Savannah River
NUCLEAR SOLUTIONS℠

Post-Construction Report for the Lower Three Runs Integrator Operable Unit Upper Subunit (U)

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LIST OF ABBREVIATIONS AND ACRONYMS

~	approximate, approximately
ac	acres
amsl	above mean sea level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Co	cobalt
Cs	cesium
cy	cubic yards
EA	Exposure Area
FFA	Federal Facility Agreement
ft	feet
FS	Feasibility Study
FSP	Field Sampling Plan
GEL	General Engineering Laboratory
GPR	Ground penetrating radar
ha	hectares
Hg	mercury
IOU	Integrator Operable Unit
LLWF	Low Level Waste Facility
LTR	Lower Three Runs
LUC	Land Use Controls
LUCIP	Land Use Control Implementation Plan
km	kilometer
m	Meters
m^3	cubic meters
mi	mile
MNR	Monitored Natural Recovery
MNREP	Monitored Natural Recovery Effectiveness Plan
NBN	no building number
pCi/g	picocuries per gram
PCR	Post-Construction Report
PTSM	Principal Threat Source Material
RA	Remedial action
RAIP	Remedial Action Implementation Plan
RAO	Remedial Action Objective
RCOC	Refined Constituents of Concern
RI/BRA	Remedial Investigation/Baseline Risk Assessment
ROD	Record of Decision
RPD	Radiological Protection Department
SCDES	South Carolina Department of Environmental Services[1]
SEMS	Superfund Enterprise Management System

[1] South Carolina Department of Environmental Services (SCDES) was known as South Carolina Department of Health and Environmental Control (SCDHEC) prior to July 1, 2024.

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

SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
TAL	Test America Laboratories
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Post-Construction Report (PCR) documents the completion of remedial action (RA) construction activities in support of the closure of the Upper subunit of the Lower Three Runs (LTR) Integrator Operable Unit (IOU). It summarizes construction activities performed to implement the RA requirements in the LTR IOU Record of Decision (ROD) (Savannah River Nuclear Solutions [SRNS] 2021) in accordance with the approved Remedial Action Implementation Plan (RAIP) (SRNS 2022a). This PCR specifically addresses construction activities associated with installing access controls for the Upper subunit of the LTR IOU and the excavation, treatment, and disposal of Principal Threat Source Material (PTSM) in the R-Area Discharge Canal.

Other selected remedies for the Upper subunit of the LTR IOU (maintenance of water in PAR Pond and Pond B and the Monitored Natural Recovery [MNR]), require long term maintenance of dam structures and periodic monitoring in accordance with the MNR Effectiveness Plan (MNREP) (SRNS 2022b). These long-term maintenance and monitoring actions will be completed in the future and documented in the 5-Year Remedy Review Reports and a Remedial Action Completion Report in accordance with the Federal Facility Agreement (FFA 1993).

This report includes the following items:

- A brief description of the Upper subunit of the LTR IOU background including RA requirements and objectives;
- A chronology of completed events related to the installation of access control features for the Upper subunit and excavation of PTSM contaminated sediments in the R-Area Discharge Canal;
- A summary of construction activities performed;
- Deviations from the original design per the approved RAIP;

- Performance standards and quality control inspections, including a summary of performance test results documenting verification of compliance with the acceptance criteria in the RAIP;
- Verification of construction completion;
- As-Built drawings;
- Forecasts of post-construction activities required for the RA; and
- Project costs.

1.2 Operable Unit Background

The LTR IOU, No Building Number (NBN), is listed as a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) unit in Appendix C of the FFA for the Savannah River Site (SRS).

1.2.1 General Description and Location

The LTR IOU watershed is located in the southeastern portion of SRS (Figure 1). LTR is a large blackwater stream that originates in the northeast portion of SRS and follows a southerly direction for approximately (~) 40-kilometers (km) (24.5-miles [mi]), discharging into the Savannah River.

For administrative purposes, the LTR IOU is delineated into Upper, Middle, and Lower subunits (Figure 2). The IOU is defined as surface water bodies (e.g., stream, lakes, and ponds) and associated wetlands/floodplains including surface water, sediment/soil (stream channel/floodplain sediment and floodplain/wetland soil), and related biota. The Upper subunit of the LTR IOU is located upgradient of the PAR Pond Dam. The Middle and Lower subunits are located below the PAR Pond Dam. The Lower subunit includes and bounds an area with a narrow land buffer of U. S. Department of Energy (USDOE) property referred to as the "tail" portion of the LTR IOU. This document describes the implementation of the selected remedy for the Upper subunit. Implementation of the selected remedy for the Middle and Lower subunits is documented in the *Removal Action*

Report for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) Tail Portion (Middle and Lower Subunits) (U) (SRNS, 2013)

1.2.2 Nature and Extent of Contamination

The Upper subunit of the LTR IOU was evaluated through the CERCLA remedial process to determine the actual or potential impact to human health and the environment. The *Remedial Investigation/Baseline Risk Assessment (RI/BRA) for the Lower Three Runs IOU* (SRNS 2017) summarizes the data associated with the unit, describes the nature and extent of the contamination in affected media, and evaluates the potential risk to human and ecological receptors.

Due to the large scale of the LTR IOU and the environmental conditions, the media assessment of the Upper subunit was performed on nine individual exposure areas (EAs). The nine EAs and dam areas are identified in Figures 3 and 4 and are listed below.

- EA1 includes Pond A and the R-Area Discharge Canal. Pond A, is ~2.6 hectares (ha) (6.4 acres [ac]), and received water from the R-Area Discharge Canal that subsequently discharged to Pond B. The canal from R-Reactor to Pond A is ~645-meters (m) (2,116-feet [ft]) long. The canal from the R-Discharge Canal to Joyce Branch is 233-m (764-ft) long.

- EA2 consists of the section of the canal system between Pond A and Pond B and is ~2,837-m (9,308-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3.0-m (9.8-ft) across the base of the canal.

- EA3 includes Pond B and the overflow canal connecting Pond B to Pond C. Pond B is ~82 ha (203 ac) and received water from the R Area, which subsequently discharged to PAR Pond. Pond B generally maintains its water level from year to year. The overflow canal from Pond B is ~547-m (1,795-ft) long.

- EA4 consists of the section of the canal system between Pond B and the North Arm of PAR Pond and is ~2,305-m (7,562-ft) long. The canal flow area (i.e., where

contaminants most likely have been deposited) is ~3.0-m (9.8-ft) across the base of the canal.

- EA5 consists of Joyce Branch (also known as the Old R-Area Discharge Canal), which is ~2,533-m (8,310-ft) long. Flow from the R-Reactor cooling water system was directed along Joyce Branch to LTR beginning in 1953 until the diversion structure was built in 1958. The diversion structure eliminated direct reactor discharges to Joyce Branch. The flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the stream channel.

- EA6 consists of PAR Pond. PAR Pond is ~1,068 ha (2,640 ac) and received water from the R Area and P Area discharges.

- EA7 includes Pond 2 and the Discharge Canal between P Area and Ponds 4 and 5. Pond 2 is ~7.9 ha (20 ac) and received water from P Area and subsequently discharged to Ponds 4 and 5. The canal from P Area to Pond 2 is ~3,582-m (11,752-ft) long. The canal from Pond 2 to Ponds 4 and 5 is ~2,081-m (6,827-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the canal.

- EA8 includes Ponds 4 and 5 and the Discharge Canal between Ponds 4 and 5 to Pond C. Pond 4 is ~14 ha (35 ac) and received water from P Area and subsequently discharged to Pond 5. Pond 5 is ~4.0 ha (9.9 ac) and received water from Pond 4 and subsequently discharged to Pond C via an 1,887-m (6,191-ft) long canal. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the canal.

- EA9 consists of Pond C. Pond C is ~54 ha (132 ac) and received water from the R Area discharged directly from Joyce Branch and from P Area through the canal system. Water from Pond C flows to PAR Pond through a reverse riser (commonly referred to as the “bubble-up”). As long as PAR Pond is 59-m (195-ft) above mean sea level (amsl), Pond C and PAR Pond will maintain the same water level. If PAR Pond

drops below 60-m (195-ft) amsl, Pond C will remain at 60-m (195-ft) amsl unless the drain gate is opened to release water.

Human health risks were evaluated based on an onsite worker (wetland researcher) for all EAs and a hypothetical recreational fisherman scenario for the EAs that can sustain populations of consumable fish (EA3, EA6, and EA9). As detailed in the Feasibility Study (FS) and RI/BRA, the refined constituents of concern (RCOCs) are cesium-137 (Cs-137) and to a lesser degree cobalt-60 (Co-60) in sediment/soil media. In addition, Cs-137 and mercury (Hg) were identified as RCOCs in fish tissue; however, the presence of Hg is primarily the result of the use of Savannah River water as part of the river water distribution system that contained elevated levels of Hg, as well as atmospheric deposition, and not attributable to SRS operations.

All EAs (EA1 through EA9) present a problem warranting action due to the potential exposure to Cs-137 and Co-60 in the sediment/soil within the canals and ponds. Cs-137 and Hg in fish tissue also present a problem warranting action in EAs that can sustain population of consumable fish (EA3, EA6, and EA9). Surface water was determined not to be a media of concern. No problems warranting action were identified for ecological receptors.

Although no PTSM RCOCs were formally identified for any EA within the LTR IOU, Cs-137 levels were detected above the PTSM threshold (144 picocuries per gram [pCi/g]) at specific locations (i.e., hot spots) within EA1, EA3, and EA5 (Figures 5 and 6).

1.3 Remedial Action Requirements and Objectives

1.3.1 Remedial Action Objectives

As stated in the ROD (SRNS 2021), the following Remedial Action Objectives (RAOs) are identified for the Upper subunit of the LTR IOU and are protective of the onsite worker and recreational fisherman:

- Protect IOU onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceed 1.0E-06 risk threshold or background levels. The primary exposure route of concern is the external radiation pathway.

- Protect the recreational fisherman from exposure to Cs-137 and Hg in fish tissue that exceed risks of 1E-06 and hazard quotient of 1, respectively. The primary route of exposure is the ingestion of fish pathway.

1.3.2 Selected Remedial Action

As stated in the ROD (SRNS 2021), the RA remedial actions selected to address the sediment/soil in the Upper subunit of the LTR IOU include the following:

Land Use Controls (LUCs) with MNR is the selected alternative for all nine EAs (EA1 through EA9).

Excavation, Treatment and Disposal of PTSM Sediment/Soil is the selected alternative for the PTSM location in EA1 (Pond A – Including R-Discharge Canal) to reduce exposure and mitigate sediment/soil migration; and

Maintain Water in Ponds is the selected alternative for EA3 (Pond B) and EA6 (PAR Pond) to maintain water levels in Pond B, PAR Pond, and Pond C to reduce exposure and mitigate sediment/soil migration.

The following subsections describe the specific elements of each of the RAs.

1.3.2.1 LUCs with MNR

LUCs with MNR is the selected RA for the entire Upper subunit (all nine EAs) and was selected because the remedy is effective in reducing exposure of contaminated media to human receptors and will achieve the RAOs by:

- Preventing contact, removal, or excavation of sediment/soil within the LTR IOU.
- Prohibiting the development and use of property for residential housing, elementary and secondary schools, childcare facilities, and playgrounds.

- Preventing fishing for consumption within the LTR IOU.

Key elements of the LUCs include the following:

- Administrative/Worker Access Controls including Institutional Controls (i.e., administrative measures) and use restrictions for onsite workers as implemented under the Site Use/Site Clearance Program. Other administrative controls to ensure worker safety include work controls/work packages that include worker training, pre-work briefings, and health and safety requirements.

- SRS access controls to prevent exposure to trespassers, as described in the 2013 Resource Conservation and Recovery Act Permit Renewal Application, Volume I, Section F.1, which describes the security procedures and equipment, 24-hour surveillance system, artificial or natural barriers, control entry systems, and warning signs in place at the SRS boundary.

- Signage posted at LTR IOU Upper subunit access points. The *Land Use Control Implementation Plan (LUCIP) for the Lower Three Runs Integrator Operable Unit (Upper Subunit)* (SRNS 2022c) provides figures with the sign locations. Signage includes Access Control Warning and No Unauthorized Fishing wording, as well as a map of the LUC boundary.

For Joyce Branch (EA5), PTSM is present in two locations (Figure 5). EA5 is located interior to the site ~7.2-km (4.5-mi) from the SRS boundary, remotely located from site operations, and is not accessible to the public (i.e., trespassers). To address the PTSM in these locations, more robust LUCs were applied at EA5 in the form of additional signage along the bank near the PTSM locations and the installation of barrier gates across roads leading to the two PTSM locations. For Pond B (EA3), the two PTSM locations (Figure 5) are covered by 5.2-m (17-ft) and 9.1-m (30-ft) of water; therefore, no additional signage or barrier gates were needed to prevent exposure.

The planned locations of the signs and gates were provided in the LUCIP (SRNS 2022c).

The MNR portion of the remedy will be implemented via the MNREP (SRNS 2022b).

1.3.2.2 Excavation, Treatment, and Disposal of PTSM Sediment/Soil

Excavation, Treatment, and Disposal of PTSM Sediment/Soil is the selected RA for EA1. Concentrations of Cs-137 were found above the PTSM threshold at a location adjacent to the access road along the R-Area Discharge Canal. This remedy is estimated to shorten the timeframe for radioactive decay to reach cleanup levels from 290 years to 225 years in EA1 by removing the PTSM at the designated location. Combined with LUCs with MNR, this RA will achieve the RAOs by eliminating potential exposure to PTSM sediment/soil and preventing access.

Key elements of this RA include:

- sampling to delineate the extent of PTSM contamination,
- removal and disposal of vegetation within the contaminated area and access areas,
- excavation of sediment/soil that is contaminated with Cs-137 above the PTSM threshold,
- treatment of the excavated sediment/soil by adding a drying agent prior to shipment,
- disposal in the SRS E-Area Low Level Waste Facility (LLWF), and
- post-excavation sampling to confirm the remaining sediment/soil concentrations of Cs-137 are below the PTSM threshold.

1.3.2.3 Maintain Water in Ponds

Maintain Water in Ponds is the selected RA for Pond B (EA3), PAR Pond (EA6), and Pond C (EA9). Pond C (EA9) is hydrologically connected to PAR Pond (EA6) and maintains an equivalent level with PAR Pond (EA6). The reverse riser structure associated with Pond C (EA9) allows water to flow from Pond C (EA9) into PAR Pond (EA6) using hydraulic pressure to stabilize water elevation between the two ponds. Therefore, the water level in Pond C will be maintained through implementation of this RA at PAR Pond (EA6). Maintaining water in these ponds minimizes access and breaks a direct contact pathway

that limits potential exposure to submerged, contaminated sediment/soil within the ponds. The existing dam structures provide the infrastructure to retain water in the ponds at historically consistent water levels (Figure 4). No additional actions were necessary to implement this portion of the remedy.

1.4 Chronology of Events

A tabular summary of major milestones related to the RA for Upper subunit of the LTR IOU is provided in Table 1. The ROD was signed on December 9, 2021, and announcement of the availability of the document was issued to the public on December 21, 2021. The RA implementation began on January 25, 2023, with initial layout and surveying activities performed by SRNS construction forces in support of the LUCs for the access control gates leading to Joyce Branch. On January 31, 2023, a subcontract was awarded to CTI and Associates to excavate the sediments in R-Discharge Canal that exceed PTSM thresholds for Cs-137 and to install access control gates. The subcontract team included Mathis Landscaping, which cleared the trees to gain equipment access to the R-Area Discharge Canal

Approximately 16 cubic meters (m^3) (21 cubic yards [cy]) of sediment was excavated from the canal. Excavation in the R-Area Discharge Canal was considered complete after return of the confirmation sample results on May 8, 2022. After demobilization, SRNS performed a final acceptance inspection to ensure the safe end state after completion of the subcontractor scope.

A LUCIP (SRNS 2022c) was approved in 2022 for the installation of warning signs at access points to the LTR canal and pond system and gates at access points to Joyce Branch for two areas where sediment was found to be contaminated above the PTSM threshold. Fifty-five warning signs and two gates were installed in accordance with locations identified in the LUCIP (Figure 7). As-builts of the signs and access gates were prepared (See Appendix A).

2.0 PRE-CONSTRUCTION ACTIVITIES

Sediment sampling was conducted in the R-Area Discharge Canal to delineate the extent of PTSM per the Field Sampling Plan (FSP) provided as Appendix B of the RAIP (SRNS 2022a). The sampling activity, conducted in August 2022, was along the perimeter of the initial excavation boundary with step-out sample locations along transects as shown in Figure 8. Samples were collected from all step-out locations and sent for laboratory analysis at General Engineering Laboratory (GEL) and Test America Laboratories (TAL), certified laboratories. Cs-137 was detected above the PTSM threshold (144 pCi/g) in only one sample location, TSE-01, at 195 pCi/g. The Cs-137 results from the other 20 sample locations ranged from 0.665 to 138 pCi/g. Table 2 provides the Cs-137 results from all sampling locations.

The minimum excavation area was expanded beyond the TSE-01 sample location, the southeastern corner, for a total area of approximately 46.5 m^2 (500 ft^2) (Figure 9). SRNS site survey staked the boundaries of the expanded excavation area with PVC pipe and wood posts.

3.0 CONSTRUCTION ACTIVITIES

3.1 Construction Team

SRNS provided project management, oversight, wetland inspections, confirmation sampling, worker protection, regulatory integration, and warning sign installation. Waste management support, waste transportation, and radiological protection were provided by SRNS personnel.

The prime contractor responsible for excavation of sediments within the R-Area Discharge Canal and the installation of enhanced LUCs, access control gates leading to Joyce Branch, was CTI and Associates. A sub-tier contractor, Mathis Landscaping, cleared trees adjacent to the R-Area Discharge Canal near the excavation area.

Samples to define the extent of excavation and confirmation samples were analyzed by GEL and TAL.

3.2 Equipment

Table 3 identifies the general equipment types used during remedy implementation. Photos of several pieces of equipment are provided in Figure 10.

3.3 Remedial Action Implementation

The following provides a summary of construction activities performed during the RA. The excavation area within the R-Area Discharge Canal was outlined with PVC pipes and wooden stakes based on the delineation from sample results as described in Section 2.0.

3.3.1 Pre-Mobilization and Mobilization Activities

Survey of the access control gate locations was performed by SRNS personnel using ground penetrating radar (GPR). Areas were marked to allow for excavation for the access control gate support posts.

Initial land clearing was performed to allow access to the R-Area Discharge Canal and to establish a working platform for the excavator. Trees were cut above grade and pushed to the side. No grubbing was performed so there was minimal disturbance to the soil. Filtrexx Siltsoxx® was used as the edge of the canal to mitigate migration of soil to the canal (Figure 11).

The subcontractor prepared an access path and working platform along the bank of the canal consisting of a non-woven geotextile fabric covered by approximately 12 loads of stone (rip rap and #57 stone). The platform has approximate dimensions of 30 ft by 40 ft to permit parallel tracking along the excavation footprint.

A laydown area was established for the roll off container parking, general parking, and material storage. The access road was barricaded to control access to the work area.

Radiological Protection Department (RPD) personnel surveyed all equipment prior to entering and leaving the site. Radiological surveys were performed as needed when equipment of personnel came in contact with the sediment within or along the bank of the R-Area Discharge Canal.

3.3.2 R-Area Discharge Canal Sediment Excavation

The trees were cut above ground surface and left in the area, beyond the perimeter of the equipment assess area. After tree clearing, erosion and sediment control features were placed along the bank of the R-Area Discharge Canal and a working platform was constructed using a geotextile fabric and stone. The working platform allowed for the equipment to maneuver parallel to the canal. Within the canal, a turbidity barrier (silt curtain) was installed prior to any other disturbance within the water. The turbidity barrier was installed just downstream of the excavation area.

A track mounted excavator was used to gently push vegetation within the canal to clear a pathway for the installation of a temporary cofferdam. The cofferdam was constructed using water filled bladders, also known as aqua barriers. The aqua barriers were rolled in place in a U-shape around the excavation area and extending to the bank of the canal. The aqua barriers were filled/inflated with water from the canal using two 3-inch trash pumps. Once fully inflated, the water within the cofferdam/aqua barriers was pumped out and discharges were within the canal upstream of the turbidity barrier. Filter socks were used on the discharge side of the pumps to mitigate sediment displacement.

Once the water was pumped out and the sediment was exposed, Waste Lock 770 was applied to the sediment as a treatment. The Waste Lock 770 absorbs the free liquid and stiffens the sediments to allow excavation within the boundaries. The sediment was placed in 0.7 m^3 (1 cy) multi-layer bags that contained small amounts of Waste Lock 770 and then the bags were placed in a lined roll-off container. Approximately 16 m^3 (21 cy) of sediment was excavated from the canal.

Two composite samples of sediment were collected from five random locations within the excavation area. The samples were analyzed at two different laboratories. All sample results were below the PTSM threshold of 144 pCi/g for Cs-137.

The roll off containers were covered to prevent rainwater infiltration and then staged in a paved parking area near the former entrance to the R-Area reactor perimeter fence. After

the project was completed, the roll off pans were shipped to the SRS LLWF in E-Area for disposal.

Excavation in the R-Area Discharge Canal was considered complete after return of the confirmation sample results on May 8, 2022. After demobilization, SRNS performed a final acceptance inspection to ensure the safe end state after completion of the subcontractor scope.

Prior to any vegetation disturbance, dewatering, or excavation activities, a turbidity barrier (silt curtain) was installed in the R-Area Discharge Canal, downstream of the excavation area to mitigate sediment migration. The turbidity barrier met the criteria as required for the Department of Transportation Type 1. The turbidity barrier contains a PVC coated floatation at the top with a weighted curtain that rests on the canal floor. The turbidity barrier was installed manually across the length of the canal (Figure 12).

3.3.2.1 R-Area Discharge Canal Dewatering Activities

The subcontractor's excavation plan, approved by SRNS, included dewatering a portion of the canal, exposing the sediments to be excavated, treating the sediments with a drying agent, and then excavating the contaminated media. The dewatering was achieved by installing a temporary cofferdam constructed of water filled bladders, also known as aqua barriers. Three aqua barriers were placed in a U-shape configuration to contain the area to be excavated. Manufacturer recommendations were followed to place the aqua barriers in a sequence that allows overlapping of the barriers in an alternating pattern. This pattern is required to keep the bladders secured in place. Because the bottom surface of the canal is sloped toward the middle of the canal, additional supports were added to prevent the aqua barrier that was parallel to the bank from rolling into the excavation area. The aqua barriers were filled with canal water using two trash pumps. The suction side of the pumps were exterior to the U-shape cofferdam (see Figure 12).

Once the aqua barriers were fully inflated, the excavation area was dewatered by pumping water from the interior of the cofferdam to the canal outside of the aqua barriers, but

upstream of the turbidity barrier. Filter socks were used on the discharge lines to mitigate sediment migration during dewatering (see Figure 13).

3.3.2.2 Treatment and Excavation of R-Area Discharge Canal Sediments

Following dewatering, the exposed sediments within the excavation area were treated by applying a drying agent, Waste Lock 770. The drying agent reduced the free liquids and helped to stiffen the sediments for easier excavation. Sediments and the drying agent were excavated from within an approximate 46.5 m^2 (500 ft^2) area. Sediments were excavated to a depth of approximately 0.3 m (1 ft) (see Figure 14 and Figure 15).

Waste Lock 770 was placed in the bottom of waste disposal sacks prior to adding the sediment. The excavated sediments were placed in 0.8-m^3 (1-cy) sacks. A total of 21 waste disposal sacks were used. The sacks were then loaded into a lined roll-off container. Covers were placed on the roll-off containers at the end of each day and once a roll-off container was full.

3.3.2.3 Confirmation Sampling

After excavation of approximately 0.3 m (1 ft) of sediment, SRNS personnel, assisted by the subcontractor, collected a composite sediment sample from five locations within the 46.5 m^2 (500 ft^2) excavation area. SRNS personnel packaged the sample in several containers and shipped the samples to GEL and TAL for Cs-137 analyses (see Figure 16).

The maximum Cs-137 results from GEL and TAL were 141 pCi/g and 109 pCi/g, respectively, below the PTSM threshold (144 pCi/g). All confirmation sample results are provided in Table 5.

3.3.2.4 Demobilization from the R-Area Discharge Canal

Because the analytical results from the confirmation samples were below the PTSM threshold, excavation activities were considered complete, and the subcontractor began site restoration and demobilization. The temporary cofferdam was dismantled by pumping the water out of the aqua barriers into the canal upstream of the turbidity barrier and then

cutting the aqua barriers to facilitate removal (Figure 17). The aqua barrier material was placed in the lined roll off pans for disposal as low-level waste.

The stone area adjacent to the R-Area Discharge Canal was graded to an approximate 3 to 1 slope and the stone was left in place (Figure 18). RPD personnel performed radiological scans on the equipment and released the equipment for transportation offsite.

3.3.3 Access Control Gates and Warning Signs

The subcontractor installed two access control gates across the roads leading to Joyce Branch (Figure 19) where two sample locations had reported concentrations of Cs-137 in the sediment above the PTSM threshold (144 pCi/g). The access control gates are not locked but are secured with a chain and a warning sign was placed on each gate to prevent unauthorized access to Joyce Branch.

SRNS construction personnel installed 51 signs along access points to the Ponds and canals associated with the Upper Subunit of the LTR IOU. This includes two signs that were installed along the bank of Joyce Branch as an additional warning to prevent access to the sediment where Cs-137 concentrations were detected above the PTSM threshold (144 pCi/g). A total of 55 signs were installed in the Upper subunit including the signs installed on the four access control gates. A photo of a typical sign is provided in Figure 20. Figure 21 provides the locations of LUC boundary and all access control signs and gates.

3.3.4 Secondary Waste Disposal

Waste management (handling and disposal) and transportation of construction generated wastes have met the requirements of Federal and State regulations and applicable SRS manuals and procedures. Site generated waste including sediment, aqua barrier, support posts, personal protective equipment, Job Control Waste, etc. was disposed of as low-level radioactive waste (Figure 22). SRNS provided the waste containers, transportation, and disposal of all waste (Figure 22). Table 4 provides the waste volumes resulting from the R-Area Discharge Canal RA.

4.0 DEVIATIONS FROM ORIGINAL DESIGN

Table 6 provides a summary of the deviations from the design as described in the RAIP and includes the basis and resolution of deviations from the original design. The deviations from the original design occurred during the pre-construction activities to determine the extent of PTSM in the sediment. The project team reviewed all changes prior to implementation to ensure compliance with regulatory requirements in the ROD and the RAIP. Consistent with the RAIP, notifications were made to U. S. Environmental Protection Agency (USEPA) and South Carolina Department of Environmental Services (SCDES) as appropriate.

5.0 VERIFICATION SAMPLING, TESTING AND ANALYSIS, PERFORMANCE STANDARDS, AND CONSTRUCTION QUALITY CONTROL

To ensure the performance requirements and standards were achieved, project team personnel comprised of SRNS Engineering, Project Management, Safety, and Subcontract Technical Representatives performed routine monitoring/surveillance activities. SRNS Engineering performed routine field oversight, verification of confirmation sampling results, sampling data management, and evaluation and acceptance of the analytical results.

5.1 Confirmation Sampling

Confirmation sampling was performed in accordance with the FSP that is included as Appendix B of the approved RAIP (SRNS 2022a). After excavation of sediment within the excavation boundary was complete, SRNS collected a composite sample of the remaining sediment. The composite sample consisted of sediment collected from five different locations within the 500 ft^2 limits of excavation. The composite sample was divided into four containers and sent to two offsite laboratories: GEL and TAL. The samples were analyzed for Cs-137 and all results were below the PTSM threshold of 144 pCi/g.

Table 5 provides a summary of the data returned from the two laboratories for the confirmation sample.

6.0 VERIFICATION OF CONSTRUCTION COMPLETION AND FINAL INSPECTION

6.1 Verification of Construction Completion

Per Section 4.0, construction activities have met the acceptance criteria established in the RAIP (SRNS 2022a).

SRNS inspections were held with the subcontractor to review punch list items that were developed to ensure that the end state of the ash excavation project area met the criteria of the design requirements. A final acceptance inspection for the R-Area Discharge Canal excavation and access gate installation was held on May 25, 2023, and SRNS approved the site conditions. A final acceptance inspection for the LUC access warning sign installation was held on July 17, 2023, and SRNS approved the site conditions.

6.2 Final Inspection

The regulators agreed that the February 28, 2024, viewing of the drone flyovers constituted the final walk down inspections for the Upper subunit of the LTR IOU. Final inspection was with the participation of USDOE, USEPA, and SCDES after completion of the excavation and installation of the LUC warning signs.

7.0 AS-BUILT DOCUMENTATION

7.1 As-Built Drawings

As-Built documentation for the LUC access control signs and gates is provided in Figure 7. The LUC boundary has been established as shown in Figure 21. The survey plat of the area subject to LUCs is provided in Appendix B.

7.2 Well Modifications

No monitoring wells were installed or modified as part of this RA.

8.0 POST-CONSTRUCTION ACTIVITIES

The final portion of the selected RA for the Upper subunit (all nine EAs) of the LTR IOU is LUCs with MNR and maintain water levels in EA3, EA6, and EA9. MNR is a remedy that uses ongoing, naturally occurring processes to reduce the bioavailability or toxicity of contaminants in sediment/soil (e.g., radiological decay). Monitoring of these processes will continue in the form of aerial gamma surveys and ground truthing via the collection of sediment/soil samples. Bioavailability of Cs-137 and Hg will be assessed via fish monitoring and sampling of pond systems that maintain fishable populations (EA3, EA6, and EA9). Results of the monitoring efforts will be presented in the five-year remedy reviews and will be used to document the effectiveness of the MNR component of the RA. The scope of continued monitoring to support the five-year remedy reviews will be re-evaluated after Cs-137 activities in the Upper subunit of the LTR IOU decay below the PTSM threshold (144 pCi/g) (SRNS 2022b). This is expected to be most evidenced in Joyce Branch where PTSM gamma signatures have been previously observed. MNR will also be re-assessed as technological advancements occur over time, based on results of sampling or gamma overflight data, or if environmental conditions change necessitating a modification to the existing MNREP (SRNS 2022b).

LUCs will be necessary at all nine EAs. As presented in Section 4.7 of the approved LUCIP (SRNS 2022c), the LTR IOU will be inspected per the Field Inspection Checklist in Appendix C every five years. Additional inspections may be necessary in the event of unusual weather or any other condition warranting inspection. For the LTR IOU, inspections will be performed to ensure that access signs are in place and are legible, all gates are in place and in working order, and any evidence of trespassing is documented and reported. Water levels in PAR Pond and Pond B are monitored and maintained by SRS Site Services Dam Operations. Five-year remedy reviews are required to document the effectiveness of the LUCs.

9.0 PROJECT COSTS

The estimated capital costs for the excavation, treatment, and disposal of sediments from the R-Area Discharge Canal and the installation of LUC access warning signs and gates are provided in Table 7.

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10.0 REFERENCES

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

SRNS, 2013. *Removal Action Report for the Lower Three Runs Integrator Operable Unit Tail Portion (Middle and Lower Subunits (U)*, SRNS-RP-2013-00003, Rev. 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (October).

SRNS, 2017. *Remedial Investigation/Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U),* SRNS-RP-2017-00139, Rev.1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

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SRNS, 2022a. *Remedial Action Implementation Plan for the Lower Three Runs Integrator Operable Unit (U)*, SRNS-RP-2022-00011, Rev. 1, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken SC (August).

SRNS, 2022b *Monitored Natural Recovery Effectiveness Plan for the Lower Three Runs Integrator Operable Unit – Upper Subunit (U),* Revision 1, SRNS-RP-2022-00085, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC (August).

SRNS, 2022c. *Land Use Control Implementation Plan for the Lower Three Runs Integrator Operable Unit (Upper Subunit) (U),* Revision 1, SRNS-RP-2022-00017, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC (August).

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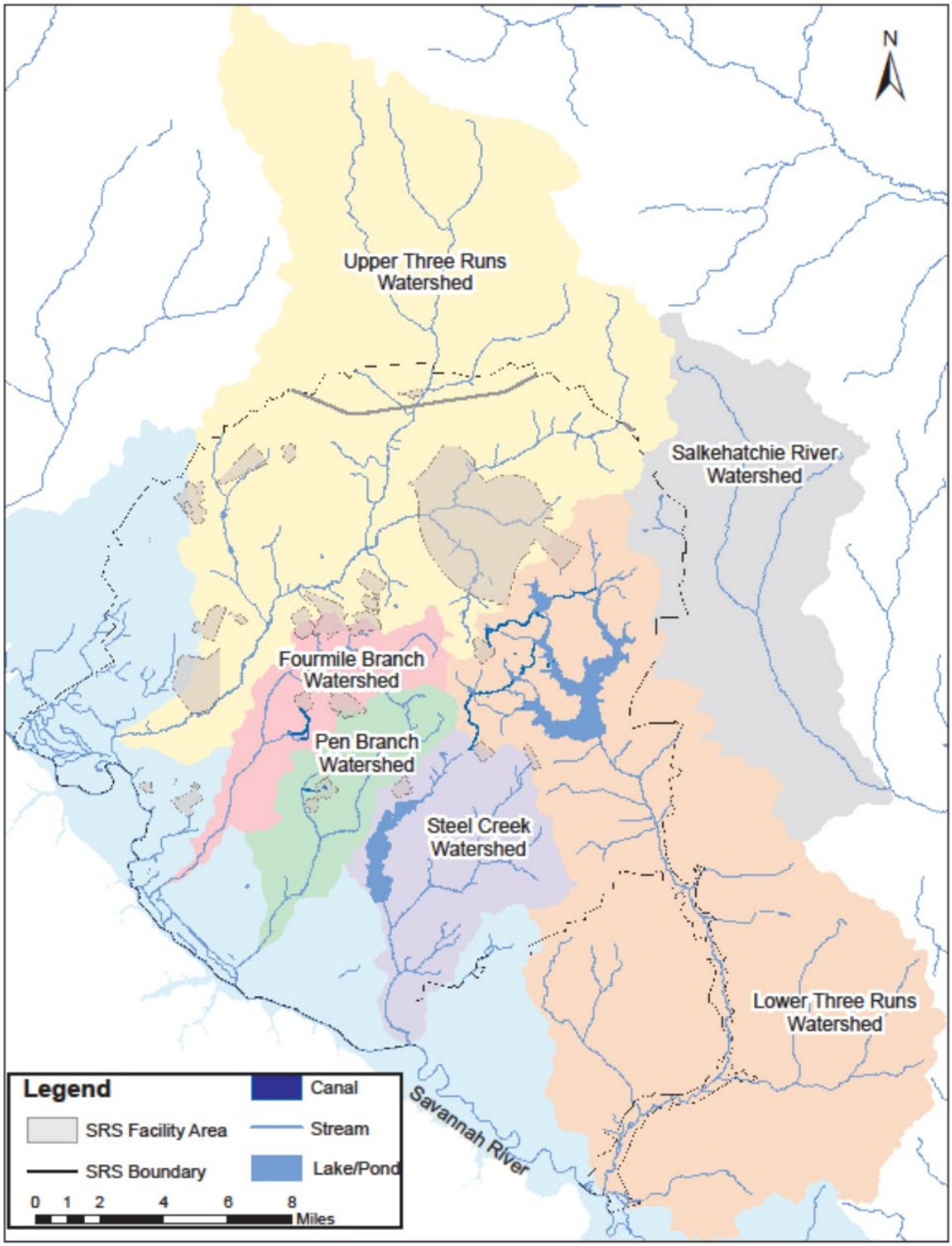

Figure 1. Location of the LTR IOU Watershed

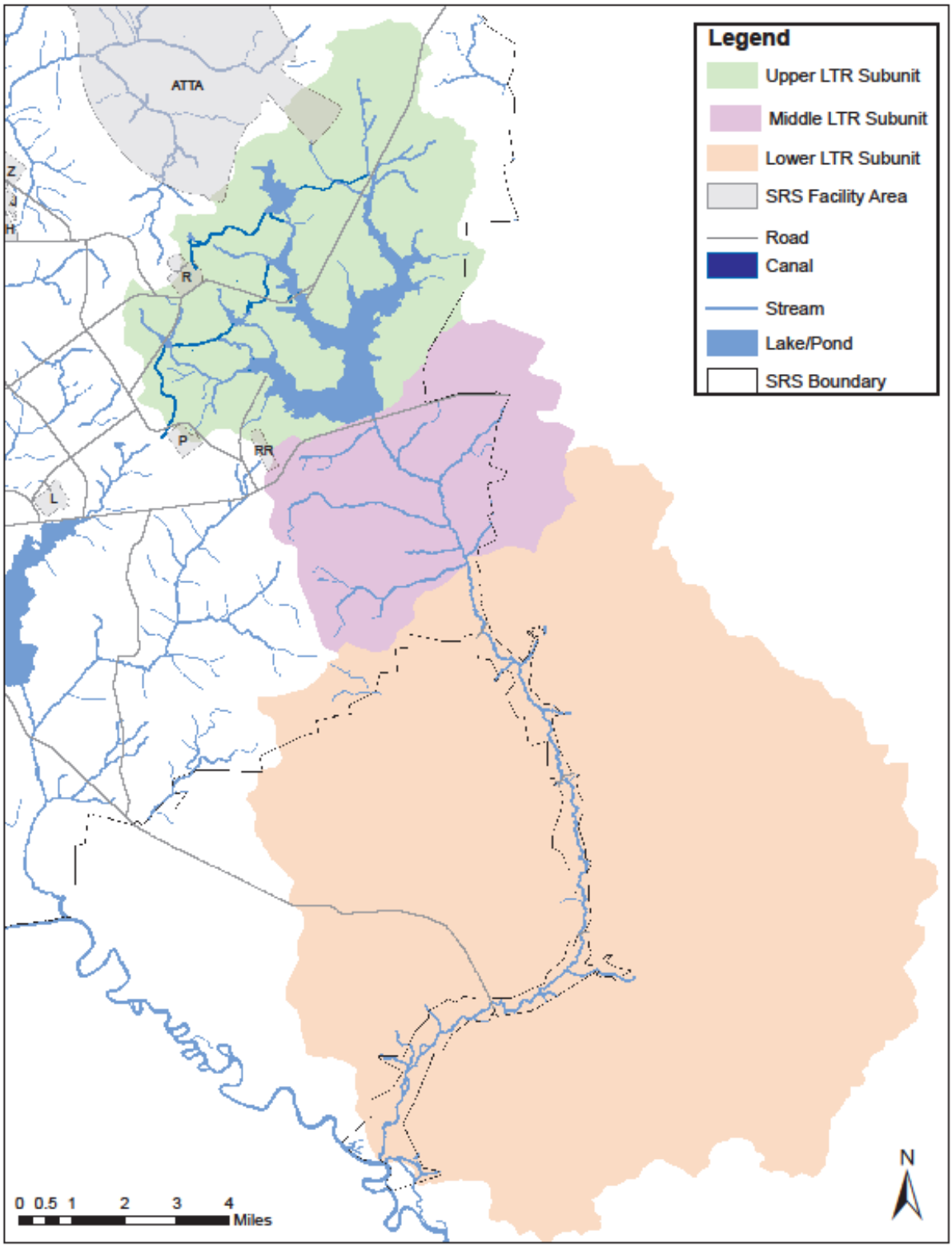

Figure 2. LTR IOU Subunits

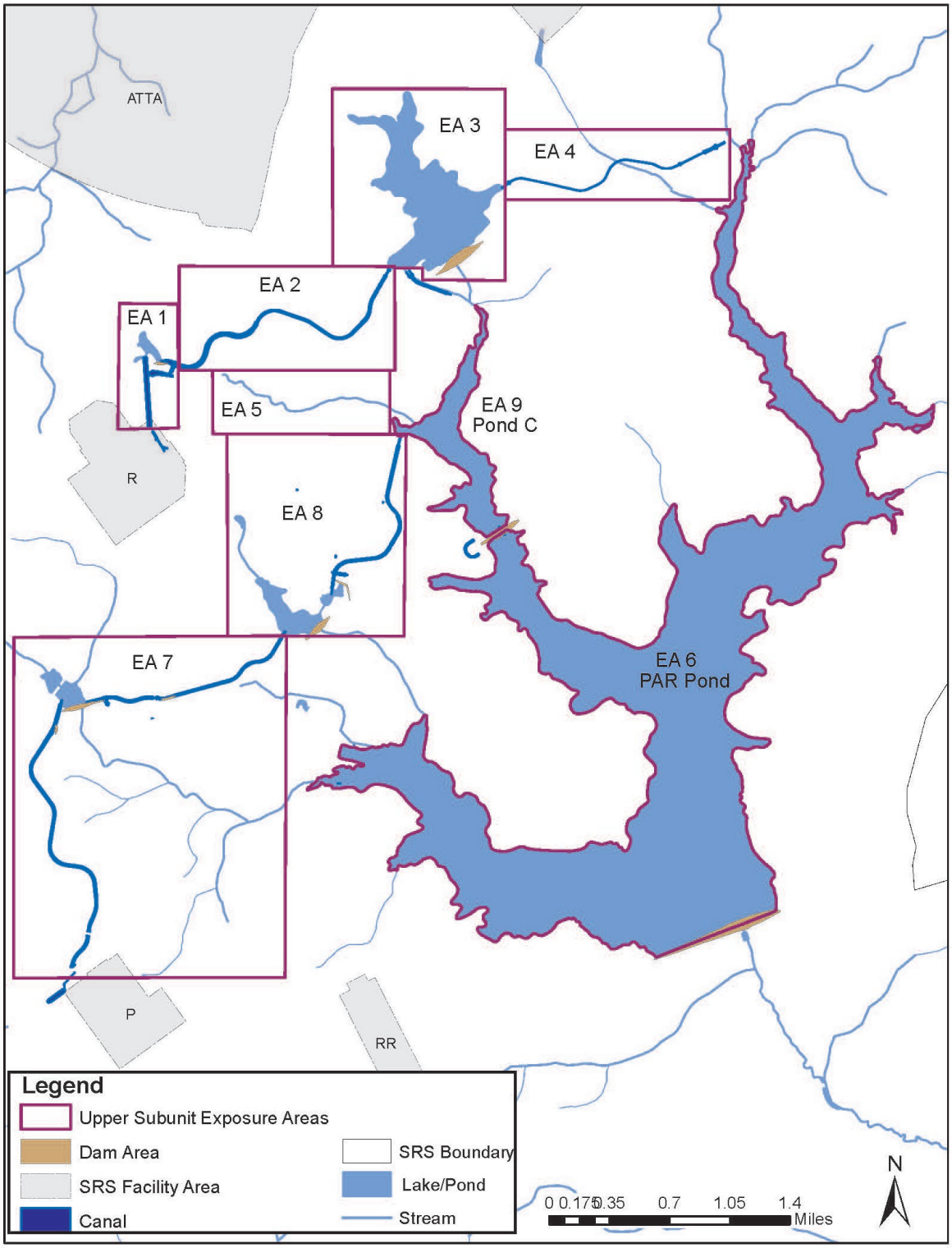

Figure 3. Exposure Areas of the Upper Subunit of the LTR IOU

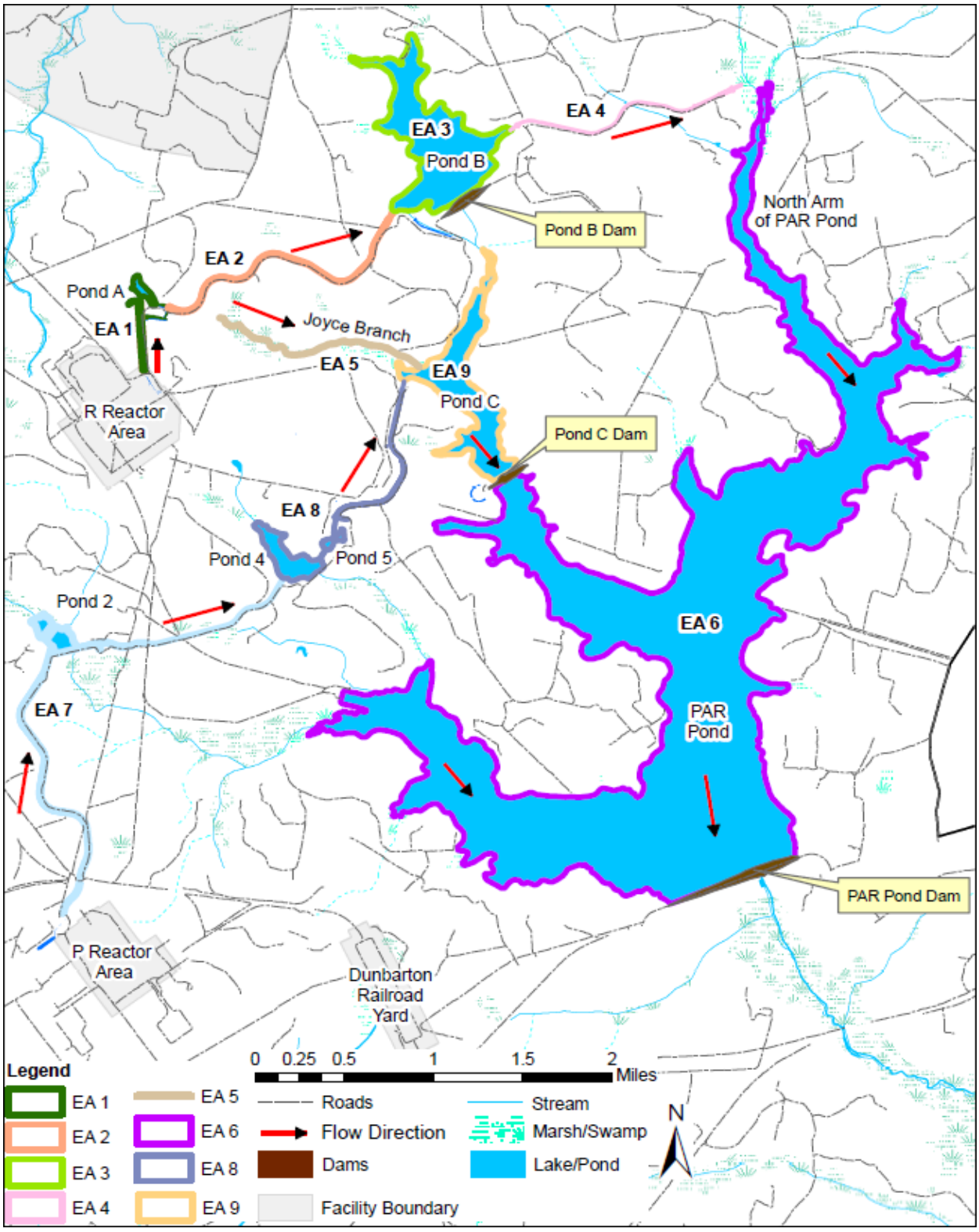

Figure 4. PAR Pond, Pond B, Pond C Dams

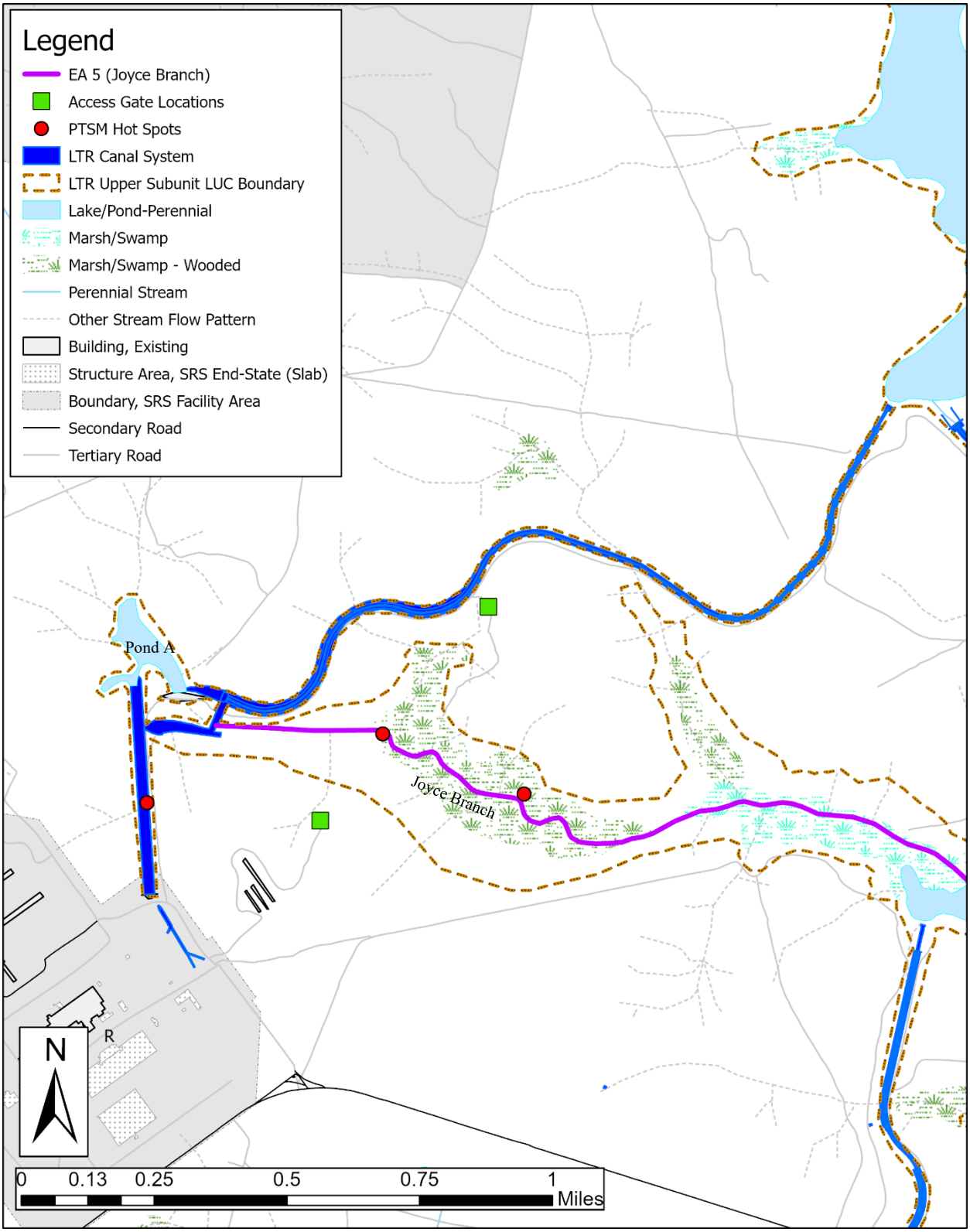

Figure 5. PTSM Locations in R-Area Discharge Canal (EA1) and Joyce Branch (EA5) in the Upper Subunit of the LTR IOU

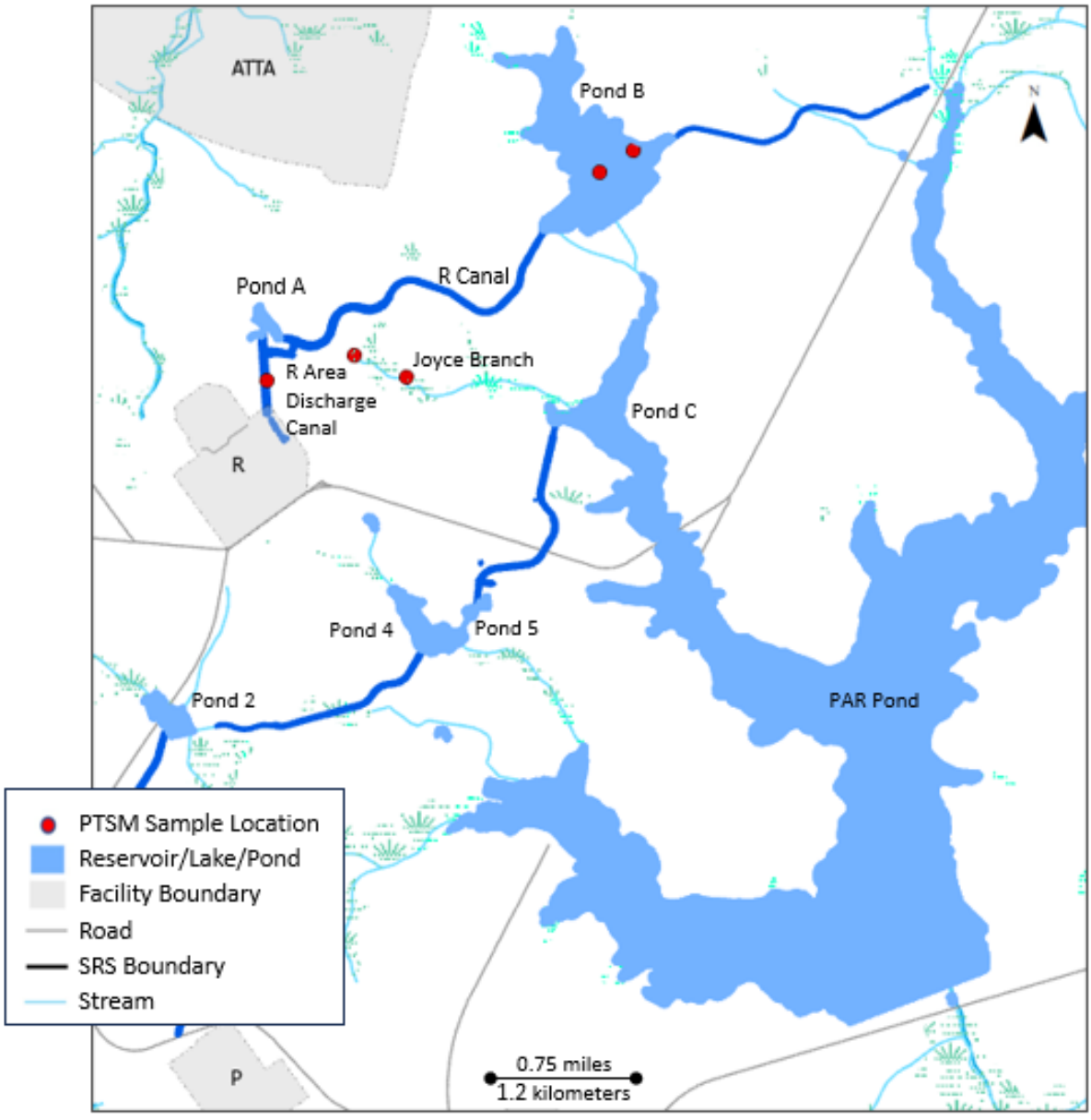

Figure 6. PTSM Locations in Pond B (EA3) in the Upper Subunit of the LTR IOU

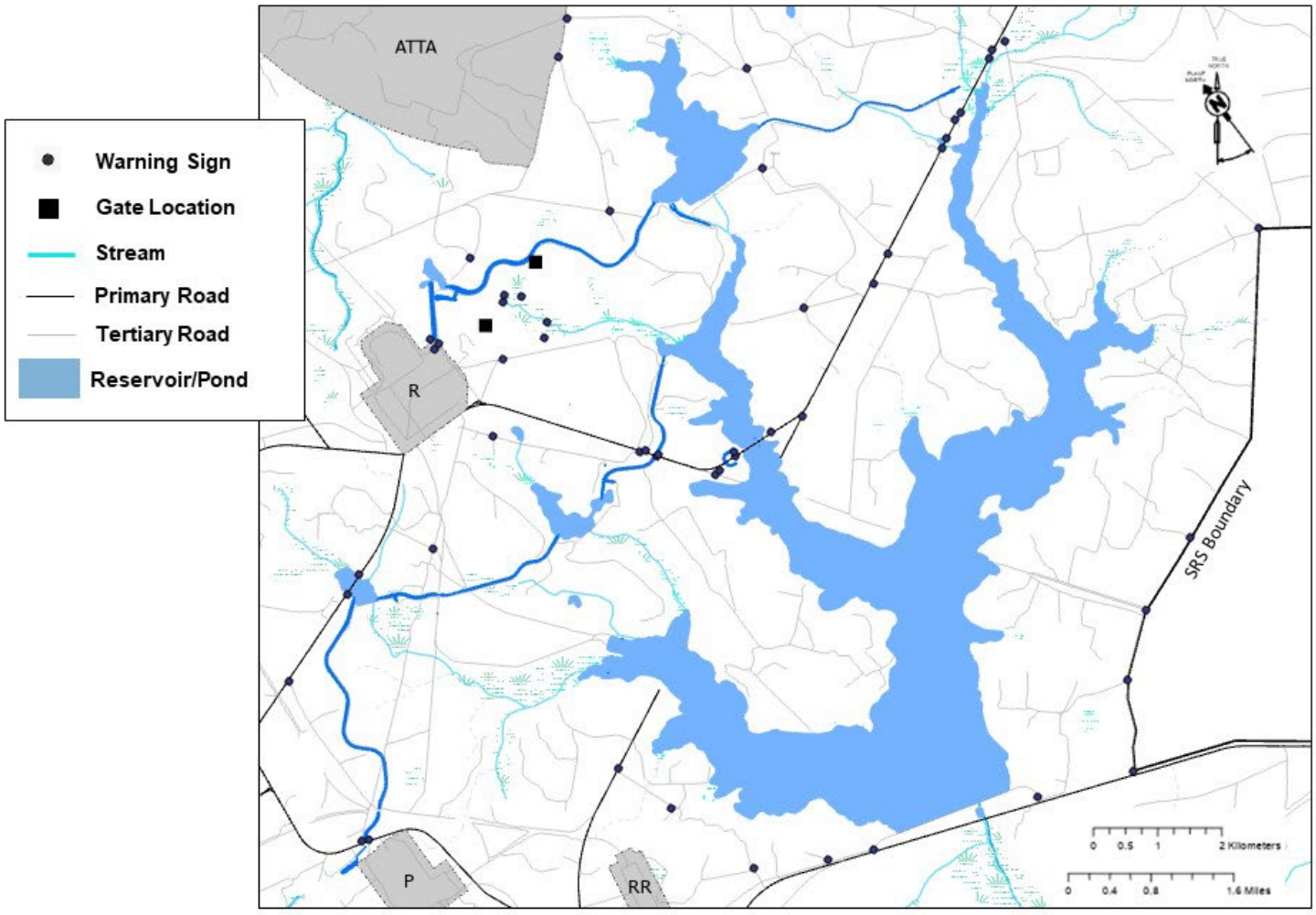

Figure 7. Land Use Control Warning Signs

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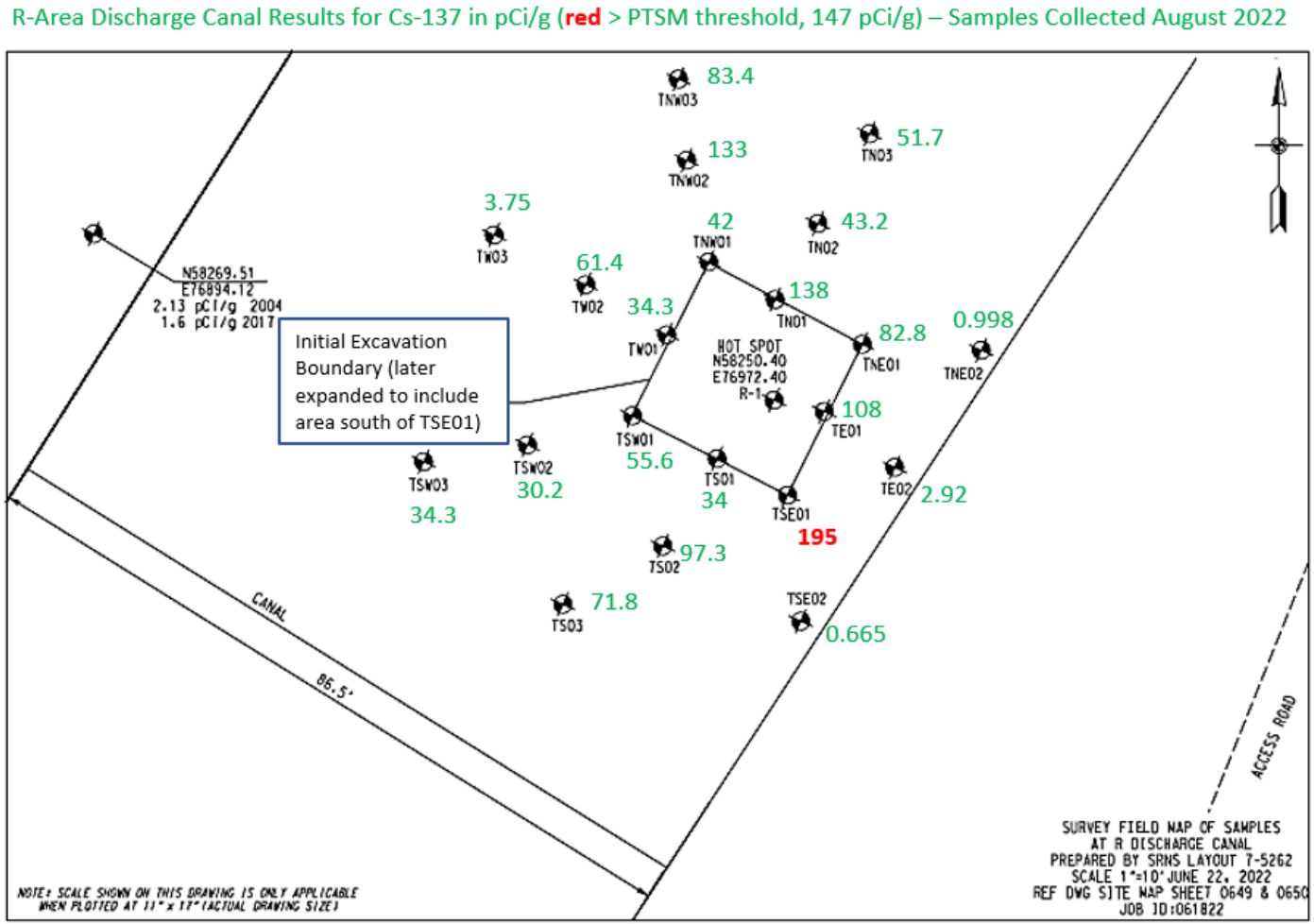

Figure 8. Pre-Excavation Sampling to Determine the Limits of Excavation

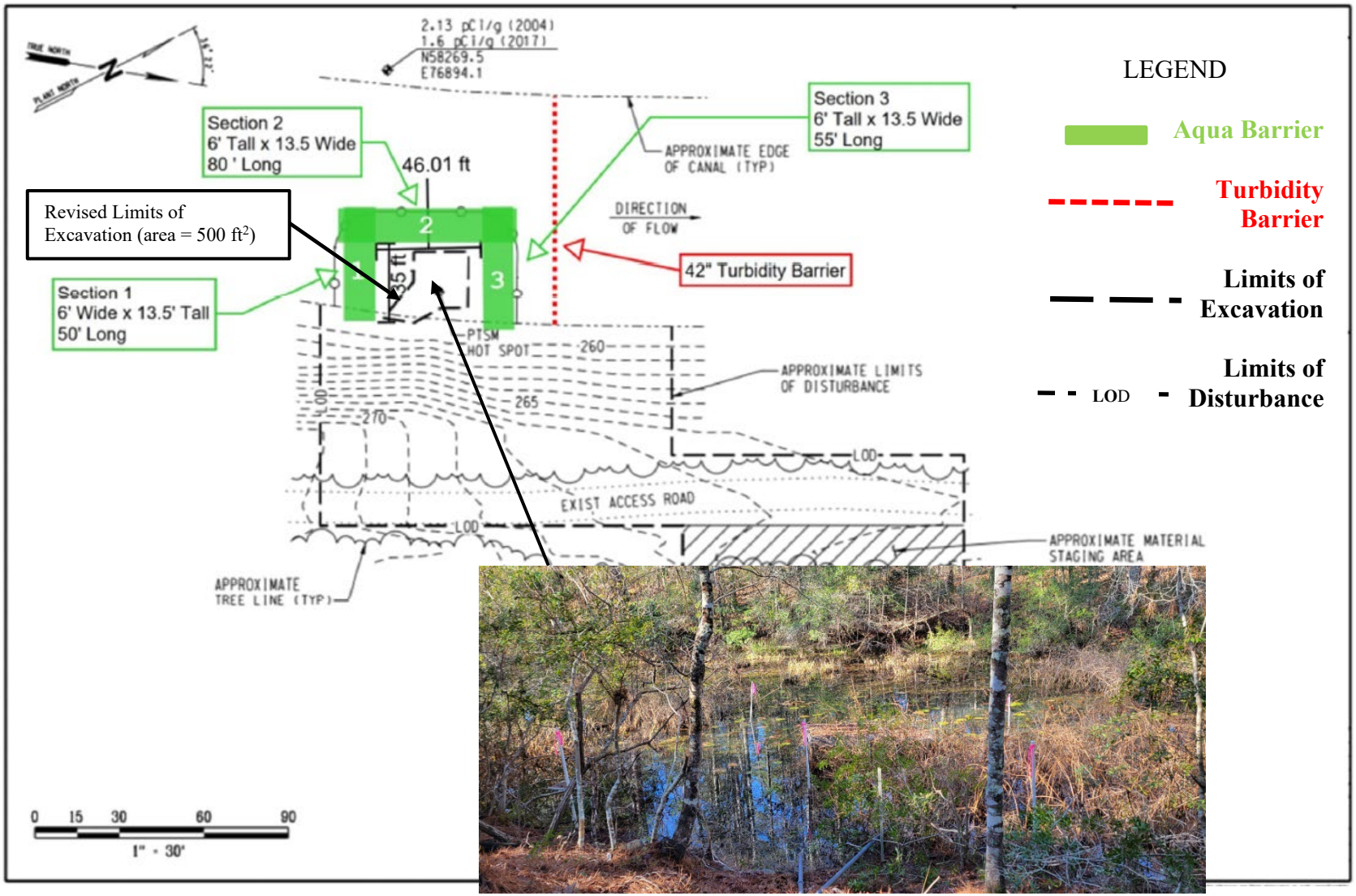

Figure 9. Revised Limits of Excavation and Excavation Design

Figure 10. Photos of Equipment - Telehandler

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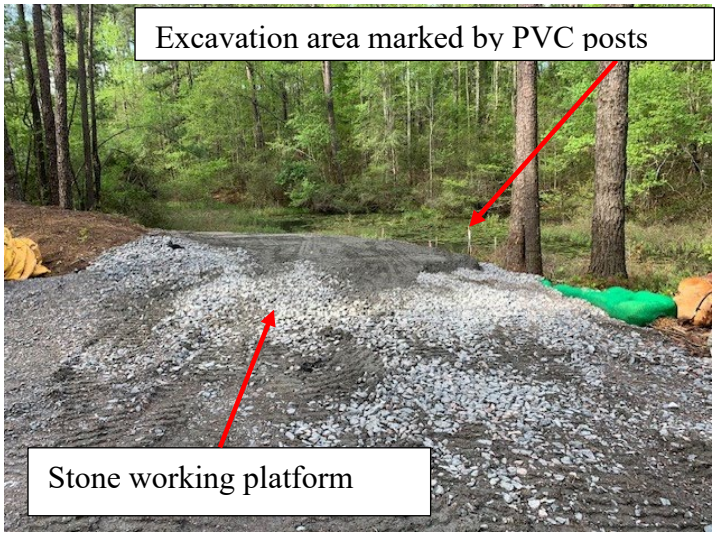

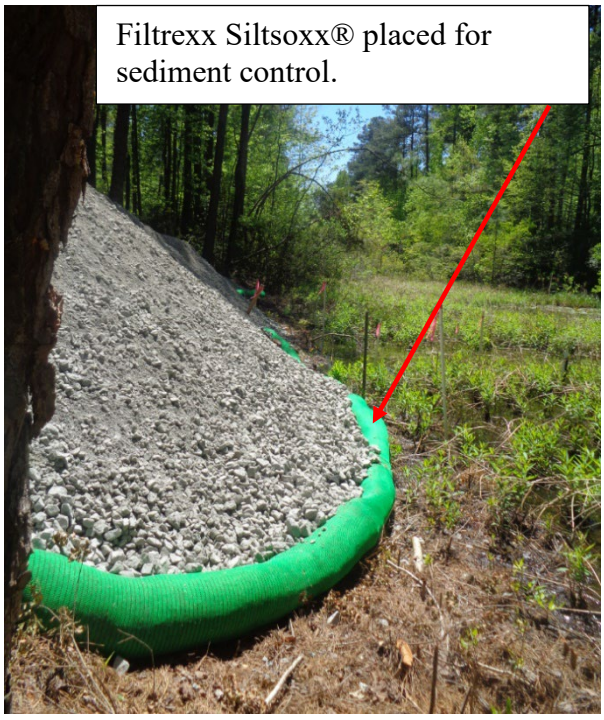

Figure 11. Tree Clearing and Placement of Stone for Working Platform

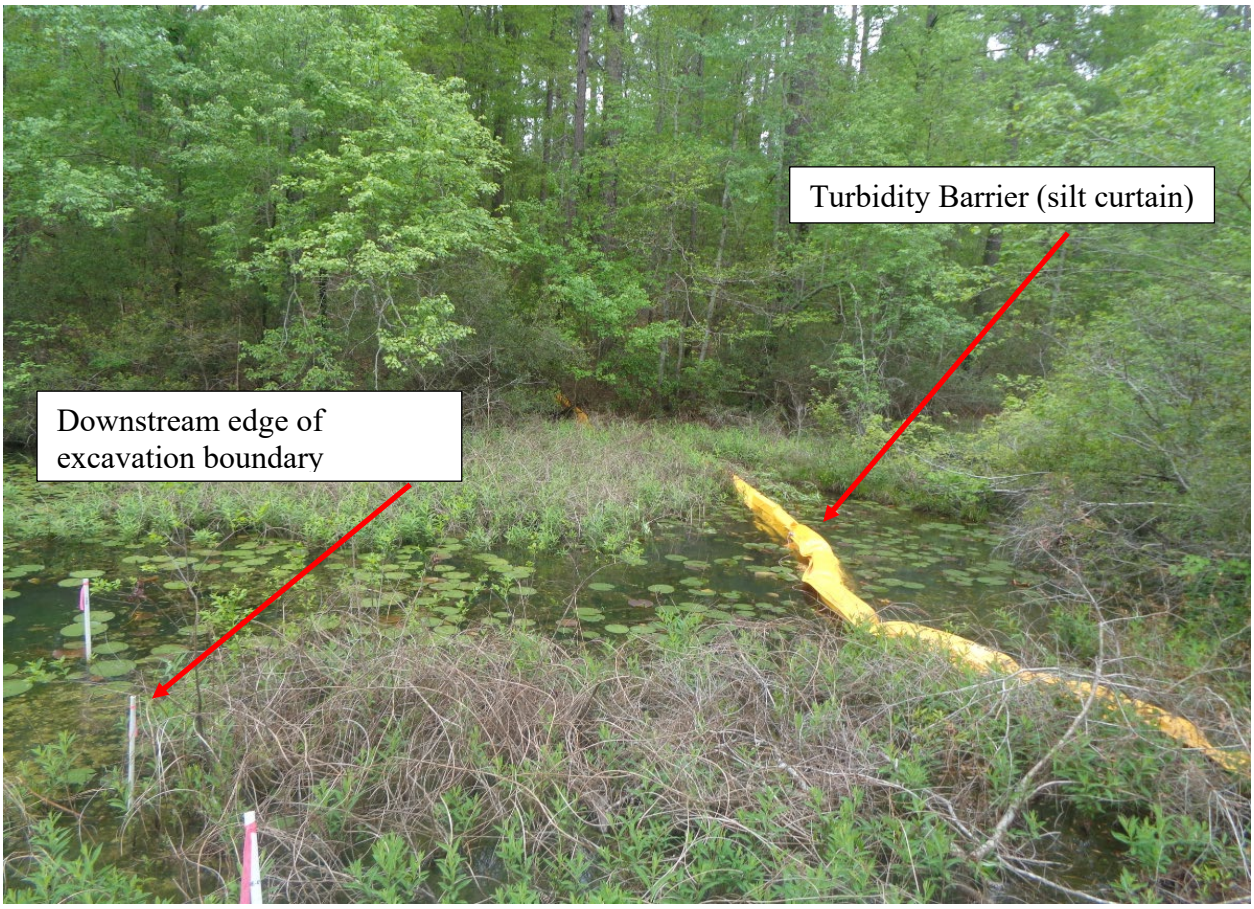

Figure 12. Turbidity Barrier Downstream of Excavation Area

Aqua Barrier Layout Prior to Inflation

Aqua Barriers Inflated with Canal Water

Figure 13. Cofferdam Construction Using Aqua Barriers

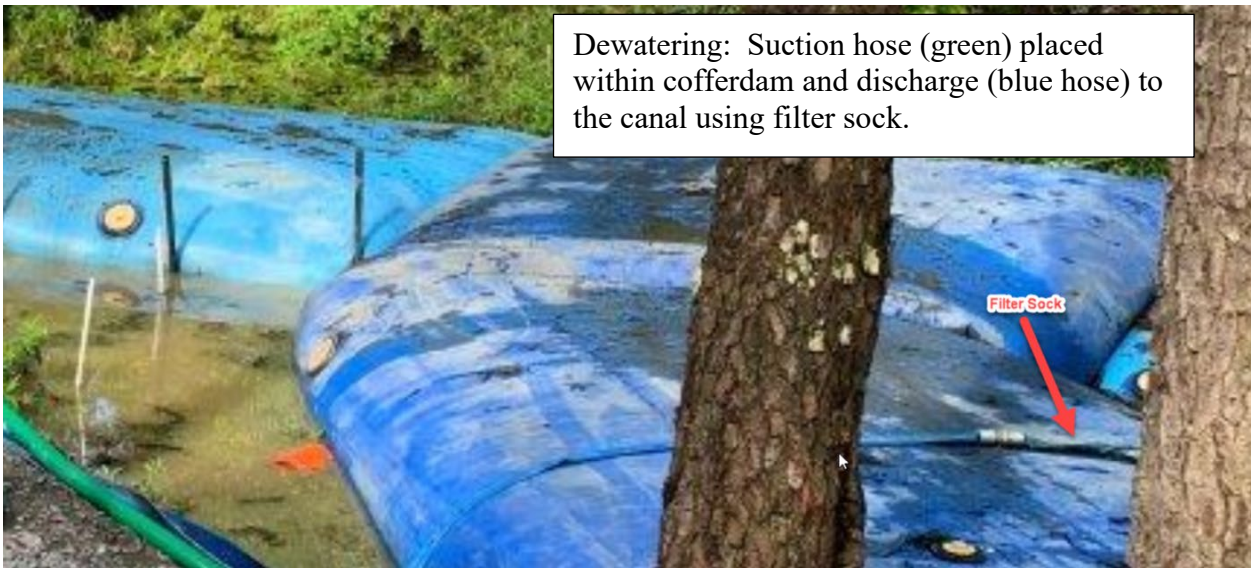

Figure 14. Dewatering of Excavation Area and Treatment of Sediments

Figure 15. Excavation of R-Area Discharge Canal Sediments

Figure 16. Confirmation Sampling

Figure 17. Demobilization Activities and Removal of Aqua Barrier

Figure 18. Final Grading and Final Acceptance Inspection

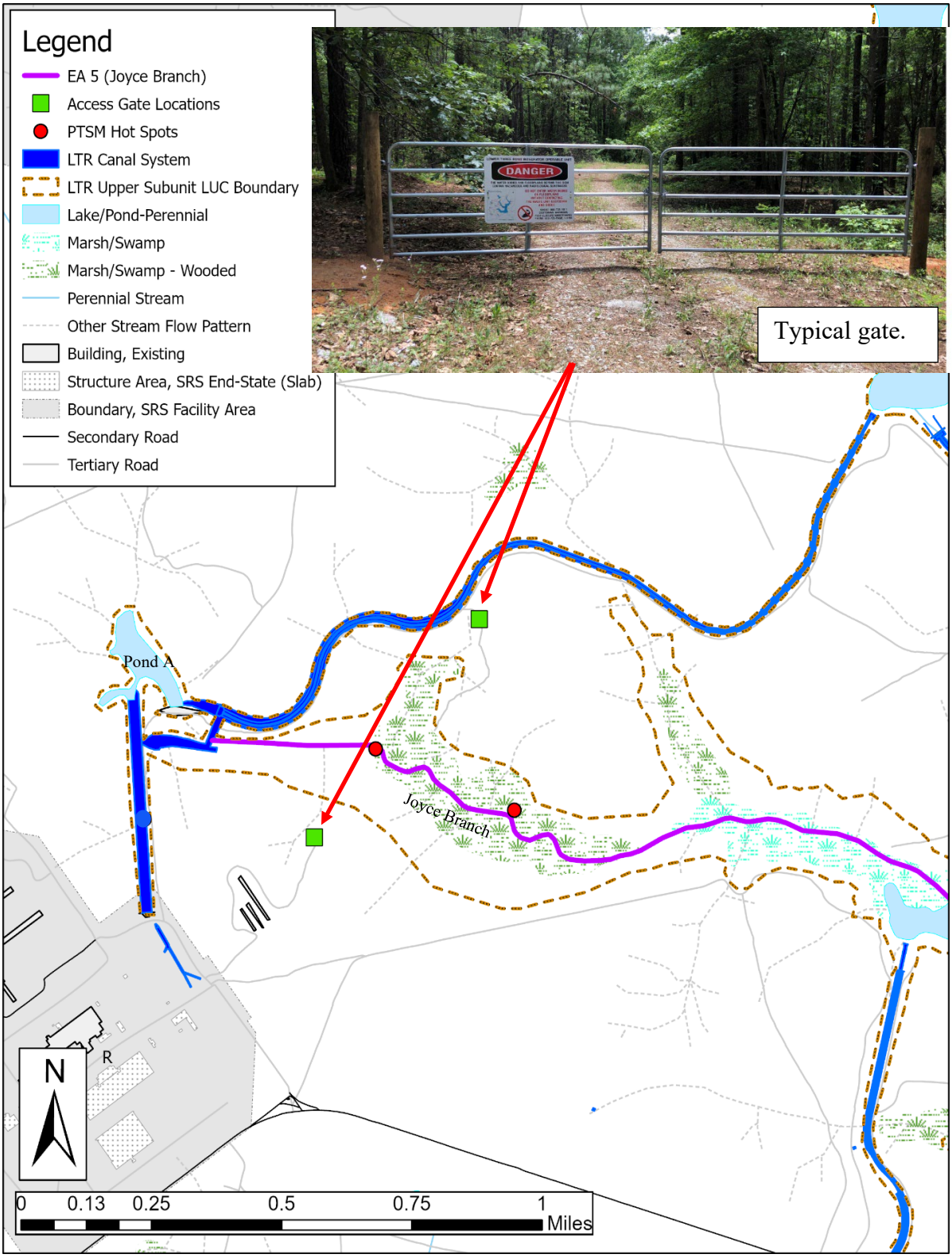

Figure 19. Access Gates Installed Near Joyce Branch (typical)

51 Signs were installed on posts at access points to the LTR IOU waterbodies and floodplains.

4 Signs were installed on gates: 2 at access points to the LTR IOU waterbodies and floodplains.

Figure 20. Access Control Warning Signs (*typical)*

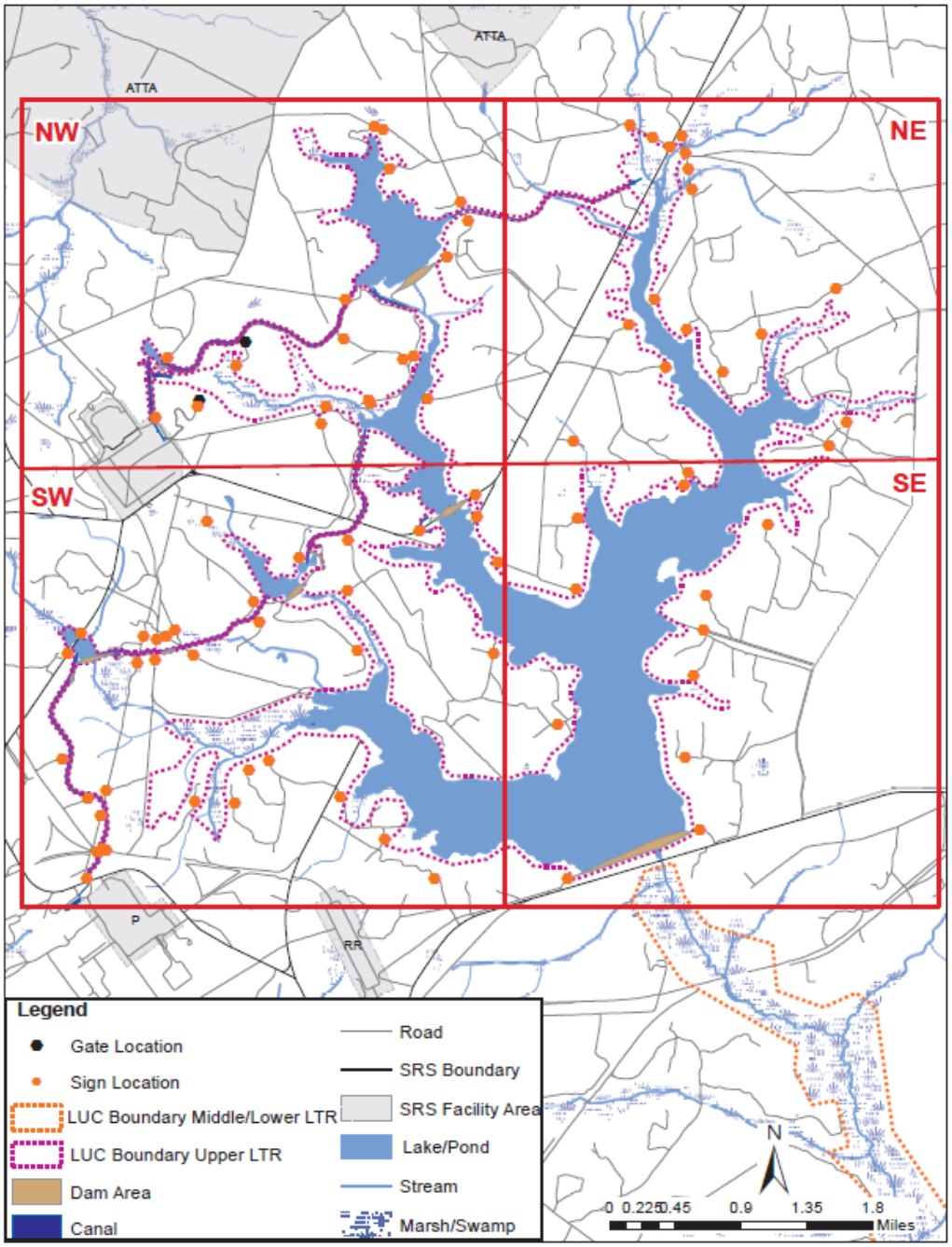

Figure 21. Land Use Control Boundary, Warning Signs, and Gate Locations

Figure 22. Disposal Containers

Table 1. Chronology of Events

Description of Activity	Start Date
ROD (SRNS 2018a) signed	December 9, 2021
Sampling to determine PTSM extent in R-Area Discharge Canal	August 9, 2022
GPR survey and layout for access control gates leading to Joyce Branch (RA Start) performed by SRNS	January 25, 2023
Initial survey for LUC signs	January 30, 2023
Subcontract Award to CTI for R-Area Discharge Canal Excavation and access control gate installation	January 31, 2023
Pre-job brief held with subcontractor for R-Area Discharge Canal	March 27, 2023
Subcontractor (Mathis) began clearing trees adjacent to R-Area Discharge Canal	March 29, 2023
Erosion control features installed on the R-Area Discharge Canal bank and stone placed for working platform.	April 5, 2023
Access gate installation near Joyce Branch completed	April 10, 2023
Turbidity barrier/silt curtain installed in canal downstream of excavation area in R-Area Discharge Canal	April 13, 2023
Aqua barrier (cofferdam) installation began in R-Area Discharge Canal	April 26, 2023
Aqua barrier inflation (with canal water) complete in R-Area Discharge Canal	April 27, 2023
Excavation area dewatered in R-Area Discharge Canal	May 1, 2023
Excavation of sediment began in R-Area Discharge Canal	May 2, 2023
Confirmation Sampling in R-Area Discharge Canal	May 8, 2023
Preliminary sample results received	May 15, 2023
Pre-job brief held with SRNS construction for the installation of access control warning signs	May 18, 2023
Demobilization of R-Area Discharge Canal equipment and site restoration complete	May 19, 2023
SRNS construction began installing access control warning signs	May 22, 2023
SRNS final acceptance inspection of R-Area Discharge Canal and access gates	May 25, 2023
SRNS final acceptance inspection of access control warning signs	July 17, 2023
Regulator viewing of the drone fly-overs constituted the final walk down inspections for LTR IOU.	February 28, 2024
As-built of LUC boundary and access control warning signs prepared	March 25, 2024

Table 2. Cs-137 Results from Sampling Event to Delineate the Extent of PTSM

DATE	SAMPLE	ANALYTE	DL	SQL	RESULT	UNITS	EASTING (UTM)	NORTHING (UTM)
8/9/2022	TE-01	Cs-137	0.105	1.69	108	pCi/g	446262	3682512
8/9/2022	TE-02	Cs-137	0.0614	0.389	2.92	pCi/g	446265.2	3682512
8/9/2022	TN-01	Cs-137	0.11	1.91	138	pCi/g	446258.3	3682514
8/9/2022	TN-02	Cs-137	0.0922	1.18	43.2	pCi/g	446258	3682518
8/9/2022	TN-03	Cs-137	0.0425	0.631	51.7	pCi/g	446257.6	3682521
8/9/2022	TNE-01	Cs-137	0.122	1.62	82.8	pCi/g	446261.7	3682515
8/9/2022	TNE-02	Cs-137	0.036	0.183	0.998	pCi/g	446265.2	3682517
8/9/2022	TNW-01	Cs-137	0.0876	1.12	42	pCi/g	446255.7	3682514
8/9/2022	TNW-02	Cs-137	0.131	2.37	133	pCi/g	446253	3682517
8/9/2022	TNW-03	Cs-137	0.0545	0.903	83.4	pCi/g	446251	3682519
8/9/2022	TS-01	Cs-137	0.0562	0.858	34	pCi/g	446260	3682509
8/9/2022	TS-02	Cs-137	0.115	1.78	97.3	pCi/g	446260.2	3682505
8/9/2022	TS-03	Cs-137	0.0776	1.15	71.8	pCi/g	446258.6	3682501
8/9/2022	TSE-01	Cs-137	0.144	2.68	**195**	pCi/g	446262.7	3682509
8/9/2022	TSE-02	Cs-137	0.0481	0.219	0.665	pCi/g	446265.7	3682506
8/9/2022	TSW-01	Cs-137	0.0751	1.19	55.6	pCi/g	446256.7	3682508
8/9/2022	TSW-02	Cs-137	0.0346	0.513	30.2	pCi/g	446254.3	3682505
8/9/2022	TSW-03	Cs-137	0.0392	0.553	34.3	pCi/g	446251.7	3682503
8/9/2022	TW-01	Cs-137	0.0679	0.982	34.3	pCi/g	446256	3682511
8/9/2022	TW-02	Cs-137	0.0455	0.742	61.4	pCi/g	446252.7	3682511
8/9/2022	TW-03	Cs-137	0.0455	0.352	3.75	pCi/g	446249	3682511

Notes: DL = detection limit
SQL = sample quantitation limit
UTM-Universal Transverse Mercator

Table 3. Equipment Types and Activities

General Equipment Type	Equipment Use
Excavator (CAT 320)	Used to assist in aqua barrier placement/removal, removal of vegetation from within the canal, and excavation of sediments after dewatering.
Skid Steer	General grading, stone placement, and gate installation.
Telehandler	Used to lift equipment and materials within the canal
Telescopic Aerial Work Platform	Used for installing steel support posts for aqua barrier.
Gas Powered Post Driver	Used to drive steel support posts in ground for aqua barrier.
Auger attachment for skid steer	Post hole excavation for gate supports
Roll Off Pans/Trucks (lined and covered)	Temporary storage and transport of low level waste.
Pickups	General site operations.
Dump Trucks	Delivery of stone

Table 4. Approximate Quantities of Excavated Sediment and Job Control Waste

Description	Quantity
Contaminated Sediment	21 cy
Metal posts (7 @ 12 ft each)	84 linear ft
Aqua Barrier (3 empty bladders: 2 @13.5 ft x 50 ft, 1 @ 13.5 ft x 80 ft)	2,430 ft^2
Job control waste/PPE (9 bags)	~2 cy
Total Waste Containers	3 roll offs

Table 5. Confirmation Sample Results

Sample ID	CAS No.	Chemical Name	Sample Date	Sample Type Code	LAB ID	Result (pCi/g)
PE-02-PE-05	10045-97-3	Cs-137	5/8/2023	REG	GELFY19	141
PE-02-PE-05-SPL	10045-97-3	Cs-137	5/8/2023	SPL	TALFY22	105
PE-02-PE-05-SPL	10045-97-3	Cs-137	5/8/2023	SPL	TALFY22	107.0
PE-03-PE-05	10045-97-3	Cs-137	5/8/2023	REG	GELFY19	129

Table 6. Summary of Design Changes

Item	Change	Reason
1	All samples collected during the pre-excavation sampling event to determine the limits of excavation (LOE) were sent to an offsite laboratory for analysis.	Screening level data for the samples collected during the pre-excavation/LOE delineation were not consistent between methods. To provide a definitive boundary for the LOE, all samples were sent to an offsite laboratory for Cs-137 analyses.
2	The LOE was extended to encompass an approximately 100 ft^2 more area.	Cs-137 results from the sample collected at the southeast corner of the initial/assumed LOE boundary (sample TSE-01) were above the PTSM threshold (144 pCi/g). Although no other results were above the threshold, the boundary was extended to the south due to this result.

Table 7. Project Cost Comparison

Project Construction Cost Comparison			
	ROD Cost *($K)*	**Incurred Cost** *($K)*	**Delta Cost** *(%)*
Capital costs associated with excavation, treatment and disposal of sediment contaminated with Cs-137 above PTSM threshold (144 pCi/g) and the	$486	$1,008*	-2%
Capital costs associated with the installation of LUC access warning signs and gates, establishment of LUC boundary and initial monitoring/development of MNREP.	$696		
PAR Pond and Pond B Dam Operations and Maintenance Costs	$2,083	NA **	TBD

*** -Capital costs for excavation/treatment/disposal and warning signs/gates were not collected separately.**
**** - PAR Pond and Pond B Dam Operations and maintenance are performed by SRS Site Services.**

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APPENDIX A

As-Builts

Land Use Control Access Warning Signs
and
Land Use Control Boundary

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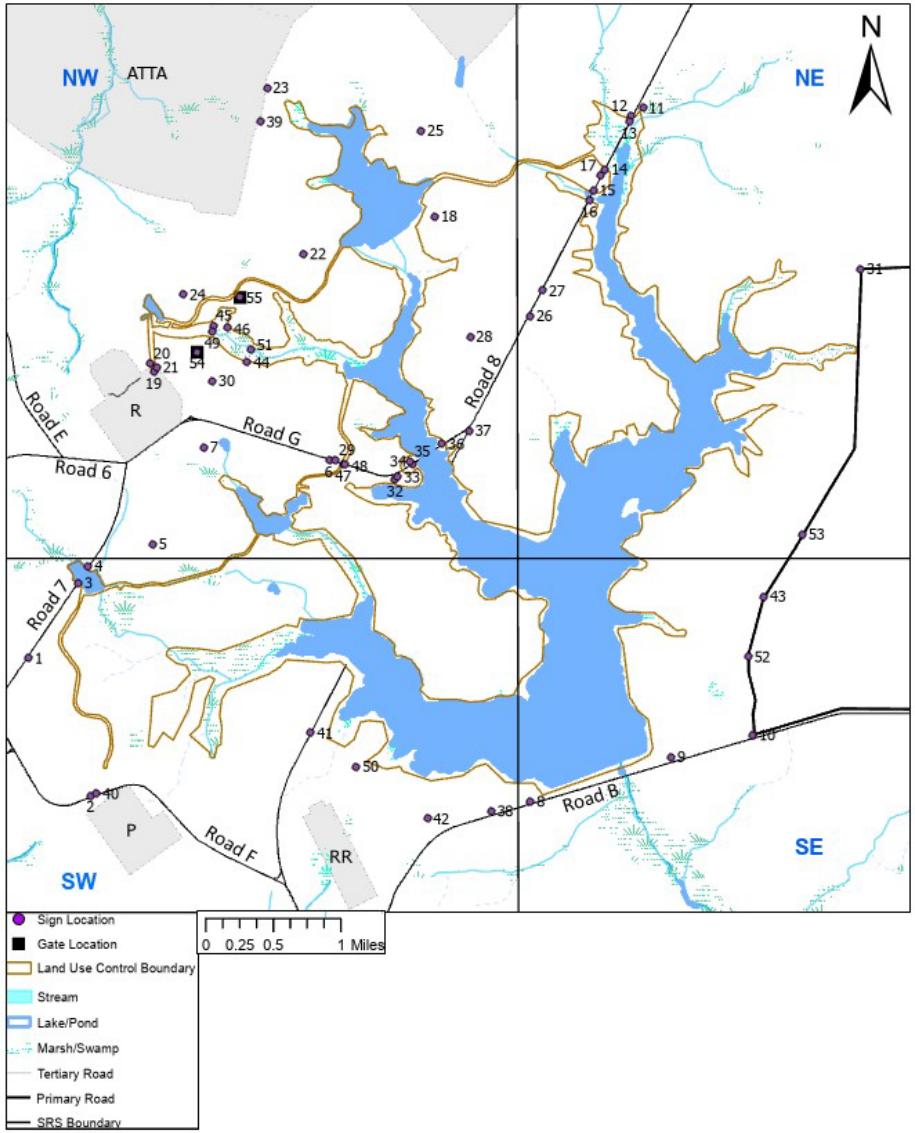
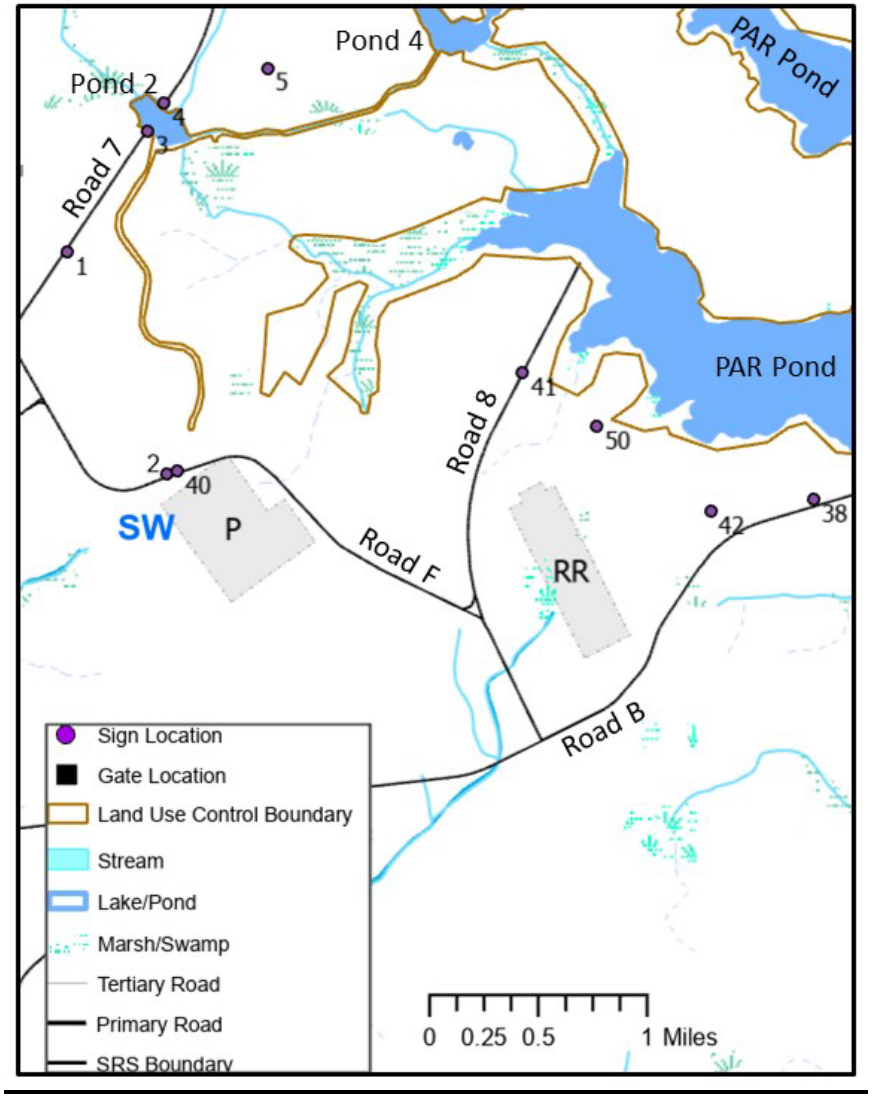
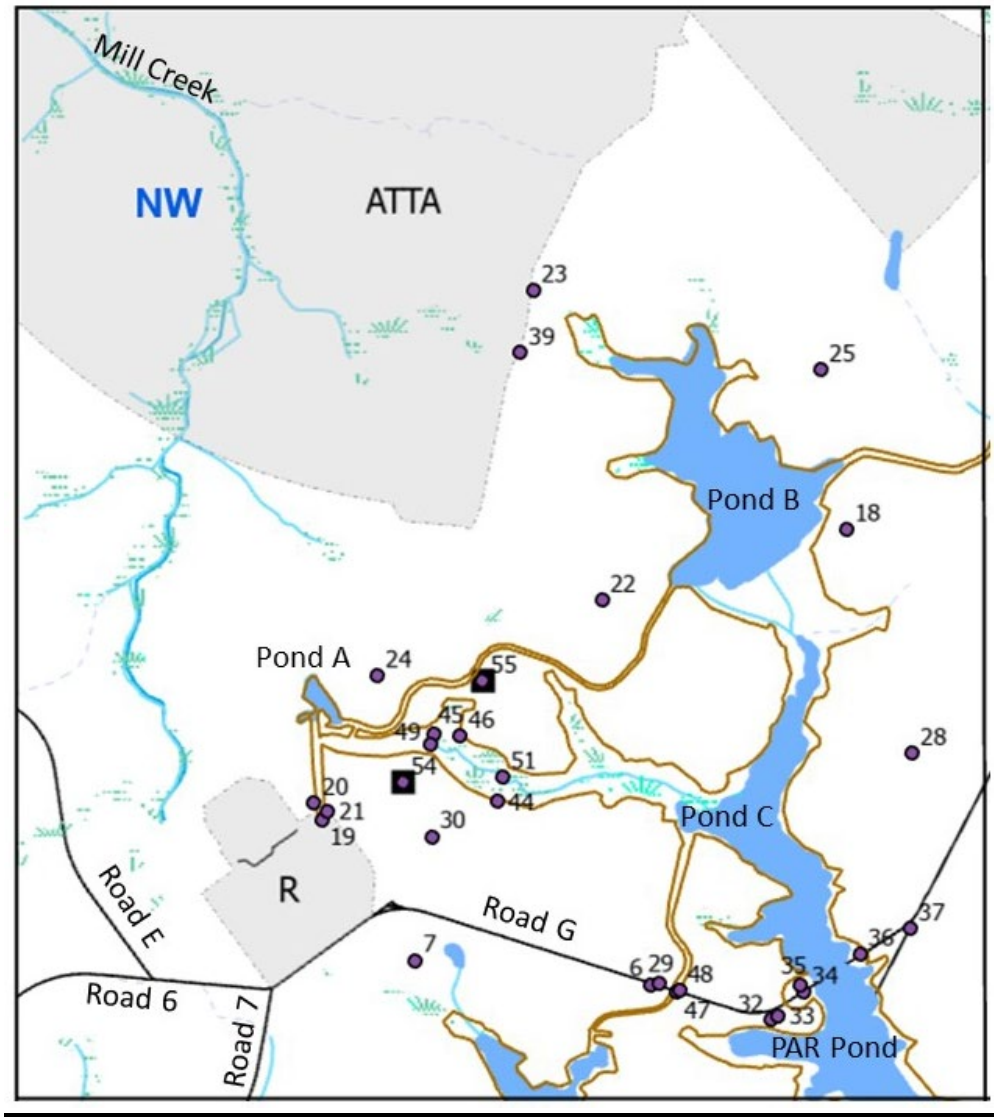


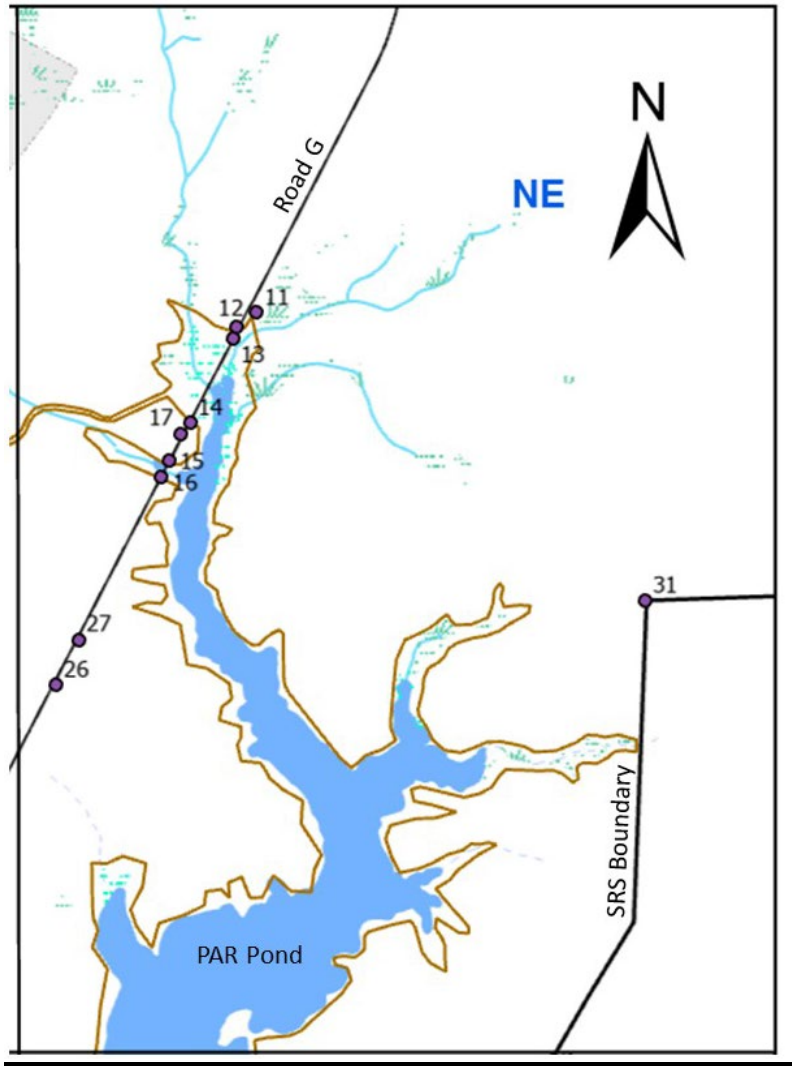
LUC Boundary and LUC Warning Sign Locations – As-Built



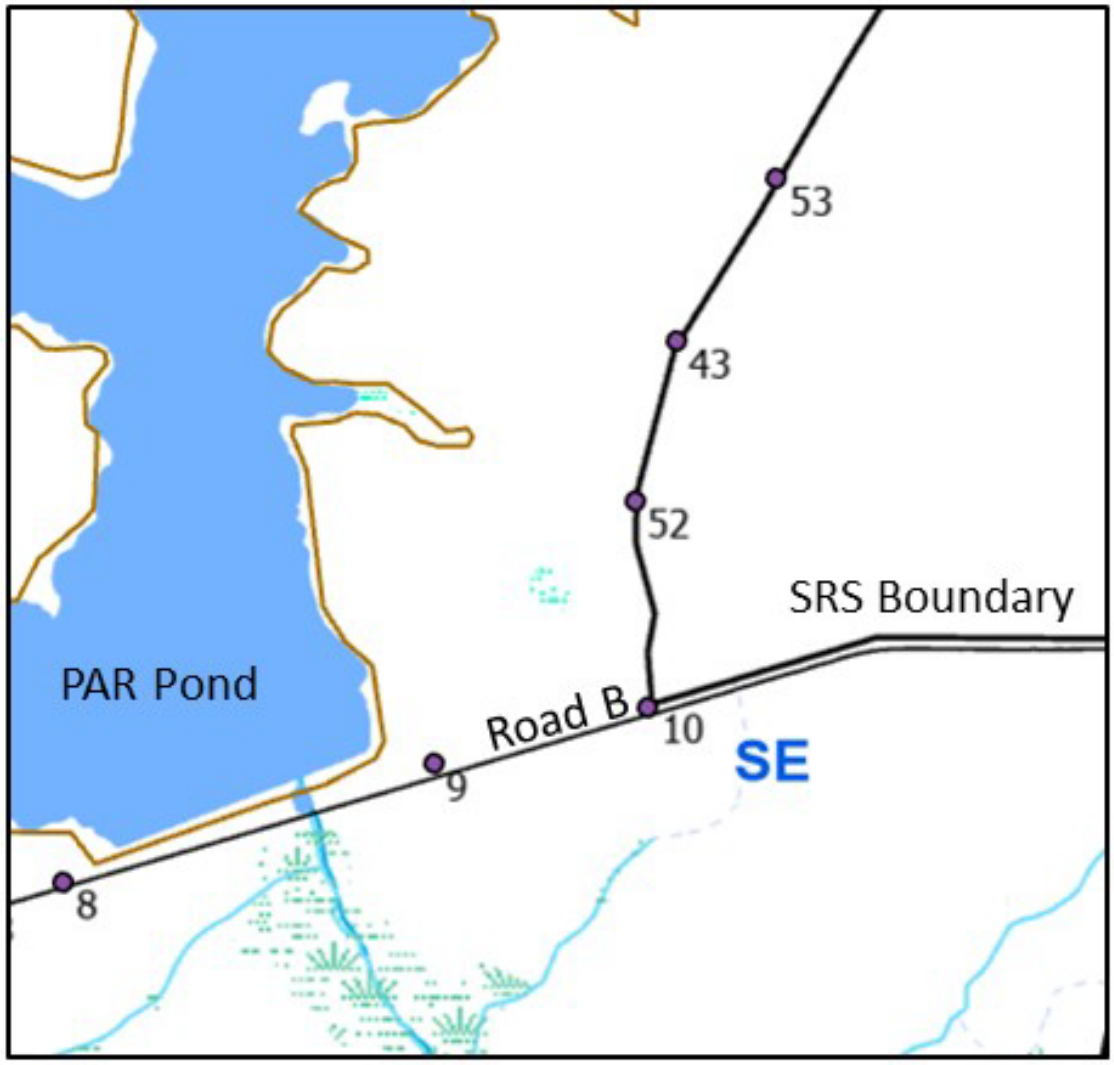
LUC Boundary and Quarter Map of LUC Warning Sign Locations – As-Built



LUC Boundary and Quarter Map of LUC Warning Sign Locations – As-Built (continued)



LUC Boundary and Quarter Map of LUC Warning Sign Locations – As-Built (continued)



LUC Boundary and Quarter Map of LUC Warning Sign Locations – As-Built (continued/end)

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APPENDIX B

SURVEY PLAT OF AREA SUBJECT TO LAND USE CONTROLS

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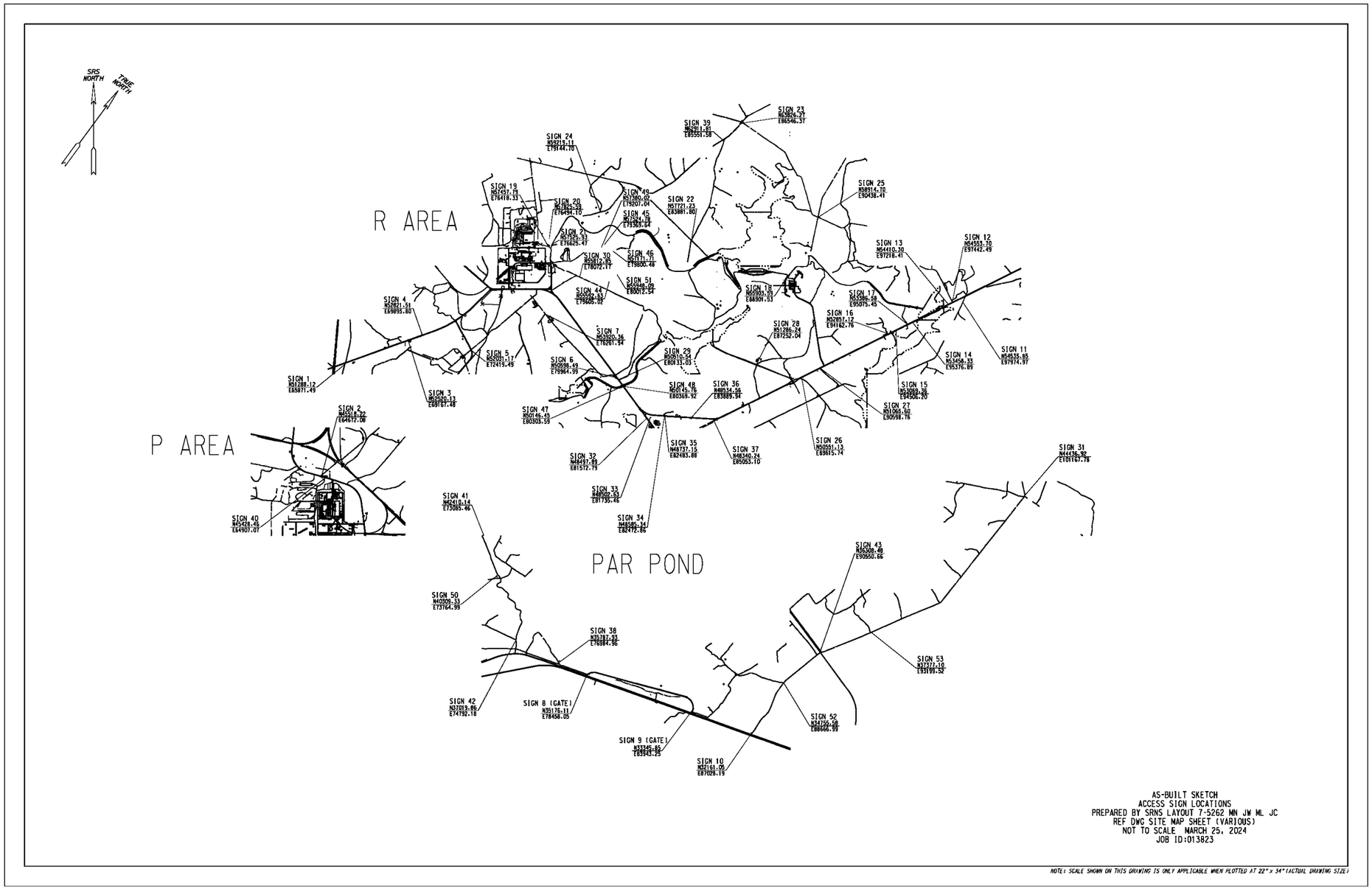

As-Built Survey Map of LUC Warning Sign Locations

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SIGN	SRS_EASTING	SRS_NORTHING	SIGN	SRS_EASTING	SRS_NORTHING	SIGN	SRS_EASTING	SRS_NORTHING
1	65871.83	51289.07	20	76494.56	57824.88	39	85551.61	62911.92
2	64672.37	45518.99	21	76625.22	57526.31	40	64906.82	45428.91
3	69171.11	52516.84	22	83883.67	57721.87	41	73085.85	42410.88
4	69896.03	52821.88	23	86546.17	63826.91	42	74792.20	37021.20
5	72419.89	52030.81	24	79144.38	59219.37	43	90557.43	36308.22
6	79964.05	50597.30	25	90438.63	58913.63	44	79605.63	55592.63
7	76261.60	53920.98	26	89614.48	50550.79	45	79370.31	57525.65
8	78454.17	35179.20	27	90598.29	51065.50	46	79800.01	57171.75
9	83937.78	33348.68	28	87251.85	51286.24	47	80304.10	50146.80
10	87028.26	32161.17	29	80131.86	50511.92	48	80369.73	50145.50
11	97974.32	54536.77	30	78071.70	55813.11	49	79208.32	57382.01
12	97446.46	54555.77	31	101167.89	44437.04	50	73764.78	40308.16
13	97218.93	54410.71	32	81573.13	48496.25	51	80011.94	55948.22
14	95374.02	53456.57	33	81735.43	48501.53	52	88666.87	34755.42
15	94507.72	53066.23	34	82472.30	48585.30	53	93199.62	37377.14
16	94158.39	52851.59	35	82483.83	48737.05	54	78261.92	57083.87
17	95075.46	53385.74	36	83889.92	48534.44	55	80865.94	57819.86
18	88900.90	55902.81	37	85052.38	48339.44			
19	76418.96	57455.75	38	76984.55	35788.58			

As-Built Survey SRS Coordinates of LUC Warning Sign Locations

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APPENDIX C

FIELD INSPECTION CHECKLIST

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FIELD INSPECTION CHECKLIST
FOR
LOWER THREE RUNS IOU

☐ **SCHEDULED** ☐ **UNSCHEDULED**

A= Satisfactory **X**= Unsatisfactory (Explanation required)	**A** or **X**	Observation of Corrective Action Taken
1. Verify that the roads are accessible.		
2. Verify that signage [55] are in acceptable condition, have the correct information, and are legible from a distance of 25 feet.		
3. Verify that gates are closed, secure and in good condition.		
4. Verify that there are no unauthorized excavation, digging, or construction activities that are disturbing the contaminated soil/sediment within the LUC boundary		
5. Verify that there is no evidence of trespassing within the LUC boundary (e.g., cans, bottles, fishing-tackle)		

Inspected by:

(Print Name) (Signature) (Date)

Post-Closure Manager:

(Print Name) (Signature) (Date)

CAUTION:

The inspector shall notify the Post-Closure Manager (PCM) and Environmental Compliance Authority (ECA) **IMMEDIATELY** if there has been a breach or compromise of the land use controls of this waste unit. The notification shall be in accordance with SRS post-closure inspection procedures.

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