS	$ 5,000	$ 5,000
Sedimentation Basin Stormwater Pipe & Spillway	1	LS	$ 15,000	$ 15,000
Place Install Riprap	160	CY	$ 63	$ 10,080
Three Rivers Disposal				
Excavate and Load Topsoil/Coal Residue from Lower 5 Acres	12100	CY	$ 2.76	$ 33,396
Truck Topsoil/Coal Residue to Three Rivers	14520	LCY	$ 15.19	$ 220,559
Disposal Fee	12100	MT	$ 65	$ 786,500
Gravel Removal from Work Area				
Excavate and Load Gravel Road and Pad	20,000	CY	$ 3	$ 60,000
Haul	20,000	CY	$ 3	$ 60,000
Specialty Lower-Tier Subcontractor				
Excavate and Till Total Depth - (12 Weeks)				
Mobilization (4 Over Size Loads @ 1200 Miles Each)	1	LS	$ 35,000	$ 35,000
Rip with a 48" Parabolic Ripper	15	AC	$ 2,400	$ 36,000
Cross Rip with a 48" Parabolic Ripper	15	AC	$ 2,400	$ 36,000
Rip/Cross Rip with a 48" Parabolic Ripper (Assume 2 Add. Passes)	2	EA	$ 9,000	$ 18,000
Speading of Lime	15	AC	$ 1,200	$ 18,000
Offset Disc and Roll (Lime Incorporation)	15	AC	$ 6,000	$ 90,000
Offset Disc and Roll (Lime incorporation) (Assume 2 Add. Passes)	2	EA	$ 18,000	$ 36,000
Demobilization (4 Over Size Loads @ 1200 Miles Each)	1	LS	$ 35,000	$ 35,000
Material (Lime Cost)				
Liming Agent to be Spread on Acreage	1200	TONS	$ 150	$ 180,000
Dust Control				
Water Truck (5000 Gallons)	10	WKS	$ 2,420	$ 24,200
Labor - Teamster	10	WKS	$ 700	$ 7,000
Site Stabilization				
Stabilization of Area (Vegetation i.e., Hydroseeding)	653	MSF	$ 43	$ 27,753
Subtotal - Direct Capital Cost				$ 2,282,487
Weekly Interface/Performance Meetings	3%	of Subtotal Direct Capital		$ 68,475
Total Direct Capital Cost		(Sum of * Items)		**$ 2,350,962**
Indirect Capital Costs				
Engineering & Design	15%	of Direct Capital Excluding Hauling		$ 191,894
Project/Construction Management	25%	of Direct Capital		$ 587,740
Health & Safety	5%	of Direct Capital		$ 117,548
Overhead	30%	of Direct Capital		$ 705,289
Contingency	20%	of Direct Capital		$ 470,192
Total Indirect Capital Cost				**$ 2,072,664**
Total Estimated Capital Cost				**$ 4,423,625**
Direct O&M Costs				
Annual Costs (During Implementation)	0.7%	Discount Rate for Costs > 30 Years Duration1		
Subtotal - Annual Costs				$ -
Present Worth Annual Costs (-0.5% Discount Rate)				**$ -**
One-Time Costs (Sampling)	1	year O&M		
Follow-Up Sampling (8 Samples)	8	EA	$ 10,000	$ 80,000
Subtotal - One-Time Costs				$ 80,000
Present Worth Annual Costs (-0.5% Discount Rate)				**$ 80,402**
Annual Costs (Land Use Controls)	30	years O&M		
Annual Inspections / Maintenance	1	EA	$ 5,000	$ 5,000
Subtotal - Annual Costs				$ 5,000
Present Worth Annual Costs (0.7% Discount Rate)				**$ 134,873**
Total Present Worth Direct O&M Cost				**$ 215,275**
Indirect O&M Costs				
Project/Admin Management	290%	of direct O&M		$ 624,298
Health & Safety	218%	of direct O&M		$ 468,224
Overhead	30%	of direct O&M		$ 64,583
Contingency	15%	of direct O&M		$ 32,291
Total Estimated Present Worth Indirect O&M Cost				**$ 1,189,396**
Total Estimated Present Worth O&M Cost				**$ 1,404,671**
TOTAL ESTIMATED COST				**$ 5,828,296**

This page is intentionally left blank.

APPENDIX A

Sampling Plan for the DCSA

Following the addition of soil neutralization amendments and time (~1.5 years) to allow the soils in the DCSA to be affected, pH sampling of the vadose zone soils will be conducted. Samples will be collected from the eight locations identified in the June 2018 sampling effort at six depth intervals down to 14 feet (4.3 meters) below ground surface (Figure A-1). A total of 10% of the samples will include duplicates for quality assurance/quality control.

Since the pH measurements from the June 2018 sampling effort showed excellent correlation between the field pH measurements and the lab analyzed pH measurements, only field pH measurements are proposed to be collected. Consistent with the June 2018 sampling event, the soil samples will be used to create soil slurries and measured for pH in the field following USEPA (https://www.epa.gov/sites/production/files/2015-12/documents/9045d.pdf, accessed 9/20/2018) and the USDA Soil Survey Field and Laboratory Methods Manual, Report No. 51 guidance (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1244466.pdf, accessed on 9/20/2018, section 4.3.1.1.1.3, page 232).

Under the *Treatability Study Work Plan for Groundwater Injection and Discharge Canal Treatment at the D-Area Groundwater* (SRNS 2018b), potable groundwater from nearby production wells in D-Area will be injected in the upper water table upgradient of the DCSA and the 489-D CPRB to raise the water table approximately 5 feet (1.5 meters) to flush and raise the pH levels. It is anticipated that the lower depth intervals of the DCSA vadose zone will become saturated. SRS will submit a Program Plan prior to collecting saturated soil samples from the DCSA.

54 total composite soil *samples (includes* 10% QA/QC – 6 duplicates)

8 locations (Figure A-1)	6 depth intervals
48417D-01	0-1’
48417D-02	1-4’
48417D-03	4-6’
48417D-04	6-8’
48417D-05	8-12’
48417D-06	12-14’
48417D-07	
48417D-08	

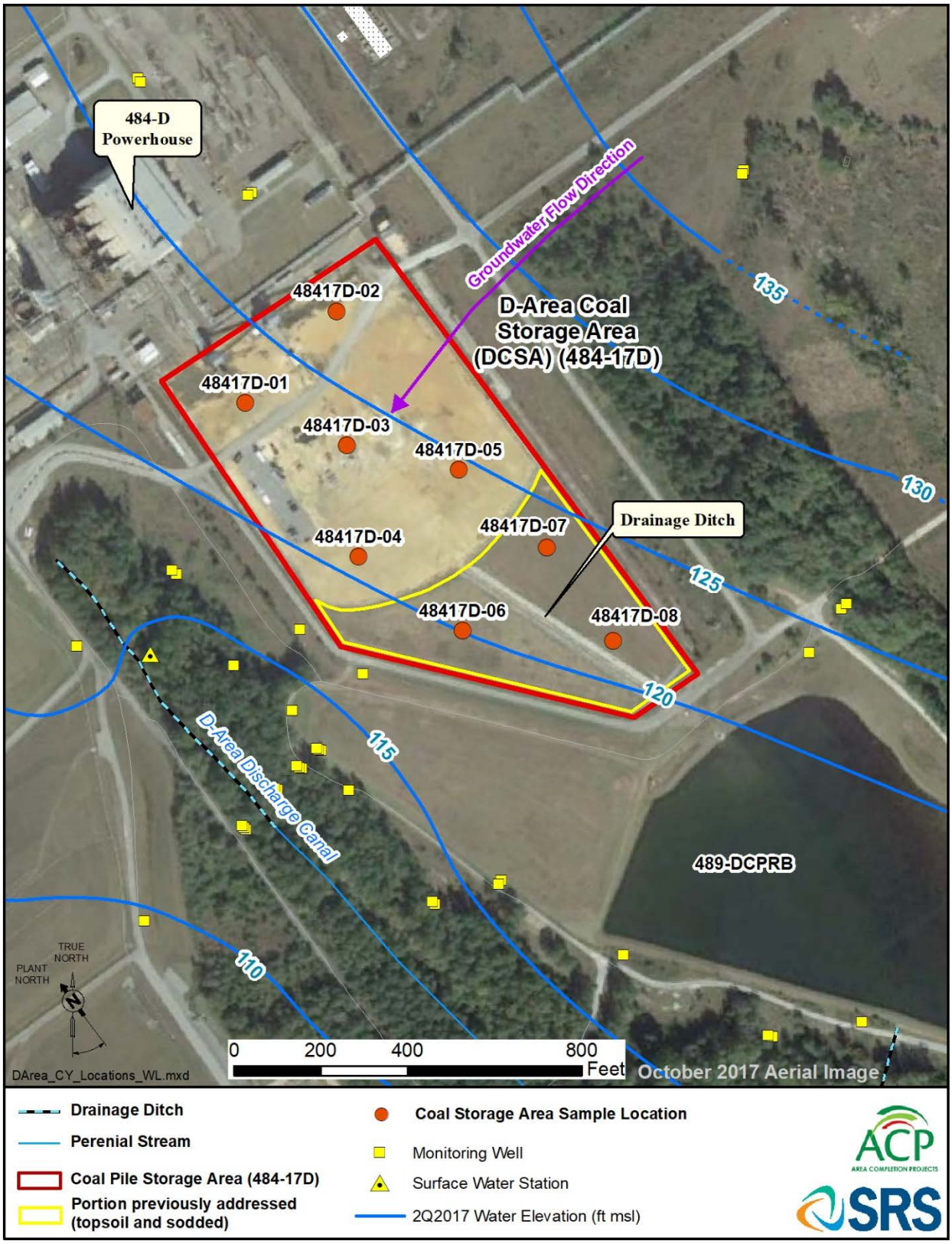

Figure A-1. Soil Sampling Locations at the DCSA