WATER STRATEGY, HYDRO LICENSING &
LAKE SERVICES

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April 1, 2024

Electronically Filed

Debbie-Anne A. Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: **Bad Creek Pumped Storage Project (P-2740-053)**
Relicensing Study Progress Report No. 4

Dear Secretary Reese:

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the Licensee, owner, and operator of the 1,400-megawatt (MW) Bad Creek Pumped Storage Project (FERC Project No. 2740) (Project), located in Oconee County, South Carolina, approximately eight miles north of Salem. The Bad Creek Reservoir (or upper reservoir) was formed from the damming of Bad Creek and West Bad Creek and serves as the Project's upper reservoir. Lake Jocassee serves as the lower reservoir and is licensed separately as part of Duke Energy's Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503).

The existing (original) license for the Project was issued on August 1, 1977 by the Federal Energy Regulatory Commission (FERC or Commission) and expires on July 31, 2027. Accordingly, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

Relicensing Studies

Pursuant to 18 Code of Federal Regulations (CFR) § 5.15(c), Duke Energy filed the Initial Study Report (ISR) with the Commission on January 4, 2024, which summarized study activities performed in 2023, as well as ILP activities expected to be completed in 2024. An ISR meeting was held on January 17, 2024. This Fourth Quarterly Study Progress Report describes the activities performed since the ISR was filed, including activities that occurred in quarter 1 (Q1) of 2024 and activities expected to be conducted in quarter 2 (Q2) of 2024. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved Revised Study Plan (RSP) and the Commission's Study Plan Determination (SPD).

Duke Energy is filing this Study Progress report with the Commission electronically and is distributing this letter to the parties listed on the attached distribution list. For parties listed on the attached distribution list who have provided an email address, Duke Energy is distributing this letter via email; otherwise, it will be distributed via U.S. mail.

Duke Energy looks forward to continuing to work with Commission staff, resource agencies, Indian Tribes, local governments, non-governmental organizations, and interested members of the public throughout the relicensing process. If there are questions regarding this filing, please contact me at Alan.Stuart@duke-energy.com or via phone at 980-373-2079.

Sincerely,

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Enclosure

cc (w/enclosure): Jeff Lineberger, Duke Energy

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Bad Creek Pumped Storage Project

Relicensing Study Progress Report No. 4

April 1, 2024

1.0 BACKGROUND

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the Licensee, owner, and operator of the 1,400-megawatt (MW) Bad Creek Pumped Storage Project (FERC Project No. 2740) (Project), located in Oconee County, South Carolina, approximately eight miles north of Salem. The Bad Creek Reservoir (or upper reservoir) was formed from the damming of Bad Creek and West Bad Creek and serves as the Project's upper reservoir. Lake Jocassee serves as the lower reservoir and is licensed separately as part of Duke Energy's Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503).

The existing (original) license for the Project was issued on August 1, 1977, by the Federal Energy Regulatory Commission (FERC or Commission) and expires on July 31, 2027. Accordingly, Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

2.0 STUDY PLAN DEVELOPMENT

In accordance with 18 CFR §5.11, Duke Energy developed a Proposed Study Plan (PSP) in consultation with agencies and stakeholders and filed it on August 5, 2022. After the filing of the PSP, Duke Energy held a site visit and Project tour on August 16, 2022, and the PSP meeting on September 7, 2022. Duke Energy also continued to consult with agencies and other stakeholders regarding its proposed studies.

Duke Energy evaluated the comments submitted by the Commission and stakeholders in response to the PSP. Based on Duke Energy's review of these comments, FERC criteria for study requests under the ILP, and readily available information (e.g., associated with the previous licensing effort or resulting from ongoing monitoring activities), Duke Energy proposed six resource studies in the

Revised Study Plan (RSP) filed with FERC on December 5, 2022. The RSP includes copies of and summarizes comments received and Duke Energy's responses.

The six studies in the RSP will support evaluation of the potential effects of continued operation of the Project as well as potential effects of construction and operation of the proposed Bad Creek II complex. These studies are:

- Water Resources Study;
- Aquatic Resources Study;
- Visual Resources Study;
- Recreational Resources Study;
- Cultural Resources Study; and
- Environmental Justice Study.

In FERC's Study Plan Determination (SPD) letter on January 4, 2023, FERC approved the proposed studies as submitted in the RSP except the Recreational Resources Study which was approved with modifications. The Recreational Resources Study was modified to include the following:

- An additional traffic counter was added at the Laurel Valley Trail Access.[1]
- Revisions to the Recreation Site Inventory Form to include the number and height of bear cables and number of latrines.

In addition, Duke Energy provided the following clarifications regarding the Discussion and Staff Recommendations included in the SPD in Study Progress Report No. 1:

- FERC recommended that Duke Energy modify the Recreation Study Plan to include the additional counties that will be used during the future recreation use analysis. Duke Energy will include Oconee and Pickens counties, SC and Jackson and Transylvania counties, NC and additional counties in SC, NC, and GA that are reported on the recreation user surveys. Since recreation user surveys had not yet been completed yet, Duke Energy was unable to list what counties would be reported at that time.
- FERC recommended that Duke Energy include the 14.8 miles of trail that follows logging and access roads in the Conditions Assessment. Duke Energy is evaluating the entire 43

[1] Although the SPD referenced "Laurel Fork Gap", Duke Energy assumes the Foothills Trail Conservancy and FERC meant to reference the Laurel Valley Trail Access.

miles of trail, including 28.2 miles of single-track trail segments and 14.8 miles of trail that follow logging and access roads in the Conditions Assessment.

- FERC recommended that the Recreation Use and Needs (RUN) Study include detail boxes and labels for all spur trails within the 43-mile portion of trail to be studied by Duke Energy. Duke Energy will prepare detailed maps of the Duke Energy-maintained, 43-mile portion of the Foothills Trail that identify parcel boundaries, current property owner(s), access locations, spur trails, structures, and facilities/amenities. Two traffic counters have been installed at the Bad Creek Hydro Project Trail Access (i.e., Bad Creek Parking Access Area and Bad Creek Road) and user surveys are being collected at this site.
- FERC requested additional details on the standards used to define the minimum acceptable values of the indicator variables used to estimate the trail's carrying capacity. Duke Energy held a Recreational Resources Study Resource Committee (RC) meeting on March 28, 2023, to discuss the carrying capacity methodology.

As discussed in Study Progress Report No. 2 and No. 3, Duke Energy provided information on a potential temporary access road to the Fisher Knob community. The study areas for the Water Resources, Aquatic Resources, Visual Resources, and Cultural Resources studies have been expanded to incorporate the areas potentially affected by the temporary road.

Pursuant to 18 Code of Federal Regulations (CFR) § 5.15(c), Duke Energy filed the Initial Study Report (ISR) with the Commission on January 4, 2024, which summarized study activities performed in 2023, as well as ILP activities expected to be completed in 2024. An ISR meeting was held on January 17, 2024 and the ISR Meeting Summary was filed with FERC on February 1, 2024. In response to comments provided on the ISR and ISR Meeting Summary, Duke Energy is submitting its reply concurrent with this Study Progress Report.

The following sections summarize progress implementing the relicensing studies since the ISR was filed.

3.0 WATER RESOURCES STUDY

The components of the Water Resources Study and status of each are provided below:

- **Summary of Existing Water Quality Data and Standards**: No additional work for this study task is anticipated; the final study report was provided in the ISR as Appendix A, Attachment 1.
- **Water Quality Monitoring in the Whitewater River Arm**: A draft interim report with preliminary water quality results from study year 1 was included in the ISR as Appendix A, Attachment 2. Activities for study year 2 will commence in Q2 (June 2024) with redeployment of water quality instrumentation in the Whitewater River arm to collect water quality information now that all four Bad Creek units have been upgraded.
- **Computational Fluid Dynamics (CFD) Modeling of Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse:** A final study report was provided in the ISR as Appendix A, Attachment 3. While the original scope and objectives of this study task have been met, recent optimization studies for Bad Creek II have indicated that variable speed pump-turbine units will be implemented at Bad Creek II instead of single-speed units, which would result in increased hydraulic capacities compared to what was originally modeled. Therefore, additional CFD modeling is being carried out to incorporate these updated hydraulic capacities. Since the increased hydraulic capacity during generation is less than 2 percent overall (Bad Creek plus Bad Creek II combined) and would result in flows comparable to previously modeled generation flows, only operations under pumping will be evaluated (the updated pumping capacity is increased approximately 9 percent overall). A summary report presenting the effects of updated pumping capacities on Whitewater River flows will be developed and distributed for stakeholder review. This evaluation will implement the same CFD model used during the feasibility study to estimate near-field (i.e., immediately downstream of inlet/outlet structures) changes in flows due to Bad Creek II operations. The final report will be attached as an addendum to the CFD study report (Appendix A, Attachment 3) in the Updated Study Report (USR).
- **CHEOPS Modeling of Water Exchange Rates and Lake Jocassee Reservoir Levels:** The CHEOPS model has been used to evaluate potential effects of Bad Creek II on the frequency, timing, and range of Lake Jocassee and Lake Keowee reservoir level fluctuations. Duke Energy has a scheduled a meeting with the Water Resources, Aquatic Resources, Operations, and Recreational & Visual Resources RCs in April to review model

results. Following the meeting, Duke Energy will provide a draft report to the RCs for review and comment.

- **Future Water Quality Management Plan (WQMP) Development:** Work to develop the WQMP will begin in Q2 of 2024.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan except the study area has expanded to incorporate a temporary access road. Potential water quality effects associated with construction of the temporary access road will be addressed in the WQMP.

4.0 AQUATIC RESOURCES STUDY

The components of the Aquatic Resources Study and status of each are provided below:

- **Entrainment Study:** The desktop entrainment study report was revised to include historical operations data, an assessment of the influence of operations with the increase of renewable energy production, pumping periods (2, 4, 6, 8, 10, and 12 hours), diurnal periods (day versus night), lake levels, and water temperature. The final report was reviewed by stakeholders and provided in the Initial Study Report as Appendix B, Attachment 1. As described above, recent optimization studies for Bad Creek II have indicated that variable speed pump-turbine units will be implemented at Bad Creek II instead of single-speed units, which would result in increased hydraulic capacities compared to what was originally modeled for entrainment. Therefore, additional modeling is being carried out to incorporate these updated hydraulic capacities and an addendum to the final report will be included in the USR (Appendix B, Attachment 1). Also, per the Commission's request in their ISR comments, a literature review will be carried out for the intrinsic population growth rate of threadfin shad. If recent literature is identified with this information, it will be considered for inclusion in the entrainment analysis and presented in the USR.
- **Effects of Bad Creek II Complex and Expanded Weir on Aquatic Habitat:** This effort will use results of the CFD and CHEOPS modeling from the Water Resources Study. CFD modeling results will be used to qualitatively evaluate potential effects to Lake Jocassee stratification, dissolved oxygen, and temperatures throughout the water column. CHEOPS modeling results will be used to assess potential effects within the littoral zone with a focus on lake level fluctuation effects. See Section 3.0 for an update on the CFD and CHEOPS

modeling. Preliminary work on the analysis and study report has begun; a draft report will be provided to the Aquatic Resources RC in Q2 2024.

- **Impacts to Surface Waters and Associated Aquatic Fauna:** The third and final fish survey at Limber Pole and Howard creeks was completed on October 9 and 10, 2023. Hydrology, hydraulics, and geomorphology surveys in support of the Stream Quantification Tool, including riparian vegetation surveys, and stream habitat data forms consisting of the North Carolina Stream Assessment Method and U.S. Environmental Protection Agency Rapid Bioassessment Protocol were completed at all streams crossed by the proposed temporary access road on October 2 and 3, 2023. Results of the mussel, fish, and stream habitat surveys were summarized in a draft report and shared with the Aquatic Resources RC on November 11, 2023, and included as Appendix B, Attachment 3 of the ISR filed with FERC on January 4, 2024. Comments on the draft report were received from the South Carolina Department of Natural Resources (SCDNR) on December 21, 2023. The draft results were also presented at the January 17, 2024, ISR meeting. A final report was distributed to the Aquatic Resources RC on February 14, 2024, and is being filed as Attachment A of this progress report.

Variance from Approved Study Plan

The Entrainment Study and Effects of Bad Creek II Complex and Expanded Weir on Aquatic Habitat were completed in accordance with the approved study plan. The Impacts to Surface Waters and Associated Aquatic Fauna study area was expanded to include the temporary access road. Stream habitat surveys for five streams within spoil locations were not completed due to safety concerns related to inclement weather. These variances were reported in the ISR.

5.0 VISUAL RESOURCES STUDY

Duke Energy has completed the visualizations identified in the study plan and is finalizing the draft study report for RC review. As has been discussed with the RC and at the ISR meeting, a lighting evaluation will be included in the study report. This will include an overview of the International Dark Sky program and guidelines but will not include an evaluation of Bad Creek II against International Dark Sky standards since Duke Energy has been unable to locate such standards for power generating facilities. The draft study report will be provided to the Recreation & Visual Resources RC during Q2 2024.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan. The temporary access road route has been incorporated into the viewshed model.

6.0 RECREATIONAL RESOURCES STUDY

The Recreational & Visual Resources RC met on February 29, 2024, to discuss the status of the Recreational Resources Study as described below.

- **Foothills Trail Recreation Use and Needs (RUN) Study**: Data collection including traffic and trail counts, in-person and online user surveys, and spot counts was completed in 2023. The data are currently being processed. The Foothills Trail carrying capacity analysis is under development. The draft study report will be provided to the RC in Q2 2024.
- **Foothills Trail Condition Assessment**: Fieldwork was completed in 2023 and the draft study report was submitted to the RC in November 2023 as well as included in the ISR. Duke Energy received comments on the draft report from the Foothills Trail Conservancy, SCDNR, and Friends of Lake Keowee Society. The RC discussed these comments during the February 2024 meeting. All comments will be considered and included in the consultation documentation with the final report. The final report will be filed with the USR.
- **Whitewater River Cove Existing Recreational Use Evaluation**: This effort has been completed and the final report was included in the ISR as Appendix D, Attachment 3. No further work in association with this task is planned.
- **Whitewater River Cove Recreation Public Safety Evaluation:** This effort will integrate the CFD modeling surface velocity data developed in the Water Resources Study with the Whitewater River cove recreational use data captured during the 2023 boating season. This effort is dependent upon updated CFD modeling of surface velocities in the Whitewater River Cove (see Section 3.0) which is on-going. The draft report will be distributed to Recreational & Visual Resources RC members in Q2 2024.

Variance from Approved Study Plan

The study is proceeding in accordance with the study plan as modified by FERC.

7.0 CULTURAL RESOURCES STUDY

The draft report was filed as Appendix E of the ISR and on January 22, 2024, the final report was distributed to the SC State Preservation Historic Office and the Catawba Indian Nation. On March 6, 2024, the Catawba Indian Nation responded with their concurrence with the final report. The final report is attached as Attachment B of this progress report[2]. This study has been completed in accordance with the approved study plan.

Variance from Approved Study Plan

The study was completed in accordance with the approved study plan; the geographic scope of the study area was expanded to encompass the proposed temporary access road.

8.0 ENVIRONMENTAL JUSTICE STUDY

The final report was filed as Appendix F of the ISR. No written comments were provided requesting modifications to the final study report. Duke Energy will continue to evaluate the need for additional outreach activities prior to the filing of the final license application.

Variance from Approved Study Plan

The study was conducted in accordance with the study plan as modified by FERC.

9.0 WILDLIFE AND BOTANICAL UPDATE

Duke Energy has proposed to develop a bat study plan and carry out additional surveys for bats at the Project due to potential clearing associated with the proposed temporary access road, spoil areas, transmission line, and other areas of proposed power complex infrastructure. This will also support Clean Water Act 404 permitting to avoid and minimize impacts to endangered species, as well as preparation of the Biological Assessment (BA) for submittal to the U.S. Fish and Wildlife Service (USFWS) [to comply with Section 7 of the Endangered Species Act] for the 404 permitting. Duke Energy will target finalizing the study plan in line with the summer survey guidance in April 2024. Duke Energy will submit the study plan to the USWFS, FERC, SCDNR, and the Wildlife & Botanical RC.

[2] Consistent with FERC policy, the Cultural Resources report is being submitted as Controlled Unclassified Information (CUI)/Privileged information.

10.0 PERMITTING ACTIVITIES

Initial work in support of Clean Water Act Section 404 / 401 permitting has begun; a pre-application meeting request was submitted to the U.S. Army Corps of Engineers (USACE) on February 23, 2024 and the meeting was held on March 28, 2024, in Columbia, South Carolina. Attendees includes representatives from USACE, USFWS, SCDNR, S.C. Department of Health and Environmental Control (SCDHEC), Catawba Indian Nation, Duke Energy, and Duke Energy's consultant (HDR Engineering, Inc.).

Attachment A: Impacts to Surface Waters and Associated Aquatic Fauna (Final Report)

IMPACTS TO SURFACE WATERS AND ASSOCIATED AQUATIC FAUNA

FINAL REPORT

AQUATIC RESOURCES STUDY

Bad Creek Pumped Storage Project
FERC Project No. 2740

Oconee County, South Carolina

February 14, 2024

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IMPACTS TO SURFACE WATERS AND ASSOCIATED AQUATIC FAUNA
BAD CREEK PUMPED STORAGE PROJECT
FERC PROJECT NO. 2740
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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
Bad Creek (or Project)	Bad Creek Pumped Storage Project
Bad Creek II Complex	Bad Creek II Power Complex
BEHI	bank erosion hazard index
CFR	Code of Federal Regulations
CPUE	catch per unit effort
DBH	diameter at breast height
Duke Energy or Licensee	Duke Energy Carolinas, LLC
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FERC or Commission	Federal Energy Regulatory Commission
KT Project	Keowee-Toxaway Hydroelectric Project
mg/L	milligrams per liter
NBS	near-bank stress
NCDWQ	North Carolina Division of Water Quality
NCSAM	North Carolina Stream Assessment Method
Protocol	SCDNR Fish Collection Protocols for Streams
RBP	Rapid Bioassessment Protocol
RSP	Revised Study Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SQT	Stream Quantification Tool
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

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1 Project Introduction and Background

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Project) (FERC Project No. 2740) located in Oconee County, South Carolina, approximately eight miles north of Salem. The Project utilizes the Bad Creek Reservoir as the upper reservoir (Upper Reservoir) and Lake Jocassee, which is licensed as part of the Keowee-Toxaway (KT) Hydroelectric Project (FERC Project No. 2503), as the lower reservoir.

The existing (original) license for the Project was issued by the Federal Energy Regulatory Commission (FERC or Commission) for a 50-year term, with an effective date of August 1, 1977, and expiration date of July 31, 2027. The license has been subsequently and substantively amended, with the most recent amendment on August 6, 2018, for authorization to upgrade and rehabilitate the four pump-turbines in the powerhouse and increase the Authorized Installed and Maximum Hydraulic capacities for the Project.[1] Duke Energy is pursuing a new license for the Project pursuant to the Commission's Integrated Licensing Process, as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11 of the Commission's regulations, Duke Energy developed a Revised Study Plan (RSP) for the Project and proposed six studies for Project relicensing. The RSP was filed with the Commission and made available to stakeholders on December 5, 2022. FERC issued the Study Plan Determination on January 4, 2023, which included modifications to one of the six proposed studies (Recreational Resources Study).

This final report includes the methods and results from Task 3 (Impacts to Surface Waters and Associated Aquatic Fauna) of the Bad Creek Aquatic Resources Study. The Aquatic Resources Study is ongoing in support of preparing an application for a new license for the Project in accordance with 18 CFR §5.15, as provided in the RSP.

[1] *Duke Energy Carolinas LLC, 164 FERC ¶ 62,066 (2018)*

2 Goals and Objectives

Tasks carried out for the Bad Creek Aquatic Resources Study employed standard methodologies that are consistent with the scope and level of effort described in the RSP filed with the Commission on December 5, 2022 (Duke Energy 2022). The goal of the Aquatic Resources study is to evaluate potential impacts to aquatic life populations, communities, and habitats, due to the construction and operation of the proposed Bad Creek II Power Complex (Bad Creek II Complex).

This report was developed in support of Task 3 of the Aquatic Resources Study (Impacts to Surface Waters and Associated Aquatic Fauna). The main objective of this task is as follows:

- Evaluating potential direct impacts to aquatic habitat (including wetlands) related to Bad Creek II Complex construction activities and weir expansion by quantifying and characterizing surface waters, including resource quality.

This objective was met through a combination of activities, including desktop description of impacted surface waters, previously conducted Natural Resource Assessments of areas of potential impact, and presence/absence of mussels and characterization of habitat quality through surveys of streams in the potential spoil deposition areas.

Duke Energy is proposing the development of a temporary access road to provide an alternate route to the Fisher Knob community during Bad Creek II Complex construction. The potential 3.7-mile-long predominantly gravel road was not proposed at the time of RSP filing. Therefore, in addition to assessing surface waters that have the potential to be impacted by construction as described in the RSP, Duke Energy evaluated surface waters that would be crossed by the access road, with the same goals and objectives as those established in the RSP.

3 Study Area

The study area includes the shoreline of Lake Jocassee, streams within potential upload spoil locations, and streams and creeks that would be crossed by the potential temporary access road as described in the June 28, 2023, Relicensing Study Progress Report No. 2 filed with FERC (Figure 3-1).

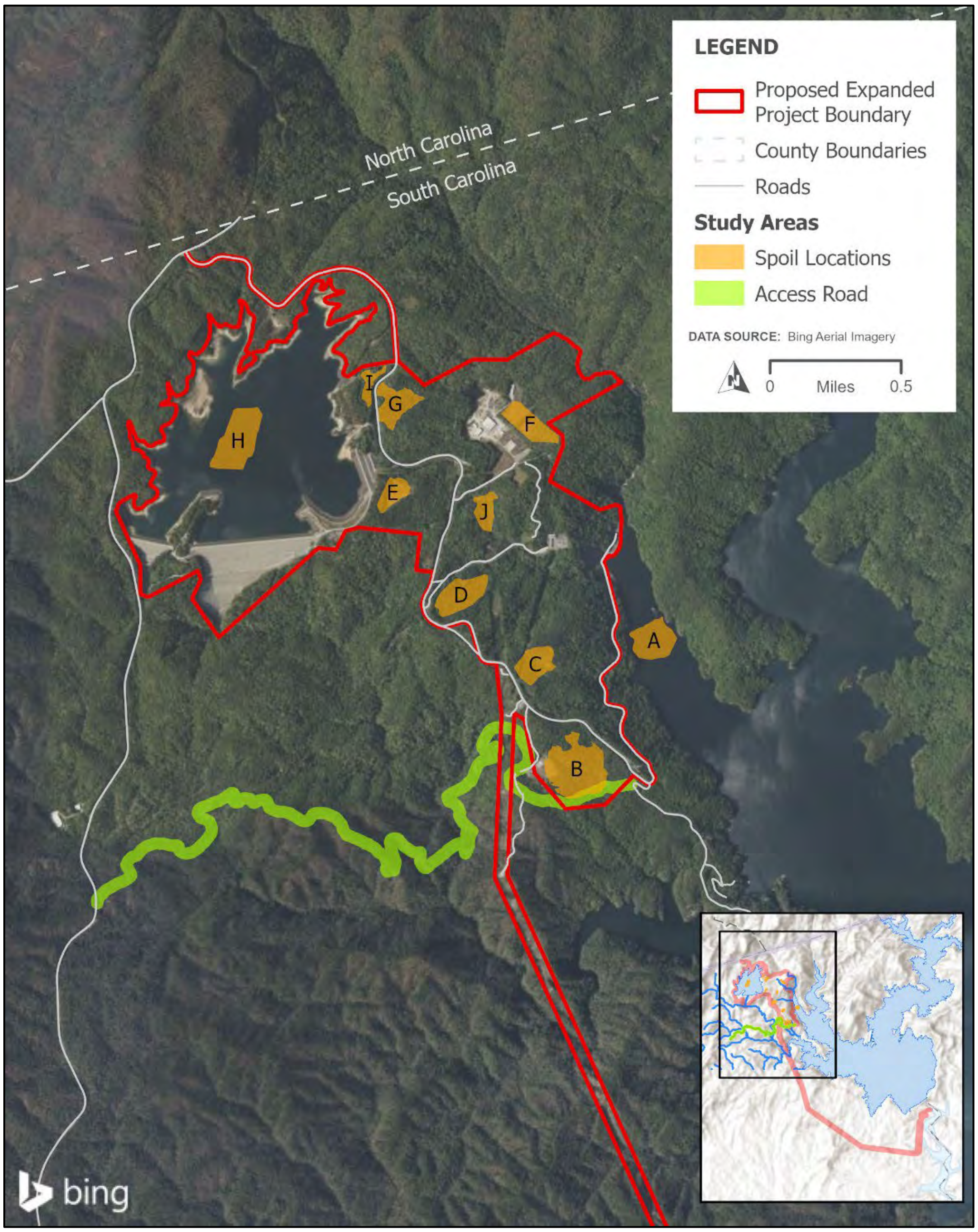

Figure 3-1. Potential Spoil Locations and Proposed Temporary Access Road Study Area

4 Overview

Construction of the Bad Creek II Complex would impact existing streams and waterbodies, including wetlands. Overburden (i.e., soil and rock) material from the construction activities are proposed to be deposited in spoil locations throughout the site. Siting for spoil location alternatives is ongoing by Duke Energy, with consideration of existing natural resources that are identified during site investigations, existing topography, and quantity of material used to expand the submerged weir in Lake Jocassee (if pursued). Although Duke Energy will avoid and minimize impacts to surface waters and wetlands to the extent practicable, it is likely that impacts to streams and wetlands will occur as a result of spoil placement.

Duke Energy is also proposing the development of a temporary access road to provide an alternate route to the Fisher Knob community and Project during the period of Bad Creek II Complex construction. The access road would be decommissioned following Project construction completion.

Duke Energy proposed to evaluate the aquatic resources (streams, wetlands, and Lake Jocassee) that may experience direct impacts from spoil placement or other construction activities. This included a characterization of aquatic resources with respect to stream types as indicated from natural resources assessments, habitat quality, and potential fauna (mussels) presence. Field activities in support of this study task are outlined below.

5 Methods

General methods for stream habitat quality surveys and mussel surveys were provided in the Aquatic Resources RSP and are detailed further below. With the addition of the proposed temporary access road and through consultation with the South Carolina Department of Natural Resources (SCDNR), additional methodologies (described below) related to the South Carolina Stream Quantification Tool (SQT) were adapted by Duke Energy into the study. A memo developed as a summary of stream survey approach methods prepared in consultation with SCDNR and filed with the Commission with the September 28, 2023, Relicensing Study Progress Report No. 3 is provided as Attachment A (HDR 2023).

5.1 Natural Resources Assessments

Natural resources assessments of the potential upland spoil locations were conducted using a combination of desktop and field assessments while applying methodologies and guidance described in the U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual (USACE 1987), the 2012 USACE Eastern Mountains and Piedmont Regional Supplement (Version 2.0) (USACE 2012), USACE Regulatory Guidance Letter 05-05 Ordinary High Water Mark Identification, and the North Carolina Division of Water Quality (NCDWQ) Methodology for Identification of Intermittent and Perennial Streams and Their Origins (Version 4.11) (NCDWQ 2010).

A delineation of surface waters and wetlands crossed by the temporary access road was completed following the same USACE and NCDWQ guidance, including flagging in the field and recording with a sub-meter accuracy GPS. The delineation was completed for a 100-foot buffer around the potential temporary access road.

5.2 Stream Habitat Quality Surveys

As stated in Section 4, the disposal of overburden material in upland locations would result in impacts to streams and wetlands and will require an individual permit from the USACE and water quality certification from South Carolina Department of Health and Environmental Control (SCDHEC) under the authorities of Sections 404 and 401 of the Clean Water Act. In preparation for these expected regulatory processes (if Bad Creek II Complex is pursued), stream habitat quality surveys were completed to provide a physical assessment of the existing conditions of streams that have the potential to be impacted.

5.2.1 Rapid Bioassessment Protocol

In accordance with the FERC-approved Aquatic Resources RSP, the stream habitat assessment portion of the U.S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocol (RBP) was completed for streams within potential spoil locations. Streams and creeks crossed by the temporary access road were also assessed, as described in the Relicensing Study Progress Report No. 3 filed with FERC on September 28, 2023, and the Aquatic Resources Study Approach to Stream Surveys technical memo, which has undergone stakeholder review. These assessments provide information regarding stream functionality and condition, which in turn can indicate the value of aquatic habitat to aquatic and terrestrial life, and ecosystem services such as nutrient reduction and support of watershed health. The USEPA RBP includes an evaluation of the variety and quality of (1) stream substrate, (2) channel morphology, (3) bank structure, and (4) riparian vegetation (Barbour et al. 1999). Ten parameters across four condition categories (e.g., poor, marginal, suboptimal, or optimal) were rated on a numerical scale of zero to twenty for each sampled reach, with higher scores indicating supportive conditions. Total scores were then compared to reference reach conditions for an overall index. Reference reaches are stable segments of streams against which streams can be compared for optimal condition.

5.2.2 North Carolina Stream Assessment Method

The North Carolina Stream Assessment Method (NCSAM) was completed for streams within potential spoil locations and streams or creeks crossed by the temporary access road. The NCSAM rates streams for three Class 1 functions: hydrology, water quality, and habitat. Within each Class 1 function, streams are rated for up to eight Class 2 functions, which may include Class 3 and Class 4 functions. The functions provided by a stream are a product of the hydrologic, geologic, morphologic, and vegetational setting of the stream and its drainage area (Gordon et al. 1992 as cited by N.C. Stream Functional Assessment Team 2013). Alterations and/or stressors can contribute to the degradation of a stream, either naturally or anthropogenically, including storm damage, excessive vegetation, beaver impoundment, stream migration, and sedimentation, which can lead to lower stream function. Parameters evaluated with NCSAM protocol include flow restrictions; streambank erosion; buffer size and type; water quality stressors; substrate composition; in-stream habitat; visual and dip netting assessments for aquatic life; presence of wetlands; shade; and others.

The NCSAM utilizes a Boolean logic chain of reasoning to convert metric evaluation results into qualitative functional ratings for individual metrics, function classes, and an overall functional rating.

5.2.3 South Carolina Stream Quantification Tool

The SC SQT was developed in a collaborative effort between federal and state representatives to provide a tool for assessing and quantifying functional lift and loss of streams in South Carolina. In May 2023, the SCDNR requested that Duke Energy apply the SQT methods to streams within potential spoil locations and streams crossed by the temporary access road. Duke Energy consulted with the SCDNR in May and June 2023 regarding the applicability and methodology of the SQT for stream assessments. In July 2023, Duke Energy and the SCDNR conducted a site visit to two potential spoil locations representative of conditions across the site. It was agreed among the SCDNR staff and Duke Energy personnel that streams within potential spoil locations are generally high functioning with limited (if any) anthropogenically caused degradation, and that field data collection to support SQT analysis for streams in these areas were not likely to produce significantly different results (i.e., lower functionality scores) than an assumption of fully functional. Therefore, Duke Energy proposed to field survey streams potentially crossed by the temporary access road, only. Documentation of all consultation for the Aquatic Resources study is included in Attachment 4 of Appendix B of the Initial Study Report.

Reach lengths for SQT assessments were 100 linear feet upstream and downstream at each potential temporary access road stream crossing based on the results of the stream and wetland delineation completed in September 2023 (see Section 5.1). Each stream was segmented into "upstream" and "downstream" reaches to facilitate comparison of stream conditions before (i.e., baseline) and after construction of the temporary access road and to provide a means for considering natural events which may influence the condition of the streams. For example, a major storm event resulting in high flows and movement of large woody debris could influence stream geomorphology and overall condition. To determine how natural events may affect the stream, the upstream reach will function as a control comparison during the period in which the road crossing is installed.

Stream surveys consisted of assessment of five functional categories including hydrology, hydraulics, geomorphology, physiochemical, and biology (South Carolina Steering Committee 2022a). Depending on the anticipated type of impact or lift, physiochemical and biology categories are optional. Guidance from the SQT suggests physiochemical parameters be measured for stream projects with "goals or objectives related to physiochemical functions or where watershed conditions suggest that uplift is possible." Construction of the proposed Fisher Knob access road would be conducted from upland locations and no in-water work would occur. Best management practices to prevent sedimentation, such as silt fencing, would be installed to prevent water quality impacts at stream crossings. Given that impacts to water quality are not anticipated and appropriate stream protection measures will be taken, no physiochemical monitoring was conducted.

5.2.3.1 Hydrology, Hydraulics, and Geomorphology

All streams crossed by the proposed access road were surveyed for the first three functional categories of the SQT (hydrology, hydraulics, and geomorphology). Stream geomorphic measurements were made using tapes, stadia rod, and a line level per the Rapid Method approach described in the SQT Data Collection and Analysis Manual[2] (South Carolina Steering Committee 2022a).

The field team identified bankfull indicators along the 100-foot reach and selected a stable riffle for the dimension survey. The channel was surveyed by stretching the tape between bankfull indicators on each bank and leveled via line level. The depth from bankfull was measured across the channel bottom and recorded. The field team used these data to compare to regional curves (SCDNR 2020) for bankfull verification.

Riffle and pool data (e.g., bankfull depth, bankfull width, low bank height, flood prone width, maximum pool depth, etc.) were collected at each feature along the reach. Due to difficulty in the field with dense vegetative cover and limited line-of-sight, stream and valley slope was measured via GIS with 2-foot topography. Stream sinuosity was also measured via GIS using the stream boundaries delineated during the natural resources assessment.

Assessments of large woody debris and bank erosion/near bank stress were made for each stream reach. Large woody debris (defined as dead and fallen wood over 1 meter in length and at least 10 centimeters in diameter at its largest end, within the channel or touching the top of streambank) was noted for each stream reach. Bank erosion was documented where present and bank erosion hazard index (BEHI) and near-bank stress (NBS) calculated.

As part of the geomorphology assessment, one 10-meter-by-10-meter vegetation plot was established on either side of channel for each stream reach and the vegetation community observed was documented in accordance with the Carolina Vegetation Survey level 2 method

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[2] https://www.dnr.sc.gov/sqt/docs/SC_SQT_Data_Collection_and_Analysis_Manual.pdf

(Lee et al. 2008). Diameter at breast height (DBH) was measured for all woody vegetation greater than 1.37 meters tall and the number of stems counted.

5.2.3.2 Stream Quantification Tool Analysis

The SQT was implemented at each 100-foot stream reach. Index values (from 0.00 to 1.00) were calculated from the metrics entered for each of the functional categories described above. For parameters incorporating more than one metric, index values were averaged. Parameter scores were then averaged to calculate total functional category scores, and scores weighted and summed by the tool for an overall existing condition score.

Table 5-1. Summary of Parameters and Metrics used in the Stream Quantification Tool

Functional Category	Function-Based Parameters	Metrics
Hydrology	Reach Runoff	Land Use Coefficient
		Concentrated Flow Points (No./1,000 ft)
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)
		Entrenchment Ratio (ft/ft)
	Flow Dynamics	Width/Depth Ratio State (observed/expected)
Geomorphology	Large Woody Debris (LWD)	LWD Piece Count (No./100 m)
	Lateral Migration	Dominant BEHI/NBS
		Percent Streambank Erosion (%)
	Riparian Vegetation	Buffer Width (ft)
		Average DBH (inches)
		Tree Density (No./acre)
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)
		Pool Depth Ratio (ft/ft)
		Percent Riffle (ft/ft)

Source: South Carolina Steering Committee 2022a; ft= feet/foot; No.= number

5.3 Fish Community Sampling

Fish community sampling was completed in Limber Pole and Howard creeks following the Fish Collection Protocols for Streams (Protocol) as described in the SCDNR Fish Sampling Guidance (SCDNR 2022) for the Blue Ridge ecoregion. Electrofishing reach lengths were determined based on the mean width of the reach with a minimum of 100 meters consistent with the Protocol. Natural obstructions (e.g., riffles, log jams, or falls) were also utilized to define sampling reach boundaries when possible. A calibrated multiparameter water quality data sonde was used to record existing water quality conditions during sampling events, including temperature, dissolved oxygen, conductivity, pH, salinity, and turbidity.

The number of electrofishing units and netters varied based on stream width and followed the Protocol. Electrofishing crews worked in an upstream direction, and all stunned fish were collected along with any reptiles or amphibians incidentally encountered. Immediately after capture, fish were placed in an aerated five-gallon bucket and processed at the mid-point and/or end of sampling depending on the reach length. All fish were identified to species and a subset of each species was measured for total length to the nearest millimeter.

5.4 Macroinvertebrate Sampling

Aquatic macroinvertebrates are good indicators of water quality due to their sensitivity to changes in physical, chemical, and biological conditions(USEPA 2023). Organisms within the Ephemeroptera, Plecoptera, and Trichoptera (EPT) genera are particularly sensitive to poor water quality and intolerant to pollution, therefore the presence of species within these groups indicate good water quality. Macroinvertebrate surveys were completed following the *SCDHEC Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC 2017). This method includes a timed-qualitative multiple habitat sampling protocol to collect macroinvertebrates, which allows for sampling representative macroinvertebrate taxa from the variety of natural habitats within a stream.

Procedures included sampling with kick nets, D-shaped dip nets, and sieves with the goal to collect as many different macroinvertebrate taxa as possible during a specified amount of time in multiple habitat types. More details on sampling methods are included in the following sections. Samples collected from all three sampling methods were combined into a sieve bucket. Organisms are separated or “picked” from the rest of the sample in the field using forceps and picking trays and preserved in glass vials containing 85 percent ethyl alcohol. Organisms were picked in approximate proportion of their abundance and no attempt was made to remove all specimens encountered. Organisms collected and preserved in vials in the field were shipped to a certified taxonomist Pennington & Associates Inc, for identification to the lowest taxonomic level to calculate species taxa richness which is of the number of different kinds of organisms (taxa) in a collection and biotic index score for each site.

5.4.1 Kick Net Collection

A 1.0-meter-square 500-1000-micron mesh net attached between poles was used for kick net sampling in riffles. The kick net was placed downstream of the riffle area sampled and held in place on either side by two biologists to catch macroinvertebrates and debris that drift into the net. The third biologist perturbed the substrate from upstream, including dislodging cobble and small boulders, moving downstream towards the net. Contents collected in the kick net were rinsed into a sieve bucket.

5.4.2 D-frame Dip Net Collection

D-frame dip nets were used to sample root wad habitats, generally located along stream margins, as well as aquatic vegetation, if present. Root wads were sampled by repeatedly thrusting a 500-micron D-frame dip net upwardly into the roots along a stretch of bank until the net was approximately one-quarter full of detritus and root debris. Several randomly selected root wads were also washed down by hand into the dip net to remove firmly attached macroinvertebrates. Aquatic vegetation was sampled by sweeping the dip net through the vegetation. Contents of the dip net sampling were rinsed into the same sieve bucket with the kick net sample for a wholly representative sample of the stream.

5.4.3 Leaf Pack Collection

Mature leaf packs were collected at areas with swift moving water and placed in the sieve bucket and discarded after elutriation. The macroinvertebrates remaining in the sieve bucket were included with those from the kick net and D-frame dip net. Samples from the sieve bucket were transferred to picking trays and macroinvertebrates were removed using forceps and preserved in glass vials containing 85 percent ethyl alcohol.

5.4.4 Visual Collection

The intent of visual collections was to specifically target microhabitats that were not sampled using the aforementioned collection methods. Stream habitat components including large-grained substrate, recessed rock crevices, woody debris, mature leaf packs, roots, and other debris were searched for macroinvertebrates, which were collected directly with forceps and placed in the glass vials containing 85 percent ethyl alcohol.

5.5 Mussel Surveys

Mussel surveys consisted of an assessment for supportive habitat, followed by timed searches where suitable habitat was identified. Suitable habitat was defined as areas with appropriate substrate (sand and gravel), presence of fish hosts for glochidia, and potentially, evidence of live mussels or shells. Mussel habitat was evaluated for streams within potential spoil locations, streams and creeks crossed by the potential temporary access road, and along the portion of Lake Jocassee's shoreline included in the study area.

Mussel surveys followed methods adapted from the USEPA Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys for the Development of Site-specific Water Quality Criteria for Ammonia (USEPA 2013). The survey consisted of timed visual and tactile searches for mussels in areas identified with suitable habitat. Timed searches were a minimum of four person-hours in Lake Jocassee and one person-hour in creeks. Habitat conditions at each sampling location were recorded including substrate conditions, shoreline composition, and basic water quality parameters (water temperature, dissolved oxygen).

6 Results

6.1 Natural Resource Assessments

The natural resources assessment to identify surface waters and wetlands within potential spoil locations was completed in September 2021 and along the proposed temporary access road in September 2023. The 2021 natural resources assessment report was attached as Appendix E to the Pre-Application Document filed with FERC in February 2022 (HDR 2021). The surface waters and wetlands within the potential spoil locations are summarized in Table 6-1 and depicted on figures provided in Attachment B. Resources identified include nine streams, three wetlands, and one open waterbody.

Table 6-1. Summary of Surface Waters and Wetlands estimated[1] within Potential Spoil Locations

Name	Type	Spoil Location	Extent (linear feet or acres)
Streams (linear feet)			
Stream 4	Intermittent	G	942
Stream 4a	Perennial	G	542
Stream 11	Unknown	J	148
Stream 13	Intermittent	D	227
Stream 14	Perennial	D	770
Stream 17	Perennial	C	286
Stream 19 (Devils Fork)	Perennial	B	1,129
Stream 20	Perennial	B	577
Stream 21	Unknown	B	172
		Total	*4,793*
Wetlands (acres)			
Wetland 4 (isolated)	Emergent	F	0.37
Wetland 7 (isolated)	Forested	F	1.15
Wetland 10 (isolated)	Emergent	E	2.96
		Total	*4.48*
Open Waterbodies (acres)			
Lake Jocassee	Freshwater	A	12.7

[1]Extent of surface waters and wetlands was estimated using desktop resources and field investigations. A delineation of surface waters is planned to be completed in 2024.
[2]Spoil location J was added after filing the Pre-Application Document, however the area was evaluated during the 2021 Natural Resources Assessment.

The 2023 natural resources assessment identified six streams or creeks crossed by the access road if the Bad Creek II Complex is pursued and the Fisher Knob access road is constructed. Streams include Limber Pole Creek, Howard Creek, Devils Fork, and three unnamed tributaries. Additional unnamed tributaries and wetlands were identified and delineated within the 100-foot buffer of the potential temporary access road, however stream habitat quality surveys and mussel surveys completed for this study considered only those crossed by the potential temporary access road. Streams and wetlands estimated or delineated along the temporary access road route are summarized in Table 6-2 and depicted on figures provided in Attachment B. Note that Devils Fork was surveyed at both locations; the survey location of “Stream 19” denoted in Table 6-1 was several hundred feet upstream of the survey location of “Stream 17”, where the potential temporary access road would cross this feature.

Table 6-2. Streams and Wetlands identified along the Temporary Access Road

Name	Type	Extent (linear feet or acres)	Potentially Crossed by Access Road (Y/N)
Streams (linear feet)			
Stream 1 (Limber Pole Creek)	Perennial	397	Y
Stream 2	Perennial	273	N
Stream 3	Perennial	62	N
Stream 4	Intermittent	314	N
Stream 5	Perennial	48	N
Stream 6	Intermittent	621	N
Stream 7 (Howard Creek)	Perennial	516	Y
Stream 8	Intermittent	69	N
Stream 9	Perennial	180	N
Stream 10	Intermittent	95	N
Stream 11	Perennial	166	N
Stream 12	Intermittent	763	Y
Stream 13	Intermittent	208	N
Stream 15	Perennial	397	Y
Stream 16	Perennial	717	Y
Stream 17 (Devils Fork at road crossing)	Perennial	295	Y
Stream 18	Intermittent	87	N
Wetlands (acres)			
Wetland 1	Emergent	0.02	N
Wetland 2	Emergent	0.01	N
Wetland 3	Emergent	0.00	N
Wetland 4	Emergent	0.02	N
Wetland 5	Emergent	0.02	N
Wetland 6	Forested	0.16	N

6.2 Stream Habitat Quality Surveys

Stream habitat quality surveys were completed for streams within potential spoil areas and those potentially crossed by the temporary access road as identified during the Natural Resources Assessment (see Section 6.1); however, USEPA RPB and NCSAM forms were not completed for Stream 11 (spoil location J), Streams 13 and 14 (spoil location D), or 20 and 21 (spoil location B) due to inclement weather which presented a safety concern at the time staff was on site.

6.2.1 Rapid Bioassessment Protocol

USEPA RBP data forms were completed in September 2023 for streams within potential spoil locations and potentially crossed by the temporary access road. All streams scored above 100 in the "optimal" or "suboptimal" range (Table 6-3). Some streams had reduced scores related to limited baseflow conditions (less aquatic habitat) and/or microhabitat characteristics (e.g., presence of epifaunal substrate, level of embeddedness, velocity/depth regime, etc.). USEPA RBP data forms for the assessed streams are provided in Attachment C.

Table 6-3. Summary of USEPA Rapid Bioassessment Protocol Stream Habitat Assessments

Stream Name / Location	Stream Type	Total Score	Condition Category
Streams within Potential Spoil Locations			
Stream 4 - Spoil Location G	Intermittent	117	Suboptimal
Stream 4a - Spoil Location G	Perennial	137	Suboptimal
Stream 17 - Spoil Location C	Perennial	143	Suboptimal
Stream 19 (Devils Fork) - Spoil Location B	Perennial	155	Optimal
Streams potentially crossed by the Temporary Access Road			
Stream 1 (Limber Pole Creek)	Perennial	170	Optimal
Stream 7 (Howard Creek)	Perennial	185	Optimal
Stream 12	Intermittent	126	Suboptimal
Stream 15	Perennial	133	Suboptimal
Stream 16	Intermittent	127	Suboptimal
Stream 17 (Devils Fork)	Perennial	144	Suboptimal

[1]Condition categories include Poor, Marginal, Suboptimal, and Optimal.

6.2.2 North Carolina Stream Assessment Method

NCSAM data forms were completed for streams within potential spoil locations and those potentially crossed by the temporary access road in September 2023. All streams were rated as high functioning with the exception of Streams 4 and 4a within spoil location G, and Stream 12 along the proposed temporary access road, which were rated as "medium" primarily due to limited baseflow conditions or, for Stream 4a, related to suboptimal streamside conditions (limited buffer). A summary is provided in Table 6-4 and complete data forms and rating sheets for each stream are included in Attachment D.

Table 6-4. Summary of NC Stream Assessment Method Ratings

Stream Name	Stream Type	NCSAM Overall Functional Rating
Streams within Potential Spoil Locations		
Stream 4 - Spoil Location G	Intermittent	Medium
Stream 4a - Spoil Location G	Perennial	Medium
Stream 17 - Spoil Location C	Perennial	High
Stream 19 (Devils Fork) - Spoil Location B	Perennial	High
Streams Potentially Crossed by Temporary Access Road		
Stream 1 (Limber Pole Creek)	Perennial	High
Stream 7 (Howard Creek)	Perennial	High
Stream 12	Intermittent	Medium
Stream 15	Perennial	High
Stream 16	Intermittent	High
Stream 17 (Devils Fork)	Perennial	High

6.2.3 Stream Quantification Tool

6.2.3.1 Hydrology, Hydraulics, and Geomorphology

Stream surveys of hydrology, hydraulics, and geomorphology in support of the SQT were performed October 2-3, 2023. Streams appeared to be typical of those common to the Blue Ridge ecoregion, with limited hydraulic access to the floodplain (i.e., entrenched or moderately entrenched), low sinuosity, and moderate to high stream slopes. Streams were in good condition representative of those absent of anthropogenic influence. Riparian buffers were well vegetated with mature trees, and some areas also contained dense shrubs. Vegetation plots were placed such that each plot was representative of the plant community, structure, and age throughout the reach. Average DBH across reaches ranged from 8.2 to 18.6, with tree density up to 405 trees per acre (Table 6-5). Most streams contained coarse substrate (usually gravel), although bedrock cascades were present in one location. The smaller streams including Stream 12, Stream 16, and Devils Fork contained flow that went subsurface in several areas throughout upstream and/or downstream reaches. Areas where water re-emerged appeared to support relatively high abundance of salamanders. All streams were in stable condition throughout with limited streambank erosion. Vegetation data by plot and representative photographs are provided in Attachment E. Rapid Method forms completed for each stream reach are provided in Attachment F, and representative photographs of surveyed stream reaches are provided in Attachment G.

Table 6-5. Summary of Vegetation Plot Data

Stream/Creek	Reach	Average DBH (inches)	Average Tree Density (No. of trees per acre)
Stream 1 (Limber Pole Creek)	Upstream	9.5	405
	Downstream	10.5	223
Stream 7 (Howard Creek)	Upstream	12.3	142
	Downstream	8.5	121
Stream 12 (UT to Howard Creek)	Upstream	18.6	243
	Downstream	14.7	162
Stream 15 (UT to Devils Fork)	Upstream	8.2	101
	Downstream	9.6	223
Stream 16 (UT to Devils Fork)	Upstream	8.6	263
	Downstream	10.3	142
Stream 17 (Devils Fork)	Upstream	9.6	202
	Downstream	10.9	263

UT = unnamed tributary

6.2.3.2 Stream Quantification Tool Analysis

Information gathered during stream surveys of the lower-level functional categories (hydrology, hydraulics, geomorphology [including riparian vegetation]) were used for Rosgen classification and input to the SC SQT to develop an overall Existing Condition Score for each stream reach. Higher-level functions (physiochemical and biology) were not included. The maximum potential Existing Condition Score the streams could receive was 0.6 (0.2 per functional category) (South Carolina Steering Committee 2022b).

Most streams surveyed exhibited entrenched or moderately entrenched conditions, low sinuosity, and coarse bed material. Width-depth ratios and slope were variable. The majority of streams were classified as Rosgen B-type streams, with G-type streams noted in areas exhibiting streambank erosion, and one A-type stream. B-type streams exhibit moderate gradient with moderate entrenchment and width/depth ratios, dominated by riffle features with infrequently spaced pools. A-type streams are entrenched and confined, high-gradient streams with frequently spaced pools associated with step/pool morphology. Both A and B type streams have stable plan and profile, and stable banks. G-type streams are more unstable, entrenched streams exhibiting low width/depth ratio, moderate gradients, and high bank erosion rates.

All reaches were rated to have a "good" catchment assessment due to the limited development of the upstream drainage areas. Although typical of A, B, and G-type streams, entrenched and moderately entrenched streams were rated poorly by the SQT under the hydraulics functional category due to these streams' limited access to the floodplain. Other factors which reduced existing condition scores include streams with streambank erosion (such as the upstream reach of Stream 15 or downstream reach of Stream 16) or a limited large woody debris present (such as the upstream reach of Stream 12, and upstream and downstream reaches of Stream 15).

Stream 15 was the only stream with bedrock cascades, classified as a Rosgen A1a+ type stream with high gradient, entrenchment, no large woody debris and no streambank erosion noted. Riffles were uncommon, though small pools at the base of cascades were present. Although this reach would be considered stable, its limited access to the floodplain, constrained floodplain extent (i.e., flood prone width), lack of large woody debris, and low bedform diversity resulted in a low and moderate score for hydraulics and geomorphology functional categories.

Overall, the streams surveyed along the temporary access road generally exhibited stable, high-quality, potential reference reach-type conditions (Table 6-6). The SQT catchment assessments and existing condition matrix summaries for each stream reach are provided in Attachment J.

Table 6-6. Summary of Stream Characteristics

Stream/Creek	Reach	Entrenchment Ratio	Width/ Depth Ratio	Sinuosity	Slope	Bed Material (D50)	Rosgen Classification	Catchment Assessment	SQT Existing Condition Score	Maximum SQT Existing Condition Score	Percent Stream Functionality	Reach Description
Stream 1 (Limber Pole Creek)	Upstream	Moderately entrenched to entrenched	Moderate	Low	Moderate	11.30 (medium gravel)	B4	Good	0.48	0.6	80%	The upstream reach of Limber Pole Creek was densely covered with mountain laurel along the riparian zone. A small amount of active streambank erosion was present comprising approximately 6% of the reach. A small (low-discharge) tributary entered the creek at station 50.
	Downstream	Moderately entrenched to entrenched	High	Low	Low	14.55 (medium gravel)	B4c	Good	0.50	0.6	83%	The downstream reach of Limber Pole Creek was similar to the upstream reach and also densely vegetated with mountain laurel. All streambanks were stable.
Stream 7 (Howard Creek)	Upstream	Moderately entrenched to entrenched	High	Low	Low	34.60 (very coarse gravel)	B4c	Good	0.45	0.6	75%	The upstream reach of Howard Creek exhibited conditions typical of B-type streams in the Blue Ridge ecoregion. Some bank erosion was noted comprising 16.5% of the reach, primarily attributable to lateral drainage (i.e., a swale input) or in-channel woody debris influences.
	Downstream	Moderately entrenched to entrenched	High	Low	Moderate to high	56.69 (very coarse gravel)	B4a	Good	0.44	0.6	73%	The downstream reach of Howard Creek exhibited entrenchment and moderate width-to-depth ratio typical of B-type streams in the Blue Ridge ecoregion. A cascade approximately 20 inches high was present at station 96.5.
Stream 12 (UT to Howard Creek)	Upstream	Entrenched	Moderate	Low	High	14.29 (medium gravel)	B4a	Good	0.39	0.6	65%	Stream 12 was an intermittent stream covered in many areas with dense in vegetation, primarily mountain laurel. Some water was present at the time of survey. The channel had high gradient with step-pools. No streambank erosion was noted.
	Downstream	Moderately entrenched	Moderate	Moderate	Moderate to high	3.13 (very fine gravel)	B4a	Good	0.48	0.6	80%	The downstream reach of Stream 12 contained a small amount water at the time of survey. Step-pool features were observed for the most upstream portion of the stream before the flow went subsurface between station 49 and 54.2. A small amount of streambank erosion was present on an outside meander (5% of channel).
Stream 15 (UT to Devils Fork)	Upstream	Entrenched	Low	Low	Moderate	1.36 (very coarse sand)	G5	Good	0.37	0.6	62%	The upstream reach of Stream 15 was adjacent to a 0.16-acre forested wetland area. The stream contained limited flow at the time of survey, however a moderate amount of streambank erosion was present (approximately 26.5 percent). The stream diverged around a "forested island" in the upstream end of the reach.
	Downstream	Entrenched	Low	Low	Very high	-- (bedrock)	A1a+	Good	0.36	0.6	60%	The downstream reach of Stream 15 exhibited very high gradient with bedrock cascades. Limited stream flow resulted in sheetflow across the bedrock. Small pools

Stream/Creek	Reach	Entrenchment Ratio	Width/ Depth Ratio	Sinuosity	Slope	Bed Material (D50)	Rosgen Classification	Catchment Assessment	SQT Existing Condition Score	Maximum SQT Existing Condition Score	Percent Stream Functionality	Reach Description
												were present at the base of cascades. No bank eroding in this reach was noted.
Stream 16 (UT to Devils Fork)	Upstream	Moderately entrenched to entrenched	Moderate	Low	Moderate to high	10.20 (medium gravel)	B4a	Good	0.45	0.6	75%	The upstream reach of Stream 16 exhibited a riffle-pool pattern with stable banks and a moderate to high gradient. The stream originated at station 3.5 (subsurface from 0.0 to 3.5).
	Downstream	Entrenched	Low	Low	Moderate	20.13 (coarse gravel)	G4	Good	0.37	0.6	62%	The downstream reach of Stream 16 exhibited a moderate to high gradient and a moderate amount of streambank erosion comprising 23.5% of the reach. The lower 17 feet of the reach (station 83 to 100) was subsurface.
Stream 17 (Devils Fork)	Upstream	Moderately entrenched to entrenched	Low to moderate	Low to moderate	Moderate to high	9.32 mm (medium gravel)	B4a	Good	0.40	0.6	67%	The upstream reach of Devils Fork was a perennial feature that flowed subsurface periodically throughout the reach; approximately 27.5% of the stream channel was dry due to the disappearance of flow underground. The upstream reach exhibited high grade with step-pool features and little bank erosion present.
	Downstream	Moderately entrenched to entrenched	High	Low to moderate	Moderate	0.45 (medium sand)	B5	Good	0.37	0.6	62%	The downstream reach of Devils Fork was similar to the upstream reach in that approximately 20% of the surface water flow would disappear underground periodically through the reach. No areas of bank erosion were identified.

[1]Rosgen classification was based on an overall stream reach metrics with consideration of the “continuum of physical variables” (Rosgen 1994, 1996) and best professional judgement of Rosgen-trained scientists.

6.3 Fish Community Sampling

In accordance with the Protocol, one electrofishing unit and one netter was used for the upstream reach of Stream 1, and two electrofishing units and two netters were used at all other reaches. Surveys were completed upstream and downstream of the road crossings on July 25 and 26, September 5 and 6, and October 9 and 10, 2023. The four stream reaches maintained consistent species diversity over the three sampling events. No fish were collected in either reach of Stream 1 during 2023. Two species of fish, Rainbow Trout (*Oncorhynchus mykiss)* and Western Blacknose Dace (*Rhinichthys obtusus)*, were collected in both reaches of Stream 7 during all sampling events. Fish survey details including stream characteristics, sampling effort, water quality data, number of fish collected, catch rate, and fish density is provided in Attachment H.

In addition to the two species of fish collected, numerous aquatic salamanders from the genus *Desmognathus* were captured in both Stream 1 and Stream 7. The salamanders were captured in every reach during each sampling event, ranging from two to 15 individuals.

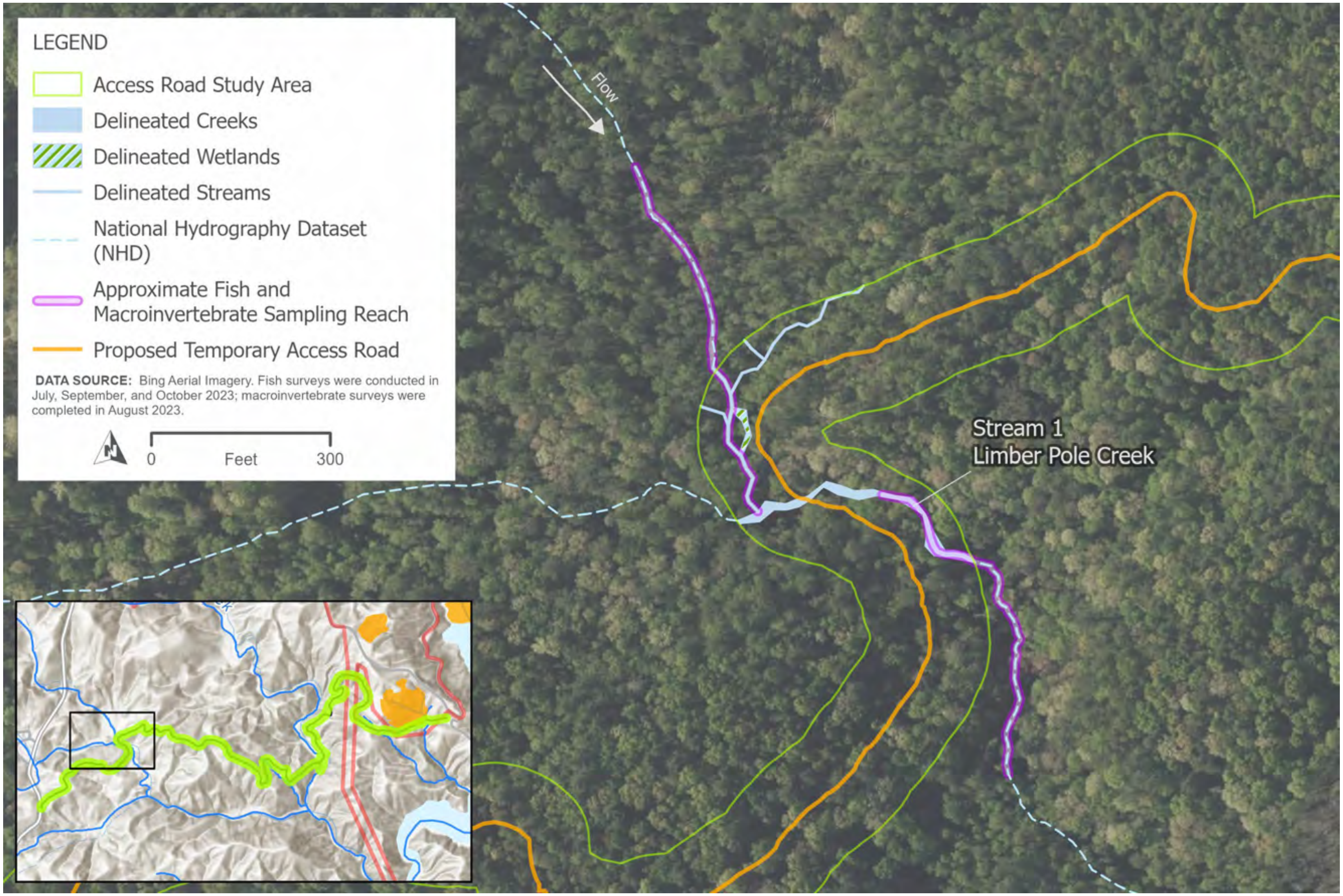

Figure 6-1. Fish and Macroinvertebrate Sampling Reaches on Stream 1 (Limber Pole Creek)

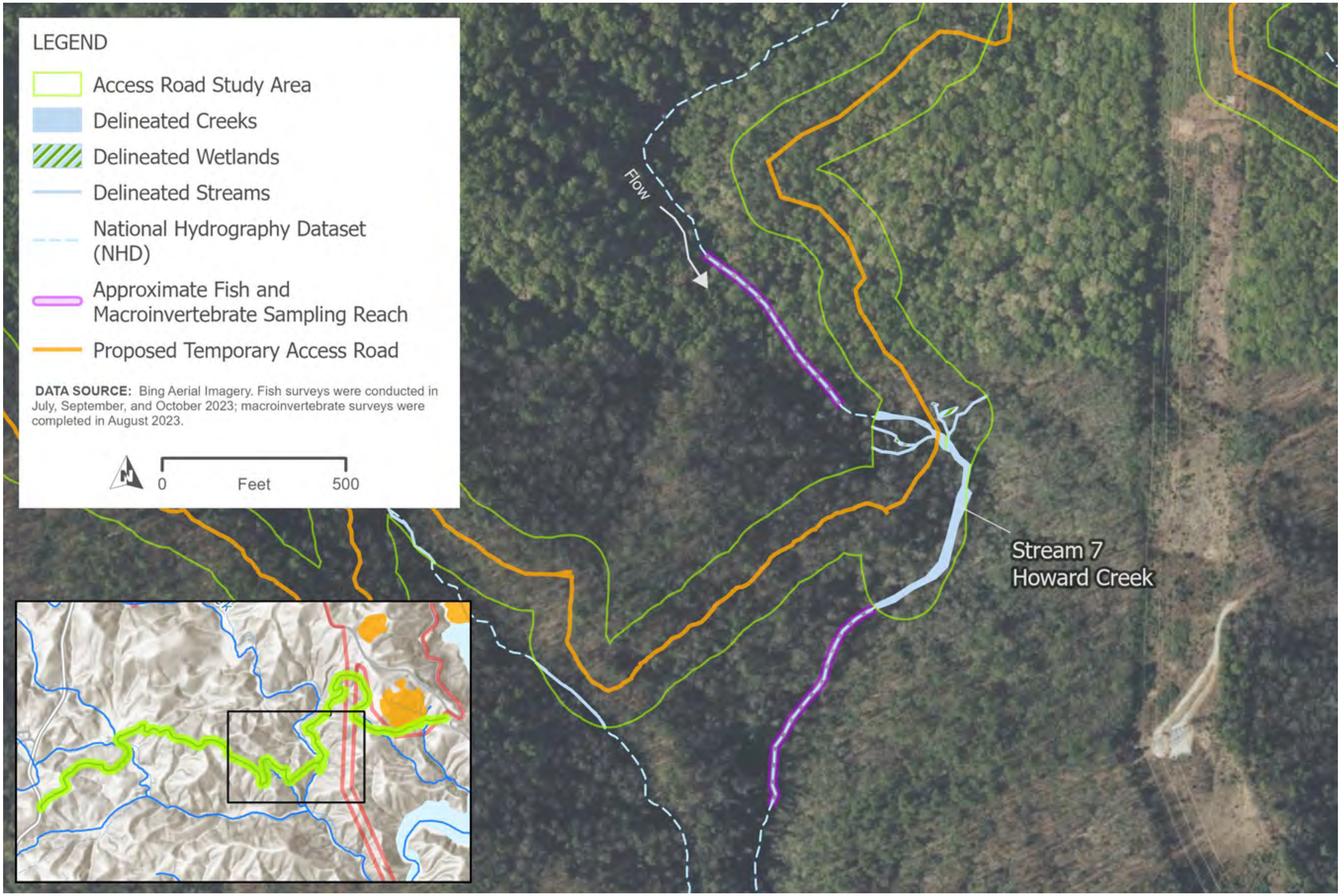

Figure 6-2. Fish and Macroinvertebrate Sampling Reaches on Stream 7 (Howard Creek)

6.4 Macroinvertebrate Sampling

Macroinvertebrate sampling was completed in Streams 1 and 7. One survey per stream reach was conducted on August 1 and 2, 2023, which is within the recommended index period (June 15, 2023, to September 15, 2023, for the Blue Ridge ecoregion). Stream reach lengths were the same as those sampled during fish community sampling conducted in July 2023 (see Figure 6-1, Figure 6-2, and Attachment H).

Biotic and EPT indices and scores were developed from the laboratory-identified taxa in accordance with the SCDHEC (2017) SOP (Table 6-7). The biotic index (BI) for a sample is a weighted average of the tolerance values referenced in SCDHEC's SOP Appendix 5 for organisms collected in sample with respect to their relative abundance. The BI value is scaled from 0.0 to 10.0, with 10 representing relative tolerance to general stressors, with lower values representing more pristine conditions.

The EPT taxa are a subset of benthic macroinvertebrate species belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) which are highly sensitive and intolerant to pollution. The EPT index represents the total number of EPT taxa collected at a site with higher values indicating higher water quality.

The BI and EPT scores are weighted based on ecoregion. The BI and EPT scores are averaged to produce a combined score to determine the bioclassification of streams in South Carolina with the highest value equaling 5.0 and the lowest 1.0. The scores are rounded to show a single decimal and are rated as follows: 1 = Poor, 2 = Fair, 3 = Good-Fair, 4 = Good, and 5 = Excellent.

Full taxonomic identification results are provided in Attachment I.

Table 6-7. Stream Bioclassification Scores[1] for Stream 1 (Limber Pole Creek) and Stream 7 (Howard Creek)

Metrics	Limber Pole Creek		Howard Creek	
	Upstream	Downstream	Upstream	Downstream
Total No. of Organisms	163	161	319	246
Total No. of Taxa	35	29	39	39
EPT Index	27	21	30	28
Biotic Index Assigned Values	1.68	2.04	2.98	2.25
EPT Score	3.93	3.19	4.31	4.06
Biotic Index Score	9.04	8.57	7.31	8.29
	6.49	5.88	5.81	6.17

Metrics	Limber Pole Creek		Howard Creek	
	Upstream	Downstream	Upstream	Downstream
South Carolina Bioclassification	Excellent/Fully Supporting			

[1]See SCDHEC (2017) for details on EPT, Biotic Index, and Biotic Index Assigned Value scores for the Blue Ridge ecoregion.

Water quality parameters were collected in conjunction with the macroinvertebrate sampling (see Table 6-8). A water quality meter (YSI Sonde) was calibrated and used to record ambient stream temperature, pH, dissolved oxygen, and conductivity. Stream 1 and Stream 7 are classified by the SCDHEC as Natural Trout (TN) waters. The results recorded in the field met the SCDHEC's surface water quality standards for TN classification (SCDHEC 2023).

Table 6-8. Water Quality Results Summary during Macroinvertebrate Sampling

Water Quality Parameter	Limber Pole Creek		Howard Creek	
	Upstream	Downstream	Upstream	Downstream
Water Temperature (°C)	19.5	20.2	19.2	19.2
Dissolved Oxygen (mg/L)	8.31	8.24	8.77	8.87
Dissolved Oxygen (%)	N/A	91.0	94.9	96.0
pH (SU)	6.10	6.89	7.42	7.44
Conductivity (µmhos/cm)	94.9	92.4	99.5	100.7

Macroinvertebrate sampling also included a review of the abundance and diversity of microhabitat types and conditions. Most habitat types or characteristics scored good to excellent with the exception of mature leaf packs, aquatic vegetation, presence of braided channels, and pine needles in streams. The forests surrounding the creeks were dominated by deciduous species and therefore limited, if any pine needles were present. The streams were also well shaded, which limits aquatic vegetation (or algae) growth. The high position (i.e., headwaters) in the watershed also limits the amount of nutrient input needed for aquatic plant growth, as well as the type of stream morphology, i.e., braided channels – the streams assessed are not conducive to braided channel formation due to steeper slopes (Table 6-9).

Table 6-9. SCDHEC Aquatic Biology Section Habitat Assessment Summary

Habitat Type	Limber Pole Creek		Howard Creek	
	Upstream	Downstream	Upstream	Downstream
Root Banks	Good	Good-Fair	Good-Fair	Good
Logs, Sticks, Snags	Good	Good-Fair	Good-Fair	Good-Fair

Habitat Type	Limber Pole Creek		Howard Creek	
	Upstream	Downstream	Upstream	Downstream
Rock/Gravel Riffle	Good	Excellent	Excellent	Excellent
Mature Leaf Pack	Poor	Poor	Poor	Poor
Aquatic Vegetation	Good-Fair	Nonexistent	Poor	Poor
Braided Channel	Nonexistent	Nonexistent	Nonexistent	Nonexistent
Amount of Pine Needles in Stream	Nonexistent	Nonexistent	Nonexistent	Nonexistent
Velocity/Flow	Good	Good	Good	Good
Sedimentation	Little or none	Moderate	Little or none	Little or none

The SCDHEC SOP adopted the USEPA's Revisions to Rapid Bioassessment Protocols for Use in Streams and Rivers and also developed a simplified form to meet the specific needs of the SCDHEC's Aquatic Biology Section. Other species observed but not collected included fish, crayfish, and salamanders, were recorded on the Macroinvertebrate Habitat Assessment Forms. Completed habitat assessment forms are located in Appendix I and a summary of the Aquatic Biology Section Habitat Assessment results are presented above in Table 6-9.

6.5 Mussel Surveys

Freshwater mussel habitat assessments were conducted in July and August, 2023. Consistent with the RSP, Duke Energy biologists surveyed potential upland spoil locations for mussel habitat and determined that no supportive habitat is present for mussel assemblages due to an absence of fish hosts necessary for mussel reproduction. SCDNR concurred with this assessment during the July 12, 2023, site visit to two potential spoil locations with streams representative of those in the area. With this conclusion, no mussel searches were completed at these locations.

Stream 1 and Stream 7 contained suitable habitat for mussels consisting of diverse substrates and creek shoreline complexity, although no fish were captured during electrofishing in Limber Pole Creek. Searches in these two streams totaling one person-hour each yielded no freshwater mussels or shells. Mussel searches were again conducted during electrofishing surveys in September and October, yielding no direct mussel observations or evidence of past or present mussel presence (shells). During the three searches in each of these two creeks, water temperature ranged from 11.6°Celsius (°C) to 20.8°C, and dissolved oxygen ranged from 7.9 milligrams per liter (mg/L) to 9.9 mg/L.

A length of approximately 600 meters of shoreline along the western shore of the Whitewater River arm of Lake Jocassee near the Bad Creek inlet/outlet structure and proposed location of the Bad Creek II Complex inlet/outlet structure was surveyed for suitable freshwater mussel habitat. This survey found a band of suitable sand habitat which stretched approximately 200 meters from the base of Whitewater Falls to the proposed location of the Bad Creek II Complex inlet/outlet structure (Figure 6-3). Three other small coves in the Whitewater River arm also exhibited suitable sand habitat to support freshwater mussels. Four total person-hours of searching these areas in Lake Jocassee yielded no freshwater mussels or shells. Non-native Asian clams (*Corbicula fluminea*) were identified, although their distribution was uncommon and patchy. During the survey, the water temperature was 27.5°C with 7.9 mg/L dissolved oxygen.

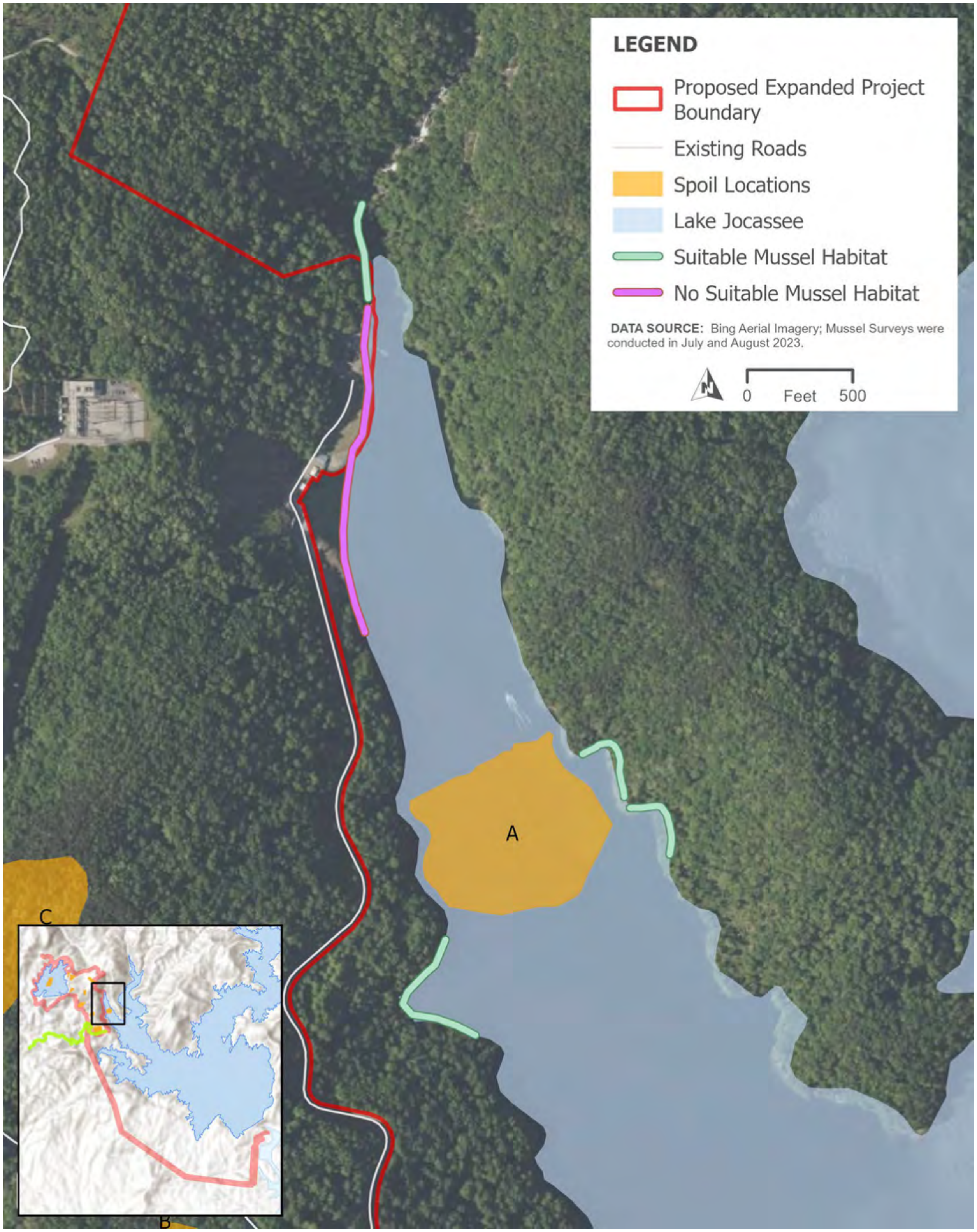

Figure 6-3. Mussel Habitat Survey Areas along Lake Jocassee Shoreline

7 Conclusions

The USEPA RBP and NCSAM methods of stream habitat quality assessments indicate that the streams within potential spoil locations and those potentially crossed by the proposed temporary access road are in fully functioning condition. Although the SQT rated streams along the temporary access road relatively low, the streams are generally in stable, functioning condition for the stream classification and characteristics which they exhibit (e.g., entrenchment). While field crews were unable to complete USEPA RBP and NCSAM forms for streams 13, 14, 20, or 21 (within potential spoil locations B and D), consistent with SCDNR determination during the July 2023 site visit (see Section 6.2.3), it is likely that these streams also present fully functioning conditions.

Macroinvertebrate surveys of Stream 1 and Stream 7 found abundant EPT taxa and habitat conditions, resulting in a high bioclassification score indicating a fully supporting system. While fish community sampling resulted in limited fish species collected from Stream 7 and none from Stream 1, this is typical of streams high in the watershed where flow may be limited in areas and high gradient sections of stream may include natural barriers to upstream movement.

No mussel habitat was identified in streams within potential spoil locations. Although suitable mussel habitat was present in Stream 1, Stream 7, and areas of shoreline in Lake Jocassee, no native mussels were observed during any of the surveys.

7.1 Impacts Assessment

Impacts to streams and wetlands within potential spoil areas would consist of fill due to the placement of French drains, followed by placement of overburden (rock) generated by the construction of the Bad Creek II Complex. French drains would be used to maintain connection of flow to downstream waters, however the surface waters and wetlands within the potential spoil locations would no longer be available as habitat to the organisms currently utilizing them. Additional evaluations are currently underway to determine natural resource impacts for the different potential spoil areas, and these evaluations are expected to inform eventual spoil site selection.

If the Bad Creek II Complex is pursued and the temporary access road is constructed, limited, if any impacts to streams crossed by the access road are expected. Streams would be spanned by bridges to avoid direct impact to streams, and best management practices, such as silt fencing, would be installed to prevent any incidental water quality impacts caused by temporary land disturbance. The road would be decommissioned following the construction completion of the Bad Creek II Complex and bridges removed.

No impacts to mussels are expected, as no native mussels were observed in the vicinity of the current or future inlet/outlet structure, or in the vicinity of the expanded underwater weir. A minor portion of suitable mussel habitat located immediately upstream of the proposed inlet/outlet structure for the Bad Creek II Complex could be impacted due to construction activities, however, as stated, no mussels were identified in this area during surveys. Aquatic organisms in Lake Jocassee would experience short-term water quality effects due to expansion of the weir (i.e., placement of rock/overburden on and in the vicinity of the existing weir) and construction of the Bad Creek II Complex inlet/outlet structure. Per the Water Resources RSP, a Water Quality Monitoring Plan will be developed in consultation with stakeholders and focused on the pre-construction, construction, and post-construction of the Bad Creek II Complex, with key components including 1) the construction of the inlet/outlet structure and expansion of the submerged weir; 2) construction in upland areas; and 3) potential upland spoil disposal.

Compensatory mitigation will be required for unavoidable impacts to surface waters (including wetlands) that are regulated under Section 404 of the Clean Water Act to ensure that impacts to aquatic resources are avoided or minimized to the greatest extent possible. Mitigation options may include on-site restoration and/or purchase credits from an approved in-lieu fee mitigation bank to offset unavoidable adverse impacts.

8 Variances from FERC-approved Study Plan

The USEPA RBP and NCSAM forms for five streams within potential spoil locations B, D, and J were not completed as required by the RSP due to safety concerns related to inclement weather. As with other streams within potential spoil locations or observed along the proposed temporary access road, and consistent with SCDNR determination during the July 2023 site visit (see Section 6.2.3), it is likely that these streams also present fully functioning conditions.

Additional acreage was included in the study area originally presented in the RSP to assess potential impacts to natural resources associated with construction of a temporary access road to the south of the Project. The temporary access road would provide ingress and egress to homeowners of the Fisher Knob community during construction, which requires public closure of Bad Creek Road. Additionally, methods for determining stream quality were expanded to include the SQT methodology, which was completed in collaboration with the SCDNR.

9 Germane Correspondence and Consultation

Germane correspondence and consultation documentation related to Task 3 of the Aquatic Resources Study is summarized in Table 10-1 and included in Attachment 4 of the Aquatic Resources Draft Study Report.

Table 10-1. Summary of Germane Correspondence and Consultation related to Task 3 of the Aquatic Resources Study

Date	Correspondents	Topic
April 19, 2023 (e-mail)	Duke Energy to Aquatic Resources RC	Transmittal of April 6, 2023, entrainment meeting summary and proposal to use the NCSAM (request for comment)
May 8, 2023 (e-mail)	SCDNR to Duke Energy	Request to use the SC SQT to evaluate streams to be assessed under Task 3 of the Aquatic Resources Study
May 9, 2023 (e-mail)	Duke Energy to SCDNR	Acknowledgement of request receipt
May 24, 2023 (virtual meeting)	Duke Energy and SCDNR	Virtual meeting with SCDNR to discuss methodology and applicability of the SQT to streams within spoil locations and along the proposed temporary access road
June 9, 2023 (e-mail)	Duke Energy to SCDNR	Transmittal of meeting minutes summary from May 24, 2023, discussion and Stream Survey Approach Memo with request for comment
June 16, 2023 (e-mail)	SCDNR to Duke Energy	Comments on Stream Survey Approach Memo
June 21, 2023 (virtual meeting)	Duke Energy and SCDNR	Virtual meeting with SCDNR to discuss SQT methodology and applicability to streams within spoil locations and along the proposed temporary access road, as well as the SQT debit calculator
June 23, 2023 (e-mail)	Duke Energy to SCDNR	Transmittal of meeting minutes summary from May 24, 2023, discussion

Date	Correspondents	Topic
June 23, 2023 (e-mail)	SCDNR to Duke Energy	Comments on May 24, 2023, meeting summary
July 12, 2023 (in-person)	Duke Energy and SCDNR	Site visit to Spoil Locations B and G on the Bad Creek II Complex project site
August 3, 2023 (e-mail)	Duke Energy to the Aquatic Resources RC	Transmittal of the revised Stream Survey Approach Memo
September 18, 2023 (e-mail)	Duke Energy to SCDNR	Question regarding number of riparian vegetation survey plots required for survey in support of the SQT
September 23, 2023 (e-mail)	SCDNR to Duke Energy	Response to question regarding the number of riparian vegetation survey plots required
November 17, 2023	Duke Energy to the Aquatic Resources RC	Distribution of the Task 3 Aquatic Resources Impacts to Surface Waters and Associated Aquatic Fauna Draft Report
December 18, 2023 (virtual meeting)	Duke Energy and SCDNR	Virtual meeting with SCDNR to discuss comments on the Aquatic Resources Impacts to Surface Waters and Associated Aquatic Fauna Draft Report
December 21, 2023	Duke Energy to SCDNR	Transmittal of meeting minutes summary from December 18, 2023, discussion
December 21, 2023	SCDNR to Duke Energy	Comment on meeting summary from December 18, 2023
December 21, 2023	SCDNR to Duke Energy	Transmittal of comments on Aquatic Resources Impacts to Surface Waters and Associated Aquatic Fauna Draft Report
December 22, 2023	Duke Energy to SCDNR	Transmittal of Natural Resources Assessment report and spatial file for streams located along the temporary access road
December 31, 2023	SCDNR to Duke Energy	Comments on the meeting summary from December 18, 2023
January 9, 2024	Duke Energy to SCDNR	Transmittal of revised meeting minutes summary from the December 18, 2023, meeting

10 References

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Attachment A

Attachment A - Aquatic Resources Study Approach to Stream Surveys Memo

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Memo

Date:	Wednesday, July 26, 2023
Project:	Bad Creek Pumped Storage Project Relicensing
To:	South Carolina Department of Natural Resources
From:	HDR Engineering of the Carolinas, Inc.
Subject:	Aquatic Resources Study Approach to Stream Surveys – Revised Post-Consultation

Project Understanding

Duke Energy Carolinas, LLC (Duke Energy or Licensee) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Project) (Federal Energy Regulatory Commission [FERC] Project No. 2740) located in Oconee County, South Carolina. Duke Energy is pursuing a new license for the Project and in accordance with 18 Code of Federal Regulations §5.11, developed a Revised Study Plan (RSP) which proposed six studies for Project relicensing, including an Aquatic Resources Study. The goal of the Aquatic Resources Study is to evaluate potential impacts to fish and aquatic life populations, communities, and habitats due to the potential construction and operation of an additional power complex (Bad Creek II Power Complex [Bad Creek II Complex]) adjacent to the existing Project. The Aquatic Resources Study is ongoing.

As additional information, Duke Energy is proposing the development of an access road to provide an alternate route to the Fisher Knob community, for use during Bad Creek II construction. The access road is not presently included in the proposed expanded FERC Project Boundary and was not yet planned at the time of preparation of the RSP. Consistent with the objective of the Aquatic Resources Study to "evaluate the aquatic resources (streams, wetlands, and Lake Jocassee) that may experience direct impacts from spoil placement or other construction activities", Duke Energy plans to evaluate surface waters that may be crossed by the access road in addition to waters within potential spoil locations as described in the RSP.

Approach to Streams within Potential Spoil Locations

According to preliminary studies and estimates for proposed material removed from underground excavations for the Bad Creek II Complex, approximately 4 million cubic yards of overburden material for the project infrastructure will need to be deposited at upland spoil locations or along the submerged weir in Lake Jocassee (Attachment 1). An additional spoil area related to the construction of a proposed transformer yard, potential spoil location J, adds an approximately 0.4 million cubic yards to the overburden amount, for a total of 4.4 million cubic yards. Nine potential streams are present within the proposed on-site spoil locations (see Table 1 and Attachment 1). Surface waters (including wetlands) in these locations were evaluated in the field during the Natural Resources Assessment completed by HDR in September 2021 (HDR 2021; Appendix E of the Pre-Application Document filed with FERC on February 23, 2022).

Consistent with the RSP, Duke Energy will complete U.S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocol (USEPA RBP; Barbour et al. 1999) stream habitat assessments for all streams within potential spoil locations. During the Joint Resource

Committee Meeting on February 22, 2023, and the Aquatic Resources Study Resource Committee Meeting held on April 6, 2023, committee members expressed interest in biological assessments. In follow-up correspondence with the Aquatic Resources Committee, Duke Energy proposed to complete stream assessments using the North Carolina Stream Assessment Method (NCSAM; N.C. Stream Functional Assessment Team 2013) in addition to the USEPA RBP.

The South Carolina Department of Natural Resources (SCDNR) also requested that Duke Energy use the SCDNR Stream Quantification Tool (SQT)[1] (South Carolina Steering Committee 2022) for stream assessments. Duke Energy consulted with the SCDNR on May 24 and June 21, 2023, to discuss the applicability and methodology of the SQT. Duke Energy, HDR, and SCDNR also participated in a site visit to Bad Creek on July 12, 2023. The site visit included Alan Stuart (Duke Energy), Allan Boggs (Duke Energy), Nick Wahl (Duke Energy), Eric Mularski (HDR), Erin Settevendemio (HDR), and Lorianne Riggin (SCDNR). The group visited spoil locations B and D (see figures in Attachment 1), which were considered locations with representative conditions of stream and riparian habitat. During the site visit, SCDNR and Duke Energy agreed that the streams within spoil locations are generally high functioning with limited (if any) anthropogenically caused degradation, and that field data collection to support SQT analysis for streams within spoil locations was not likely to produce significantly different results (i.e., lower functionality scores) than an assumption of fully functional. Therefore, field surveys of the streams within potential spoil locations applying the SQT methodology are not required.

Approach to Streams Crossed by the Access Road to the Fisher Knob Community

The potential access road would require crossings at three named streams (Limber Pole Creek, Howard Creek, and Devils Fork) and potentially other unidentified streams (see figures provided in Attachment 2). Currently, two access road routes are being considered, however only one would be developed. The routes diverge just west of Howard Creek, where Option 1 crosses Howard Creek and heads north across a ridge. Option 2 crosses Howard Creek and heads south along the left bank of Howard Creek before directing northeast. The road options converge east of the transmission line corridor west of Devils Fork. It is anticipated that Option 1 would result in fewer riparian buffer impacts and therefore this is the preferred route.

Based on review of two-foot topography contour maps, an additional three streams may be present along the access road, though the flow of these streams is currently unknown. A surface waters delineation is scheduled for mid-late August to identify stream conditions/flow of these unnamed features. If Duke Energy develops the access road, streams and creeks along the alignment will likely be spanned by [temporary] bridges. Duke Energy will conduct field assessments using the SCDNR SQT to evaluate stream function as a baseline prior to construction activities to document any changes that may occur, though none are anticipated.

Streams crossed by the access road will be assessed with the USEPA RBP and NCSAM. Stream assessments will be conducted upstream and downstream of each road crossing. The intent is to document a baseline, existing condition of the stream before the construction of the access road. When and if the road is decommissioned, the streams would be re-assessed to compare to the baseline condition. Additionally, evaluating the streams at upstream and downstream locations

[1] SCDNR Stream Quantification Tool

allows an opportunity to document changes that may have happened elsewhere (i.e., upstream) in the watershed or as a result of other factors, such as storm events.

Proposed Field Methods

Numerous methods for stream habitat and biological assessments will be used for evaluating streams in the vicinity of the Project. Field methods to be implemented at each stream are based on consultation with the Aquatic Resources Study Resource Committee (RC) and SCDNR, as discussed above. The following summary provides an overview of planned field methods for streams within spoil locations and those crossed by the potential access road.

USEPA Rapid Bioassessment Protocol

In accordance with the RSP, the USEPA RBP stream habitat assessment will be completed at all streams within spoil locations. Barbour et al. (1999) states, "an evaluation of habitat quality is critical to any assessment of ecological integrity". Stream habitat assessments are defined as the "evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community" (Barbour et al. 1999). These assessments provide information regarding stream functionality and condition, which in turn can indicate the value of aquatic habitat to aquatic and terrestrial life, and ecosystem services such as nutrient reduction and support of watershed health. The USEPA RBP includes an evaluation of the variety and quality of (1) stream substrate, (2) channel morphology, (3) bank structure, and (4) riparian vegetation. Ten parameters within the four categories are rated on a numerical scale for each sampled reach.

NC Stream Assessment Method

The NCSAM provides "an accurate, reproducible, rapid, observational, and science-based field method to determine the level of stream function relative to a reference condition" (N.C. Stream Functional Assessment Team 2013). While the NCSAM was developed for use in North Carolina, the Project is just a few miles from the North-South Carolina border and stream categories identified for the method include those in the Blue Ridge ecoregion, where the Project is located. Similarities between topography and streams in the Carolinas allow this method to provide valuable information regarding the overall function of streams with a simple and efficient tool.

The NCSAM rates streams for three Class 1 functions: hydrology, water quality, and habitat. Within each Class 1 function, streams are rated for up to eight Class 2 functions, which may include Class 3 and Class 4 functions. The functions provided by a stream are a product of the hydrologic, geologic, morphologic, and vegetational setting of the stream and its drainage area (Gordon et al. 1992 as cited by N.C. Stream Functional Assessment Team 2013). Alterations and/or stressors can contribute to the degradation of a stream, either naturally or anthropogenically, including storm damage, excessive vegetation, beaver impoundment, stream migration, and sedimentation, which can lead to lower stream function. Parameters evaluated with NCSAM protocol include flow restrictions; streambank erosion; buffer size and type; water quality stressors; substrate composition; in-stream habitat; visual and dip netting assessments for aquatic life; presence of wetlands; shade; and others.

SCDNR Stream Quantification Tool Approach

As stated above, six or more streams could be crossed by the access road and Duke Energy proposes to use the SQT field methodology for stream assessments in this area. The SCDNR SQT was developed in a collaborative effort between federal and state representatives to provide a tool for assessing and quantifying functional lift and loss of streams in South Carolina. The SQT can be used to determine the functional condition of a stream, with the SQT Debit Calculator as a means of calculating credits or debits resulting from reach-scale activities typically encountered in the Clean Water Act 404 program.

The SQT requires the assessment of five functional categories: hydrology, hydraulics, geomorphology, physiochemical, and biology (South Carolina Steering Committee 2022). Depending on the anticipated type of impacts or lift, physiochemical and biology categories are optional. Guidance from the SQT suggests physiochemical parameters be measured for stream projects with "goals or objectives related to physiochemical functions or where watershed conditions suggest that uplift is possible." Work would be conducted from upland locations and no in-water work would occur. Best management practices to prevent sedimentation such as silt fencing would be installed to prevent water quality impacts at stream crossings. The future Water Quality Management Plan (developed under the Water Resources Study) will also consider water quality in the areas of the new access road. Given that impacts to water quality are not anticipated and appropriate protection measures will be taken, Duke Energy is not proposing physiochemical monitoring.

At prior meetings with Duke Energy, Aquatic Resources RC members have expressed interest in the biological community of streams in the vicinity of the proposed Bad Creek II Complex. Duke Energy therefore proposes to conduct fish and macroinvertebrate sampling supporting the SQT assessment.

Hydrology, Hydraulics, and Geomorphology

Duke Energy will survey all streams crossed by both access road options using the first three functional categories of the SQT, which comprise hydrology, hydraulics, and geomorphology, using the Rapid Method outlined in the SQT Data Collection and Analysis Manual (South Carolina Steering Committee 2022). Parameters evaluated under these categories include reach runoff, floodplain connectivity, flow dynamics, large woody debris, lateral migration, riparian vegetation, and bed form diversity. Up to 17 metrics will be taken for the parameters evaluated; metrics selection, instruction, and applicability is provided in the SQT Data Collection and Analysis Manual (South Carolina Steering Committee 2022).

Fish Surveys

Fish surveys for use with the SQT are only applicable to perennial streams with drainage areas between 1.5 and 63 square miles (South Carolina Steering Committee 2022), which includes Limber Pole Creek and Howard Creek. As outlined by the SQT Data Collection and Analysis Manual, fish surveys will follow Fish Collection Protocols for Streams as described in the SCDNR Fish Sampling Guidance[2] (SCDNR 2022). For streams in the Blue Ridge ecoregion, sample reaches will be 30 times the average wetted width, or a minimum 100 meters with one electrofishing pass. Surveys will be completed upstream and downstream of the road crossings

[2] SCDNR Fish Sampling Guidance

three times between July and October 2023. A calibrated multiparameter water quality data sonde will be used to record existing water quality conditions during sampling events, including temperature, dissolved oxygen, conductivity, pH, salinity, and turbidity.

Macroinvertebrate Surveys

Macroinvertebrate surveys under the SQT are limited to perennial streams with a minimum three-square mile drainage area (South Carolina Steering Committee 2022), which includes Limber Pole Creek and Howard Creek. As outlined in the SQT Data Collection and Analysis Manual, macroinvertebrate surveys will be completed following the Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling[3] (SCDHEC 2017). This method uses a qualitative multiple habitat sampling protocol with kick nets, D-shaped dip nets, and sieves to collect as many different macroinvertebrate taxa as possible during a specified amount of time. One survey per stream reach will be conducted during the recommended index period (June 15, 2023 to September 15, 2023 for the Blue Ridge ecoregion). Stream reach lengths will be determined on a site-by-site basis consistent with guidance provided in SCDHEC (2017), which is typically 100 meters of stream. Water quality conditions at the time of sampling will be recorded with a multiparameter data sonde. Collected samples will be preserved in 85 percent ethanol and labeled with the station number and collection date. Samples will be transported to a qualified laboratory for identification and analysis under chain-of-custody. Identified taxa and relative abundance will be used to calculate biotic indices to assess stream conditions.

Mussel Surveys

Consistent with the RSP, Duke Energy biologists surveyed upland spoil locations for mussel habitat and determined that no supportive habitat is present for mussel assemblages. SCDNR concurred with this assessment during the July 12, 2023 site visit to two representative spoil locations with streams characteristics of those throughout the Aquatic Resources study area.

Mussel surveys of Limber Pole Creek and Howard Creek will be conducted in late July 2023 following methods adapted from the USEPA Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys for the Development of Site-specific Water Quality Criteria for Ammonia (USEPA 2013). The survey will include visual and tactile collection of mussels, identification to species, and enumeration. Habitat conditions will be documented, including substrate and water quality, through stream habitat assessments and fish surveys.

Summary of Proposed Field Methods

Field surveys of streams within spoil locations were proposed in the RSP. Since the proposed access road was not planned at the time of the filing of the RSP, the stream crossings were not included in Aquatic Resources Study; however, for completeness, field surveys will also be performed at potential stream crossing locations. The field methods proposed for each stream were developed in consultation with the Aquatic Resources RC and SCDNR. A summary of the proposed field methods is provided in Table 1, with brief descriptions of methods provided in Table 2.

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[3] SCDHEC Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling

Results and Conclusions

An overview of results of field studies will be discussed in a future meeting to be scheduled for late October or early November 2023. Results and conclusions of the stream habitat assessments and SQT will be summarized in a draft report, which will be provided to the Aquatic Resources RC in November 2023 for comment and in the Initial Study Report (to be filed with FERC by January 4, 2024).

Table 1. Proposed Field Survey Approach for Streams within Potential Spoil Locations and Road Crossings

Potential Impact	Stream Name/No.	Flow	Drainage Area (sq. mi)	Stream Habitat Assessment	Fish Survey	Macroinvertebrate Survey	Mussel Survey[1]
Potential Spoil Locations							
B	20	Perennial	0.05	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
B	21	Perennial	0.05	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
C	17	Perennial	0.05	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
D	13	Intermittent	0.04	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	N/A
D	14	Perennial	0.04	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
G	4	Intermittent	0.06	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	N/A
G	4a	Perennial	0.06	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
J	11	Perennial	0.11	USEPA RBP & NCSAM	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey
Potential Access Road Crossings							
1	Limber Pole Creek	Perennial	1.8	USEPA RBP, NCSAM, & SCDNR SQT	SCDNR Fish Collection Protocol	SCDHEC Standard Operating and Quality Control Procedures	USEPA qualitative presence survey
2	UT Howard Creek	Unknown[2]	0.03	USEPA RBP & NCSAM	Unknown[2]	Unknown[2]	Unknown[2]
3a/b	Howard Creek	Perennial	4.16	USEPA RBP, NCSAM, & SCDNR SQT	SCDNR Fish Collection Protocol	SCDHEC Standard Operating and Quality Control Procedures	USEPA qualitative presence survey
4	UT Howard Creek	Unknown[2]	0.01	USEPA RBP & NCSAM	Unknown[2]	Unknown[2]	Unknown[2]
5	UT Devils Fork	Unknown[2]	0.03	USEPA RBP & NCSAM	Unknown[2]	Unknown[2]	Unknown[2]
6	Devils Fork (Stream 19)	Perennial	0.09	USEPA RBP, NCSAM, & SCDNR SQT	NCSAM visual/dipnet assessment	NCSAM presence/absence assessment	USEPA qualitative presence survey

UT: unnamed tributary
[1]Mussel surveys will only be completed in waters determined to provide supportive mussel habitat.
[2]Aquatic life surveys would only be conducted in intermittent or perennial streams.

Table 2. Descriptions of Field Survey Protocols

Survey Type	Survey Method	Brief Summary of Methods
Stream Habitat Assessment	USEPA Rapid Bioassessment Protocol Stream Assessment	Scored condition parameters including epifaunal substrate/available cover, substrate embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles or bends, bank stability, vegetative protection, and riparian vegetative zone width.
	NC Stream Assessment Method (NCSAM)	Documentation of in-stream habitat types including aquatic macrophytes and mosses; sticks, leaf packs, or emergent vegetation; snags and logs; undercut banks and root mats; and bedform and substrate types. Observations of stream instability or stressors.
	SCDNR Stream Quantification Tool (SQT)	Hydrology, hydraulics, and geomorphology will be assessed across seven functional parameters, including reach runoff, floodplain connectivity, flow dynamics, large woody debris, lateral migration, riparian vegetation, and bed form diversity. Metrics will be taken applying the Rapid Method, using tapes and stadia rods.
Fish Surveys	NC Stream Assessment Method (NCSAM)	Visual assessment for fish and semi-aquatic life such as reptiles and amphibians.
	SCDNR Stream Quantification Tool (SQT)/ SCDNR Fish Collection Protocols for Streams	Fish surveys completed for the SCDNR SQT will follow the SCDNR Fish Collection Protocols for Streams. For streams in the Blue Ridge Ecoregion, the survey reach will encompass 30 times the average wetted width of the stream or a minimum of 100 meters with one survey pass. Two to three electrofishers, two netters, and one to two buckets will be used. Water quality parameters and photo vouchers will be taken.
Macroinvertebrate Surveys	NC Stream Assessment Method (NCSAM)	Presence/absence survey of macroinvertebrates in all available habitats, including riffles, pools, snags and logs, leaf packs, macrophytes, root mats, hard substrates, and banks. Macroinvertebrates sampled via dipnet with mesh size between 0.5-0.8 mm.
	SCDNR Stream Quantification Tool (SQT)/ SCDHEC Standard Operating and Quality Control Procedures	Macroinvertebrate surveys completed for the SCDNR SQT will follow the SCDHEC Standard Operating and Quality Control Procedures. This includes a qualitative, multiple habitat sampling protocol with kick nets, D-shaped dip nets, and sieves to collect as many different macroinvertebrate taxa as possible during a specified amount of time. Stream reach lengths are typically 100 meters. Collected samples will be preserved in 85 percent ethanol and labeled with the station number and collection date. Samples will be transported to a qualified laboratory for identification and analysis under chain-of-custody. Macroinvertebrate surveys under the SQT are limited to waters with a minimum 3-square-mile drainage area.
Mussel Surveys	Adapted from USEPA Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys	Visual sampling approach to determine mussel presence, richness, and relative density. Mussels collected visually and tactilely (grubbing) during timed searches within well-defined areas.

References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

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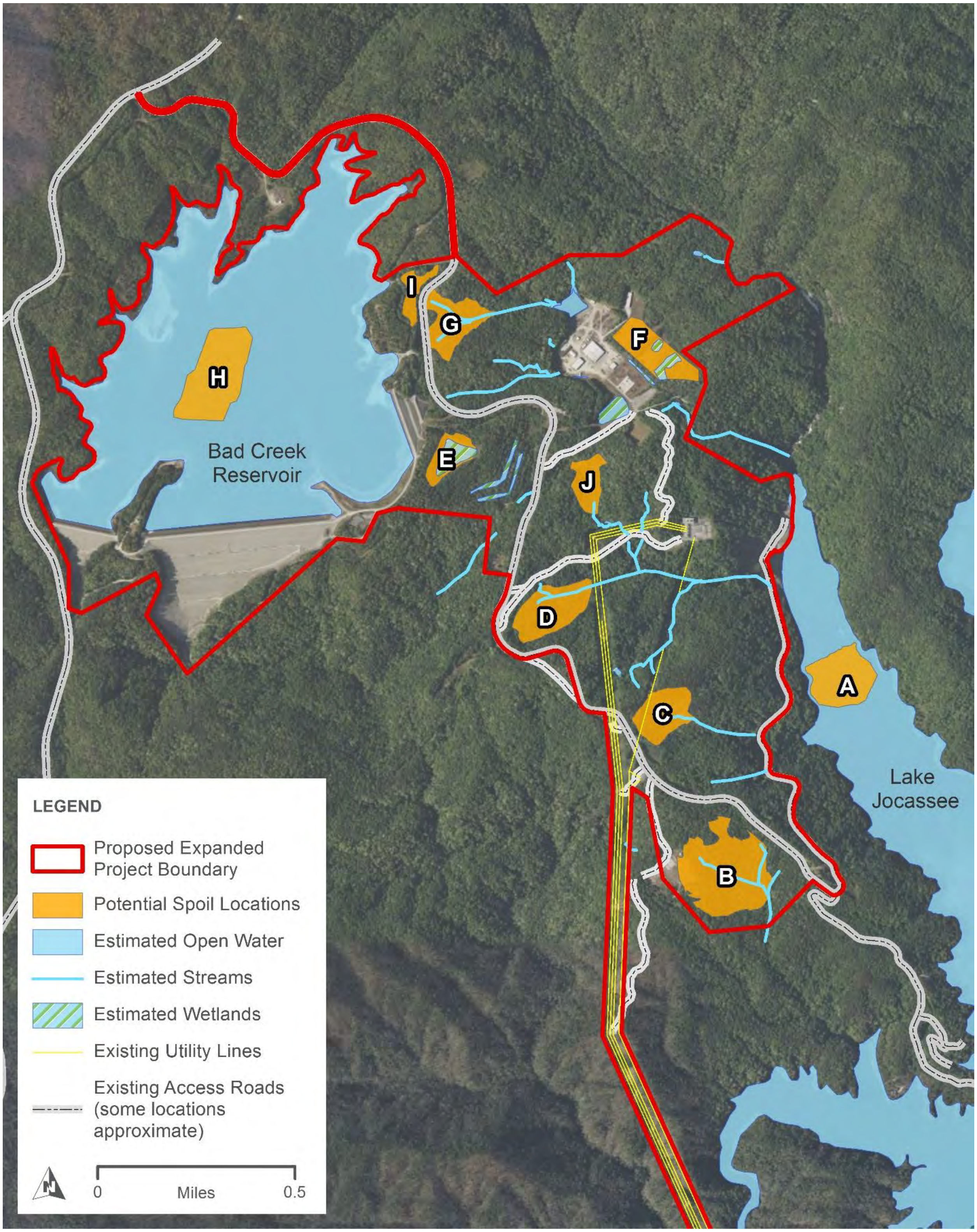
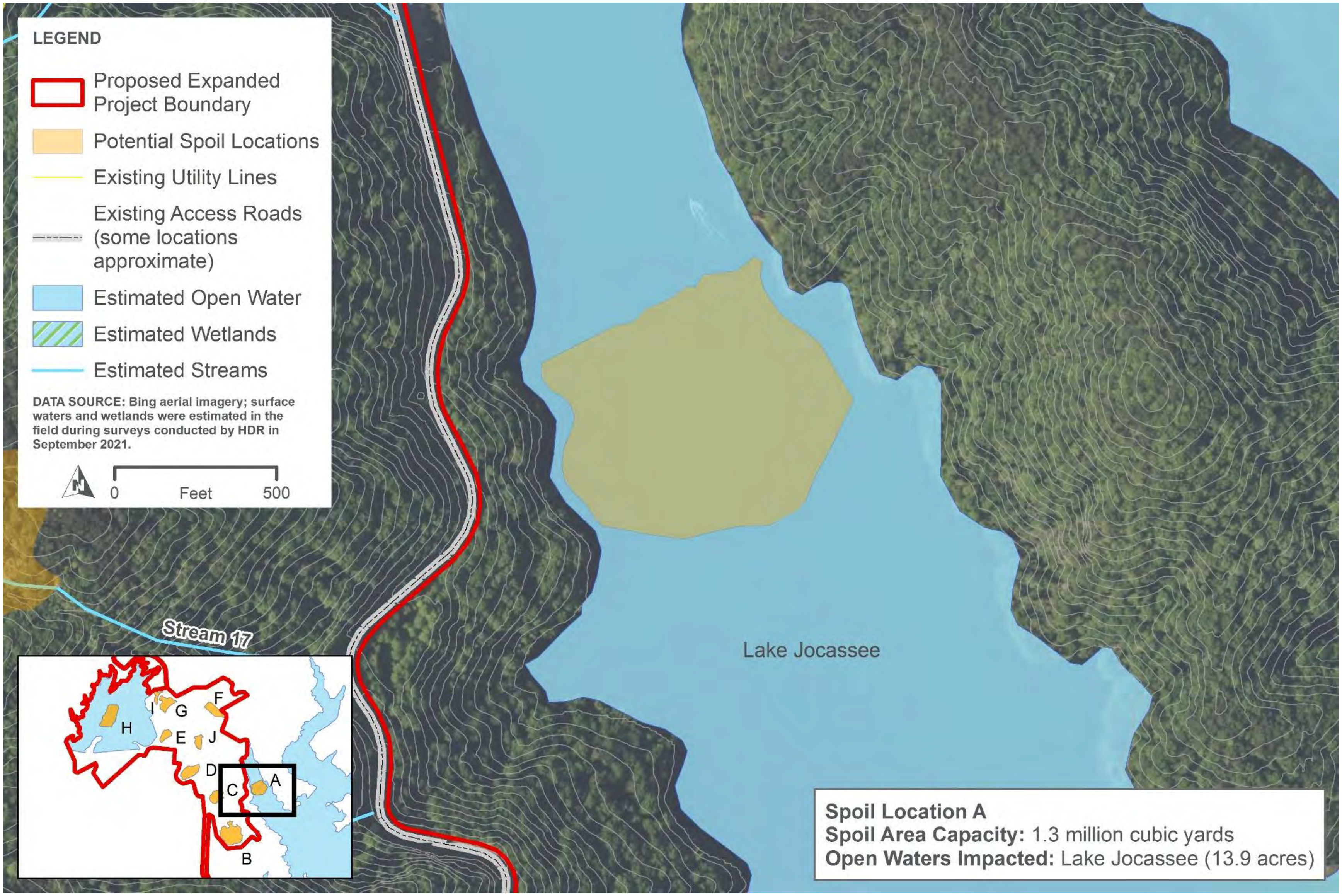
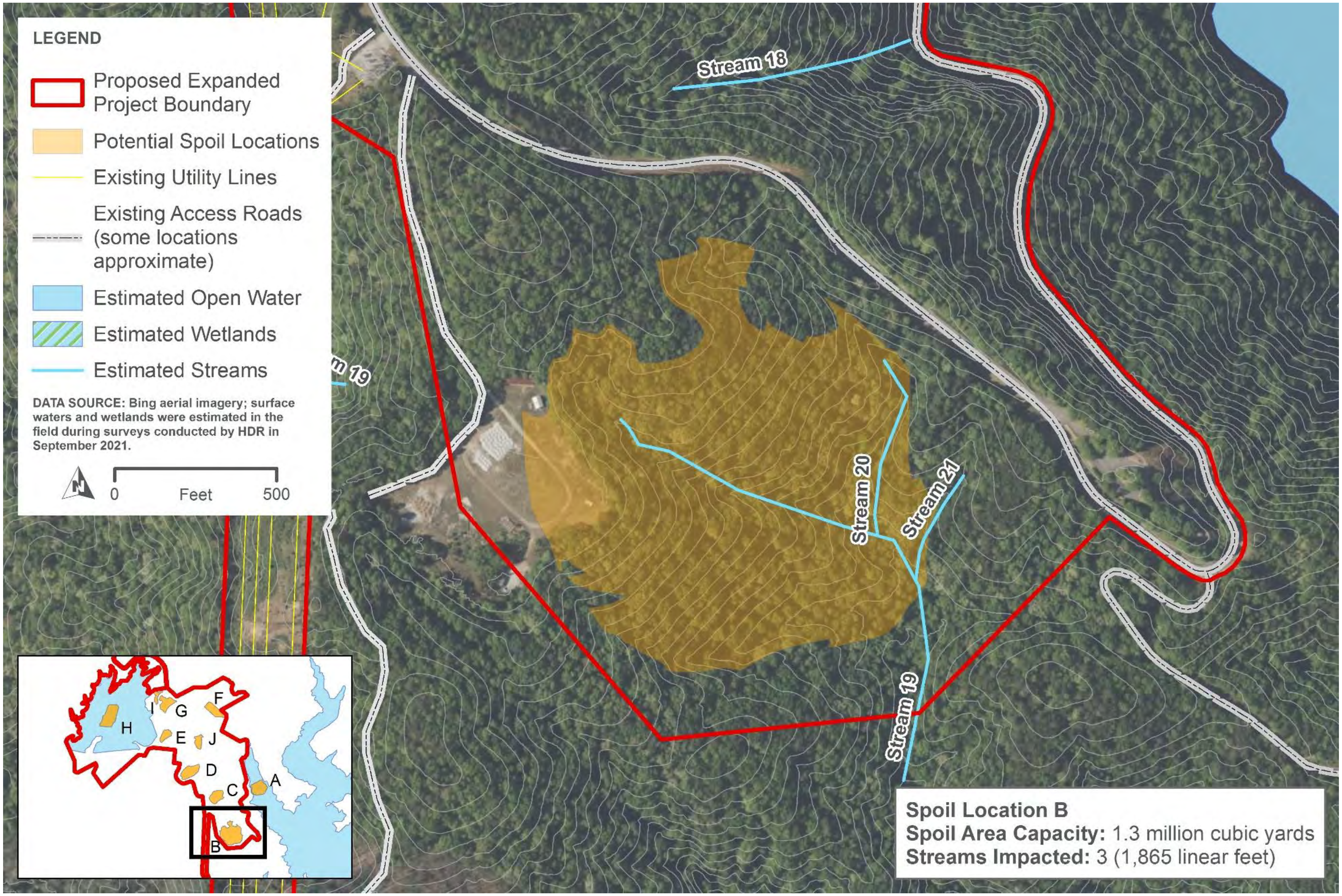
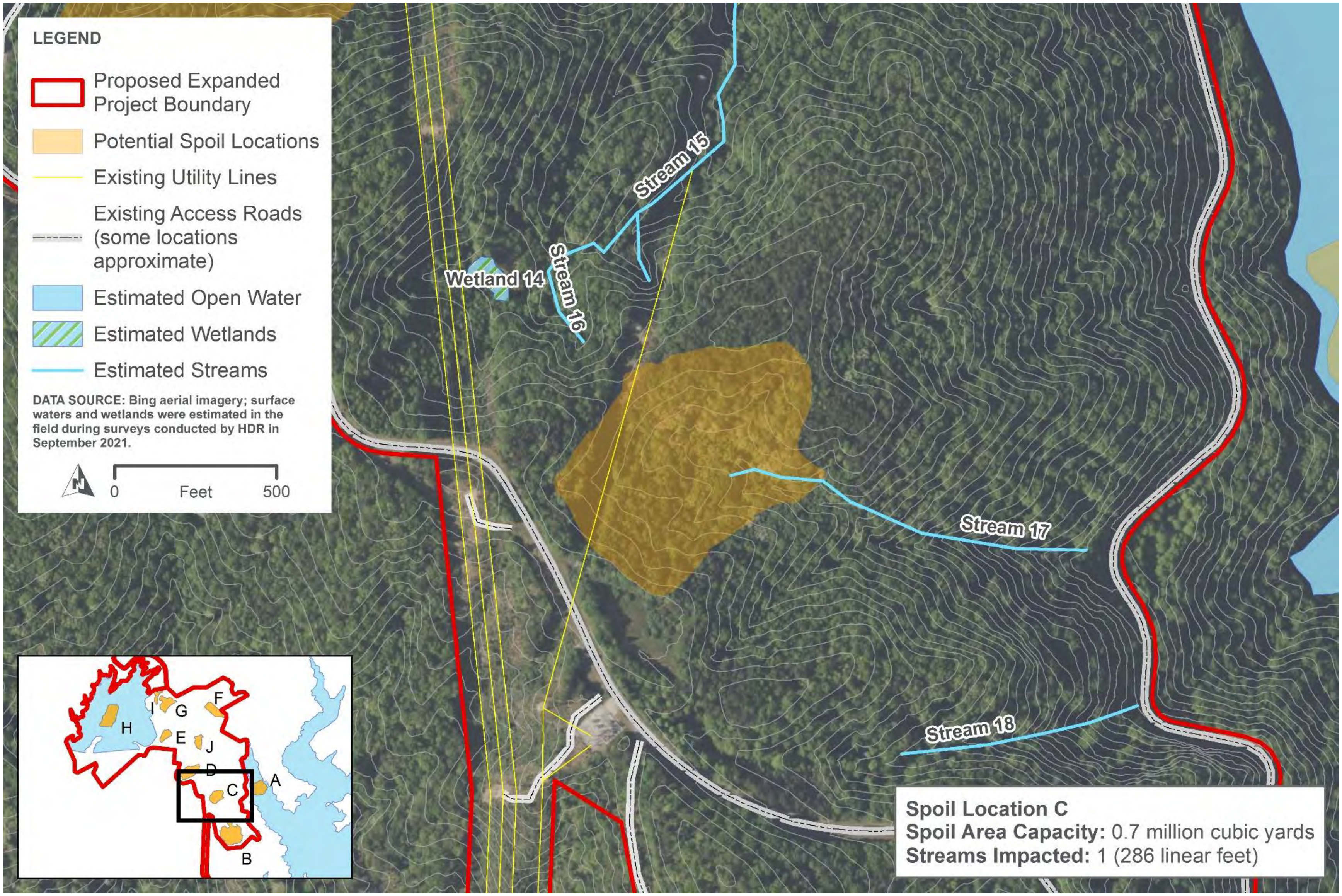
Attachment 1

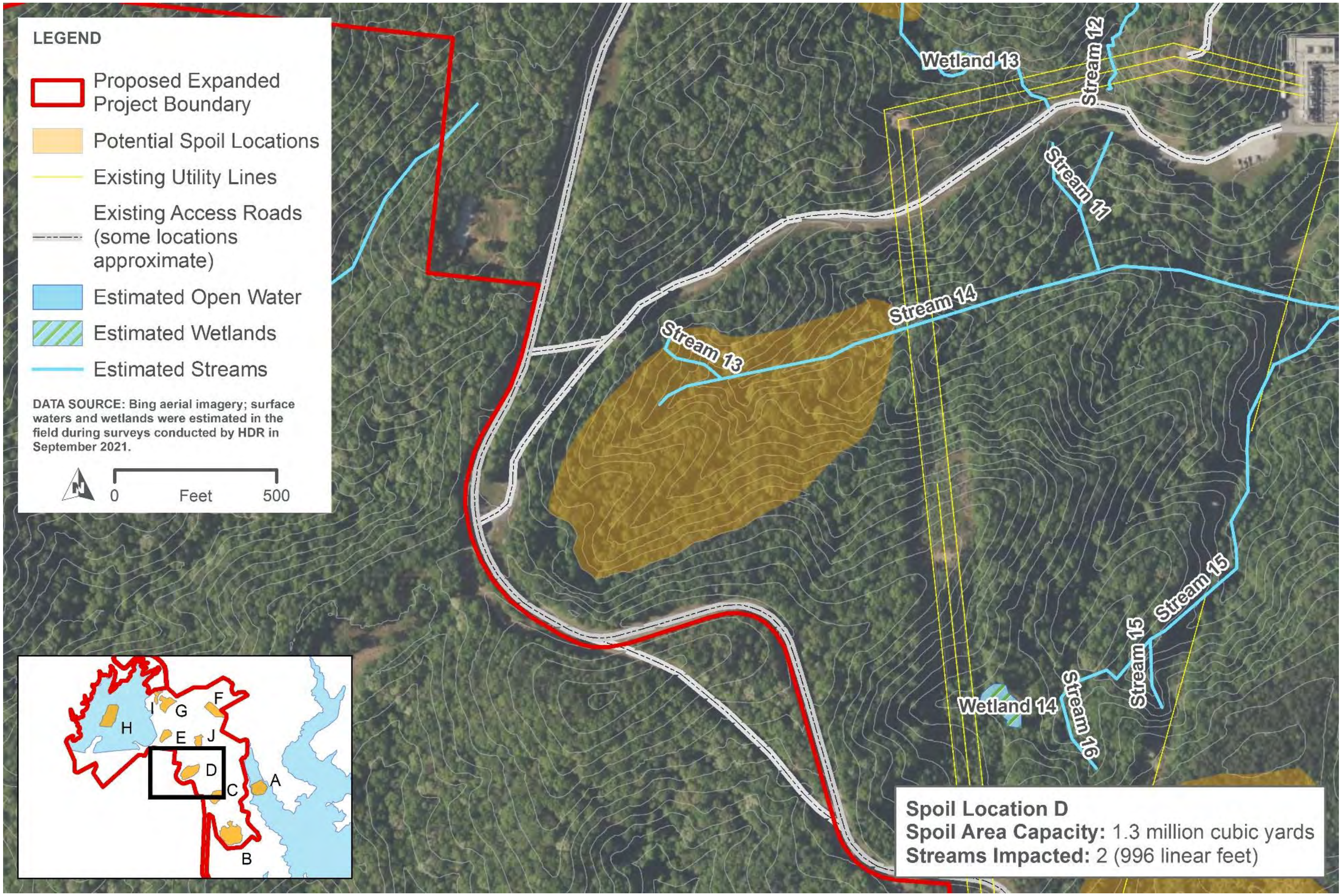
Attachment 1 – Streams and Wetlands within Potential Spoil Locations

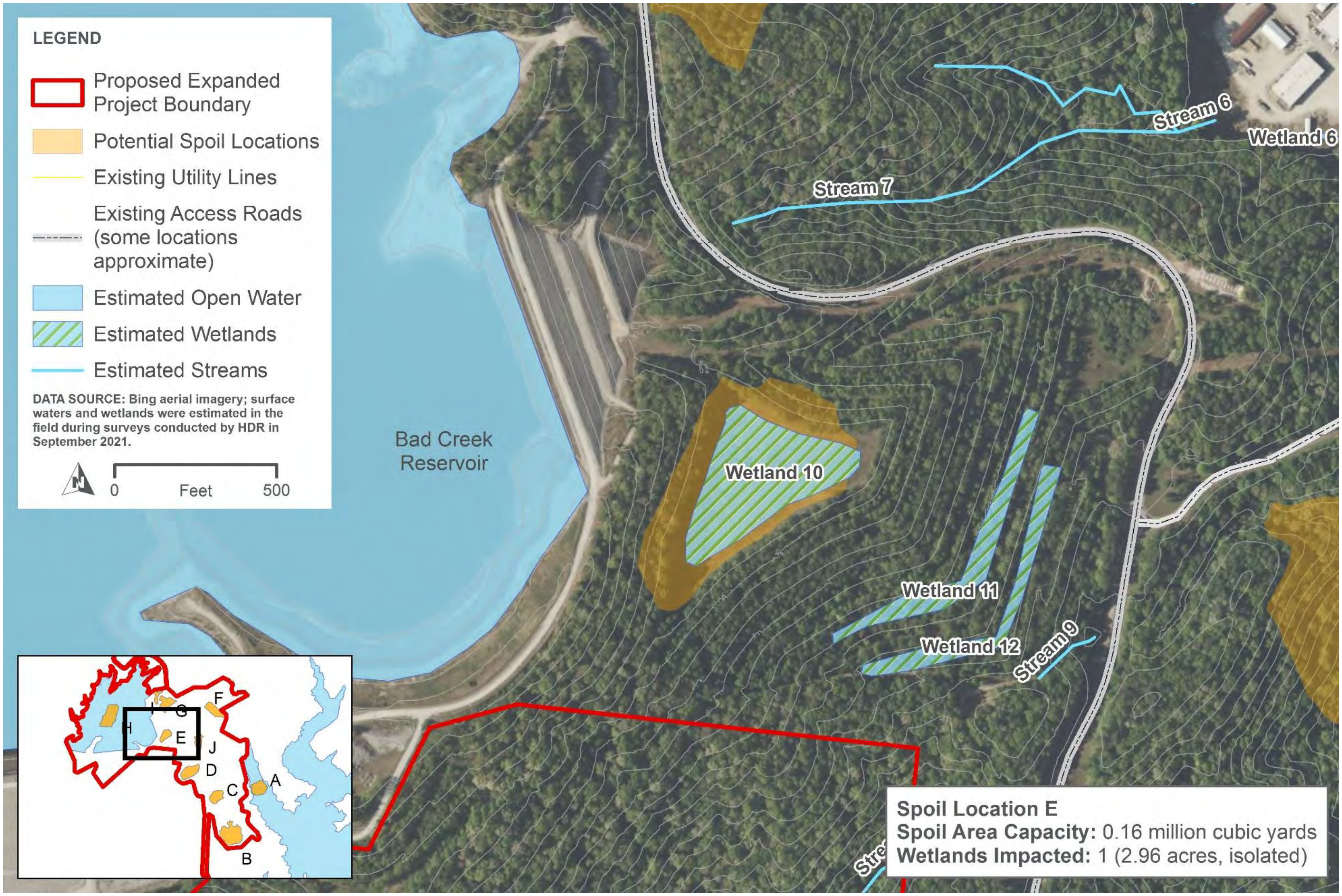

Bad Creek Reservoir
Lake Jocassee
A
B
C
D
E
F
G
H
I
J
LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Estimated Open Water
Estimated Streams
Estimated Wetlands
Existing Utility Lines
Existing Access Roads (some locations approximate)
0
Miles
0.5

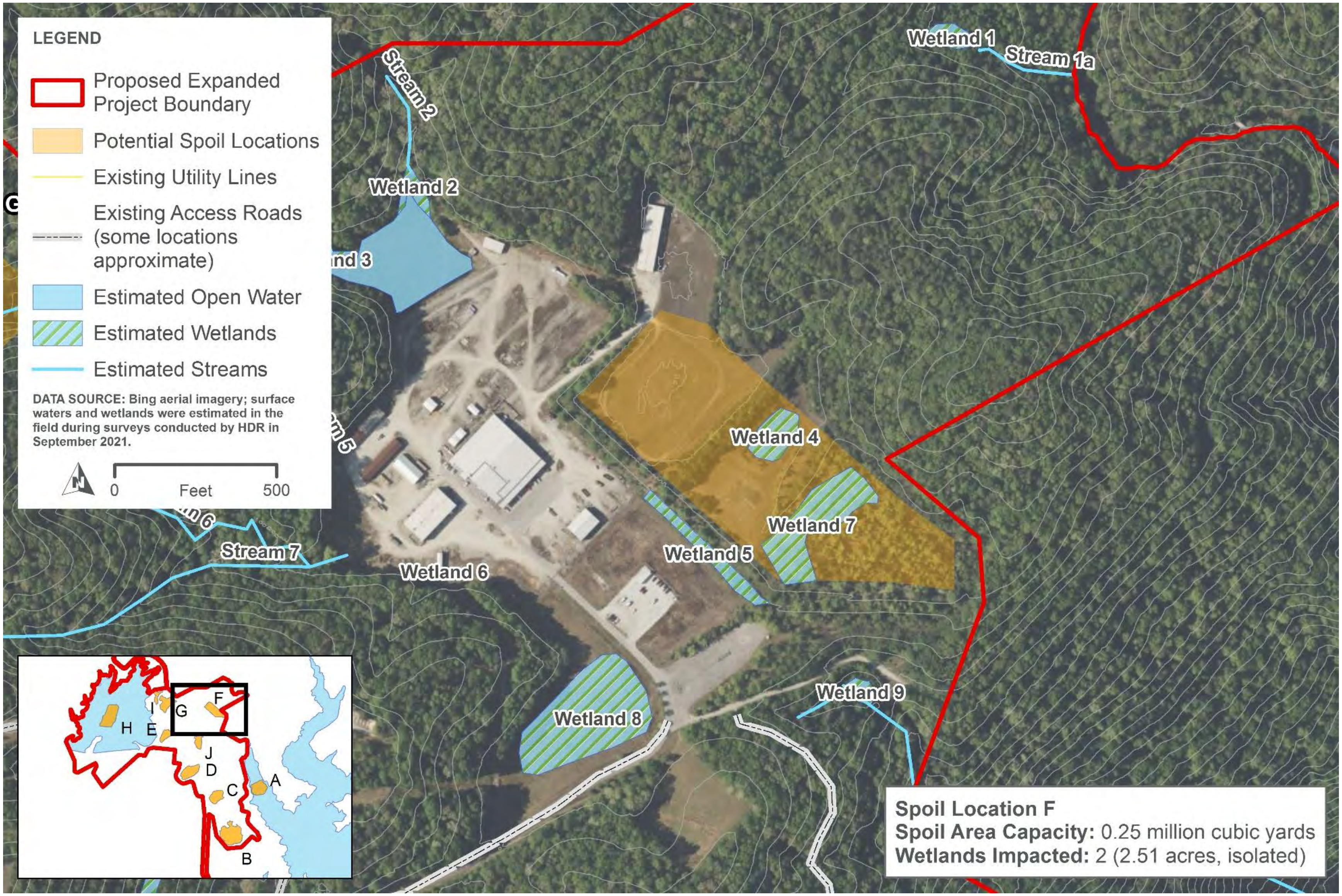

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Stream 17
Lake Jocassee
H
I
G
F
E
J
D
C
A
B
Spoil Location A
Spoil Area Capacity: 1.3 million cubic yards
Open Waters Impacted: Lake Jocassee (13.9 acres)

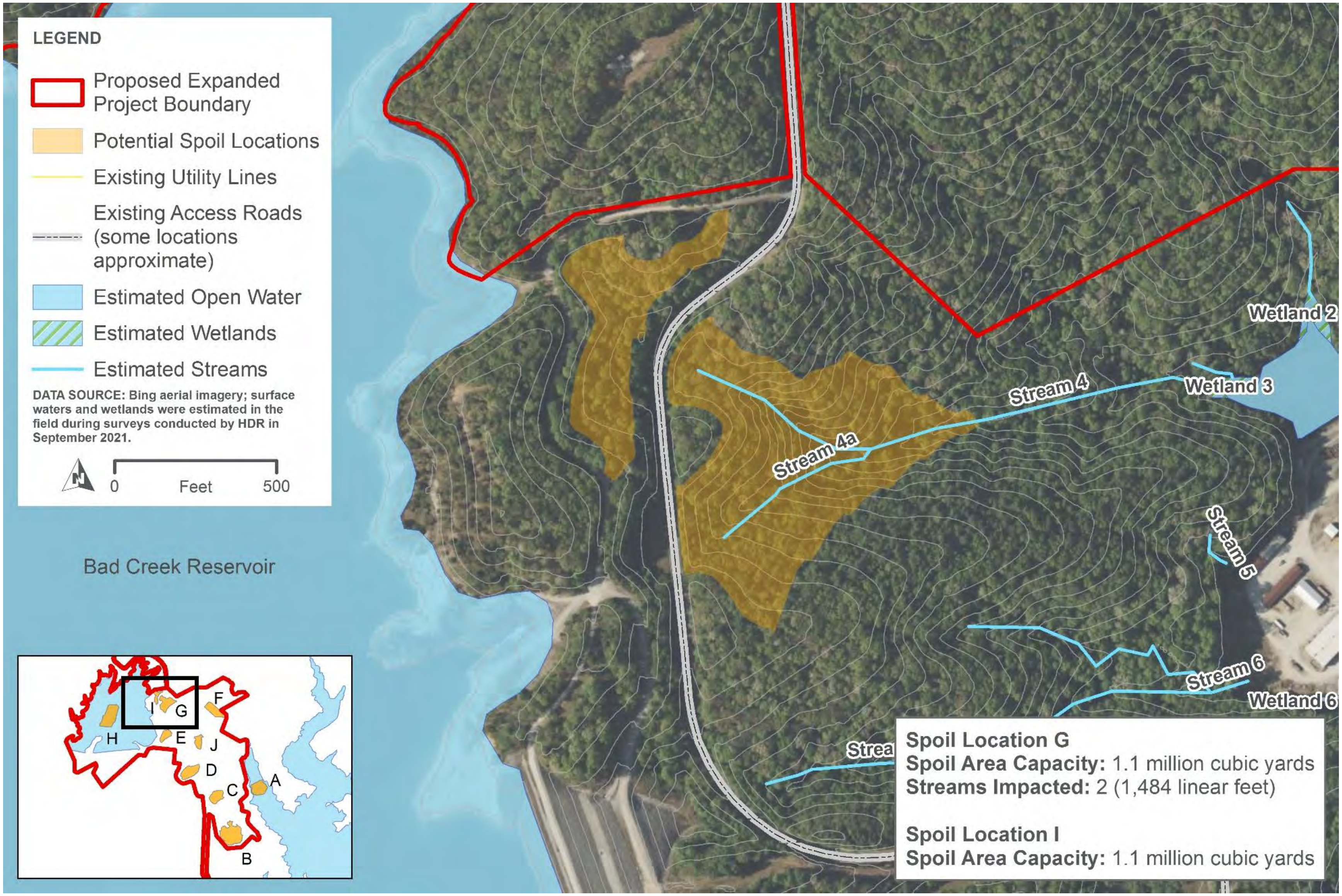

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Stream 18
Stream 19
Stream 20
Stream 21
Stream 19
H
I
G
F
E
J
D
C
A
B
Spoil Location B
Spoil Area Capacity: 1.3 million cubic yards
Streams Impacted: 3 (1,865 linear feet)

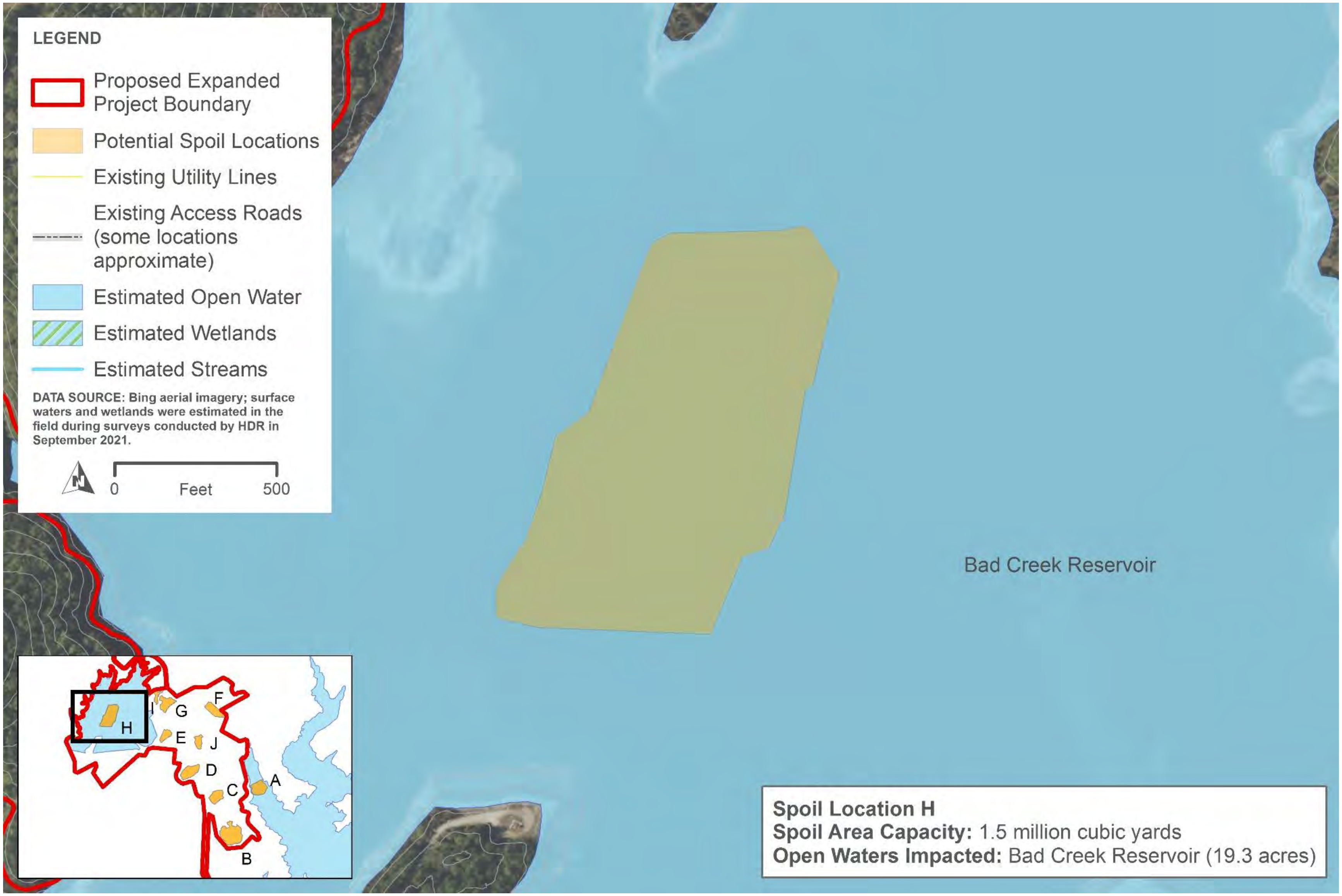

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Stream 15
Stream 16
Wetland 14
Stream 17
Stream 18
H
I
G
F
E
J
D
C
A
B
Spoil Location C
Spoil Area Capacity: 0.7 million cubic yards
Streams Impacted: 1 (286 linear feet)

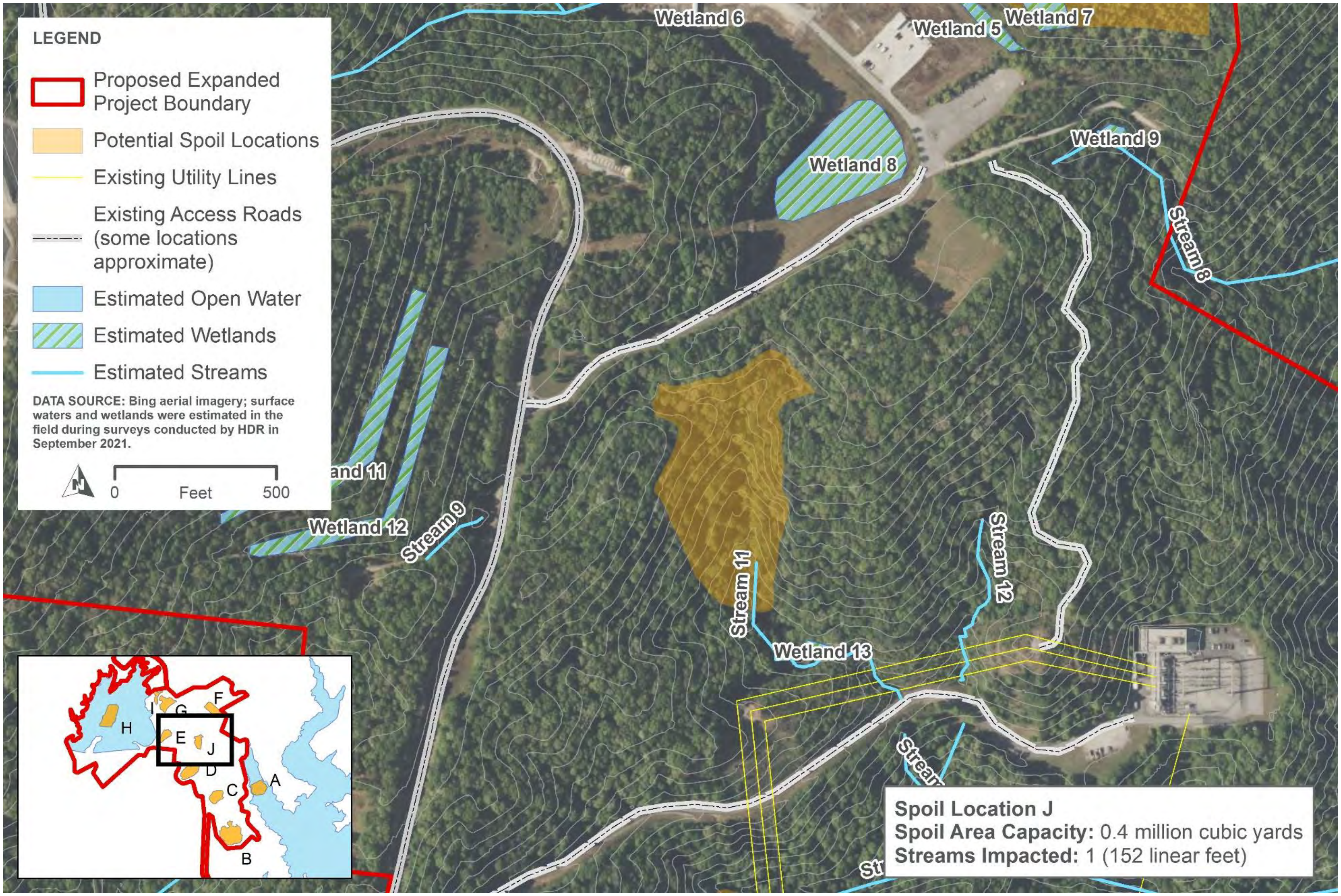

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Wetland 13
Stream 12
Stream 11
Stream 14
Stream 13
Stream 15
Stream 16
Wetland 14
H G I F E J D C A B
Spoil Location D
Spoil Area Capacity: 1.3 million cubic yards
Streams Impacted: 2 (996 linear feet)


LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Bad Creek Reservoir
Stream 6
Wetland 6
Stream 7
Wetland 10
Wetland 11
Wetland 12
Stream 9
A
B
C
D
E
F
G
H
I
J
Spoil Location E
Spoil Area Capacity: 0.16 million cubic yards
Wetlands Impacted: 1 (2.96 acres, isolated)


LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0
Feet
500
Wetland 1
Stream 1a
Stream 2
Wetland 2
Wetland 4
Wetland 5
Wetland 6
Wetland 7
Wetland 8
Wetland 9
Stream 7
A
B
C
D
E
F
G
H
I
J
Spoil Location F
Spoil Area Capacity: 0.25 million cubic yards
Wetlands Impacted: 2 (2.51 acres, isolated)

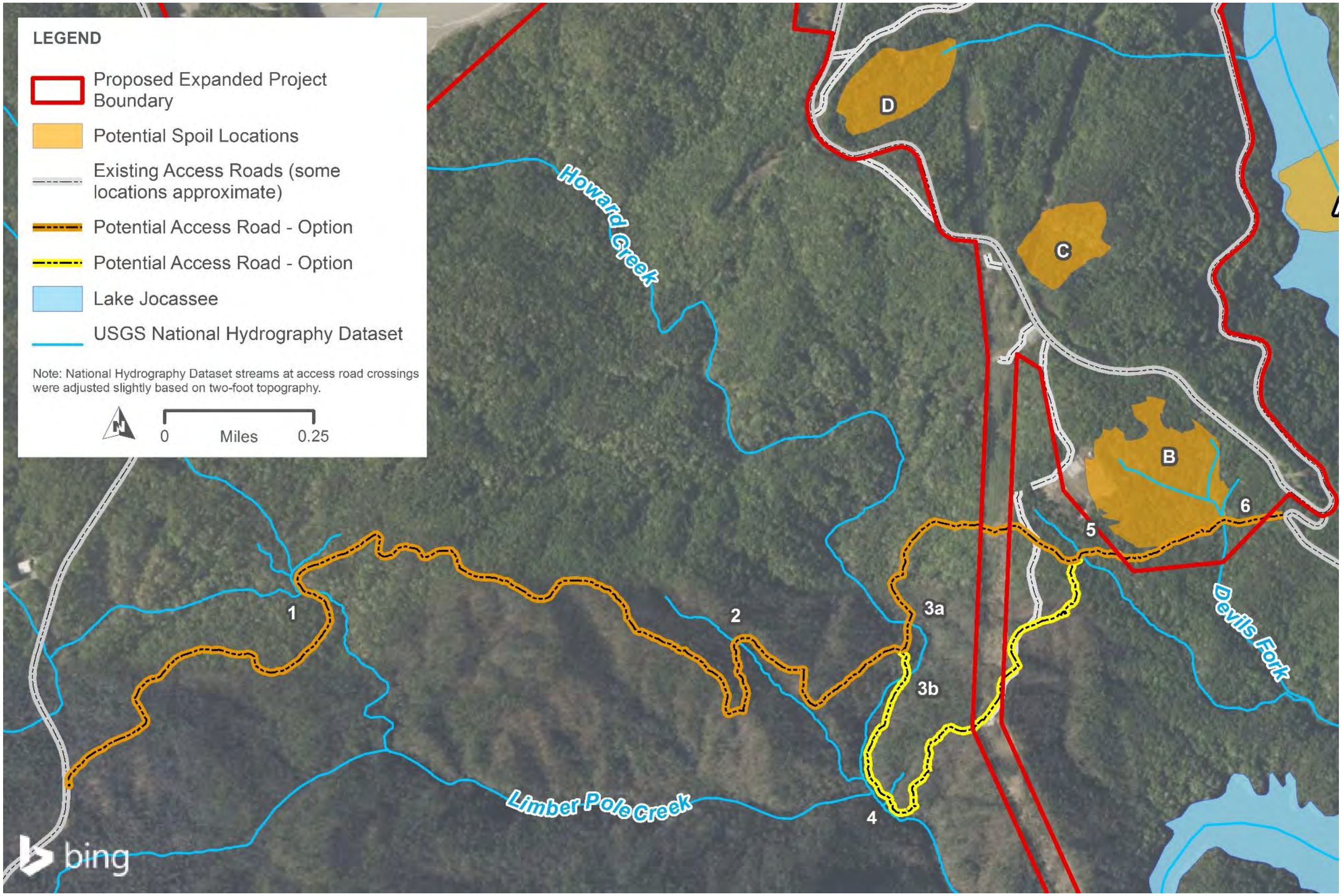

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0 Feet 500
Bad Creek Reservoir
Wetland 2
Wetland 3
Stream 4
Stream 4a
Stream 5
Stream 6
Wetland 6
Strea
H I G F E J D C A B
Spoil Location G
Spoil Area Capacity: 1.1 million cubic yards
Streams Impacted: 2 (1,484 linear feet)
Spoil Location I
Spoil Area Capacity: 1.1 million cubic yards

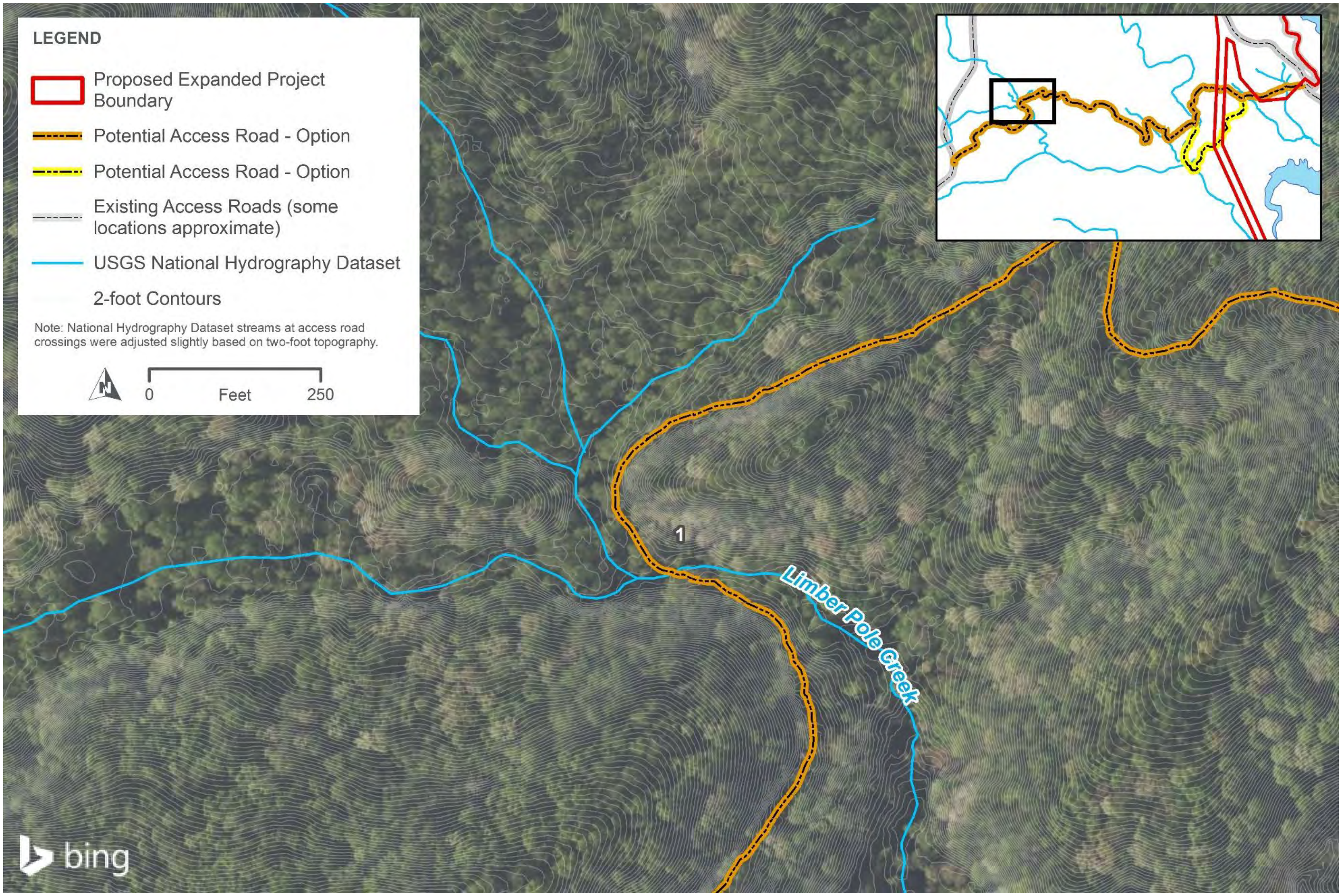

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0
Feet
500
Bad Creek Reservoir
Spoil Location H
Spoil Area Capacity: 1.5 million cubic yards
Open Waters Impacted: Bad Creek Reservoir (19.3 acres)
A
B
C
D
E
F
G
H
I
J

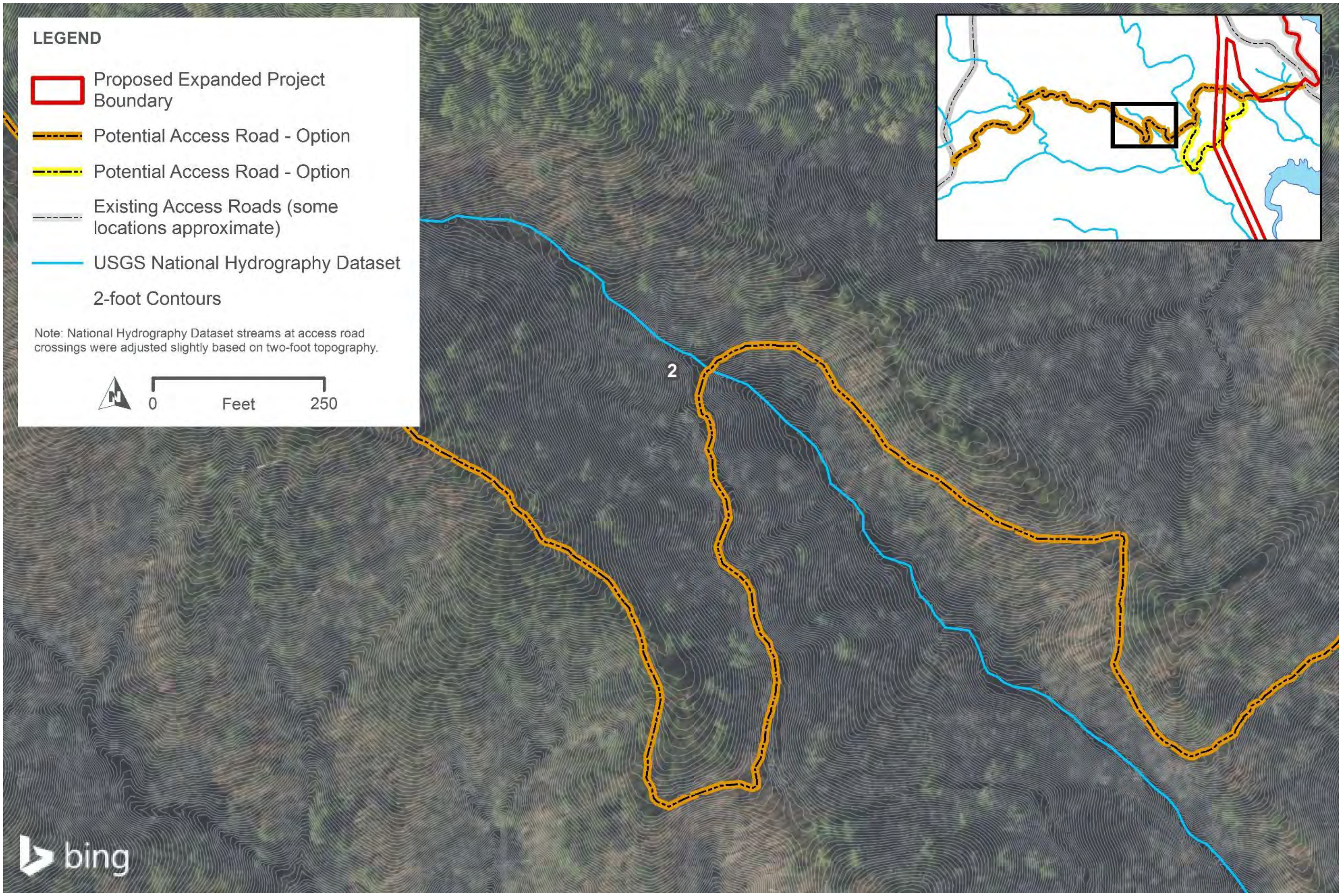

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0
Feet
500
Wetland 6
Wetland 5
Wetland 7
Wetland 8
Wetland 9
Stream 8
Wetland 12
Stream 9
Stream 11
Stream 12
Wetland 13
H
I
G
F
E
J
D
C
A
B
Spoil Location J
Spoil Area Capacity: 0.4 million cubic yards
Streams Impacted: 1 (152 linear feet)

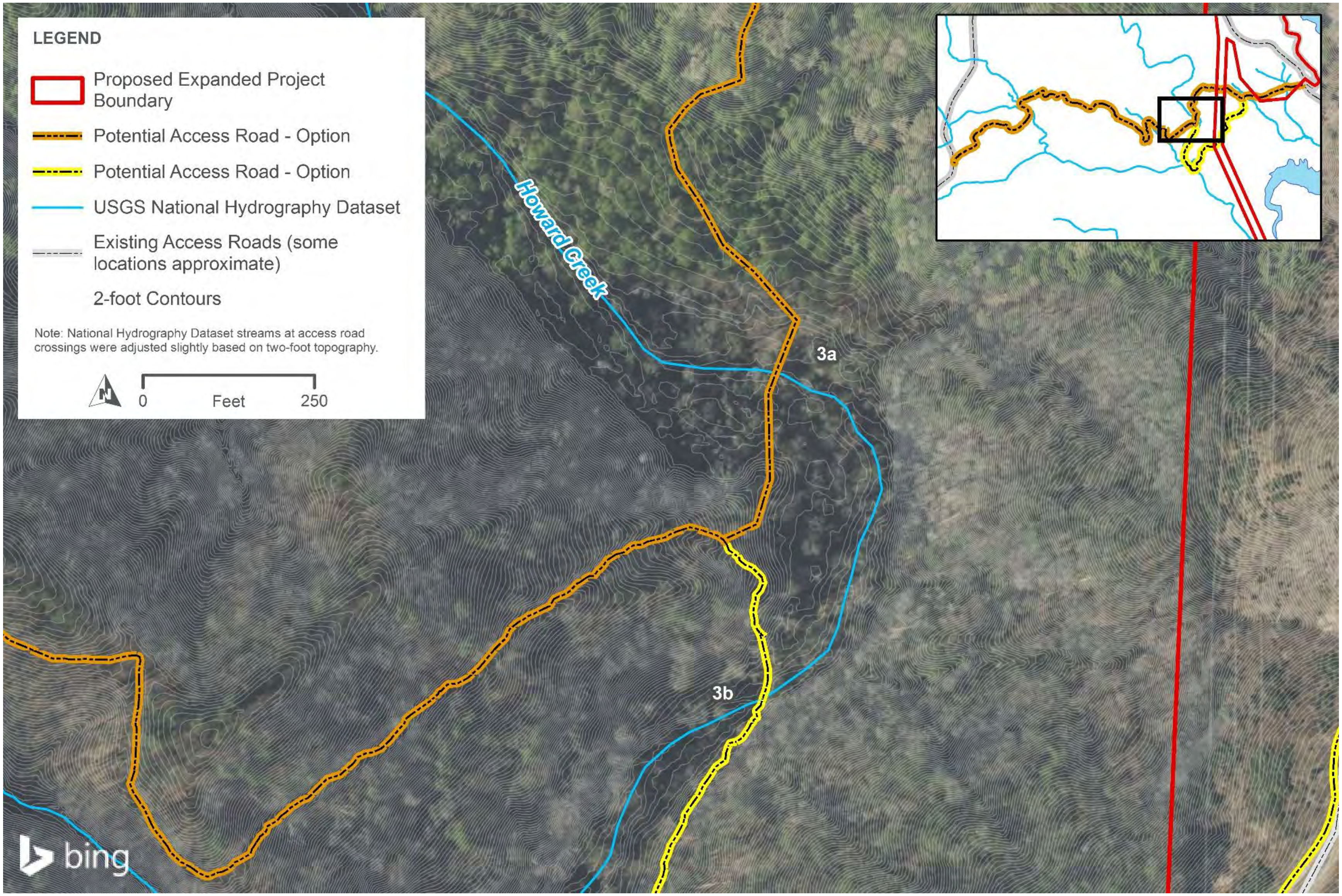
Attachment 2

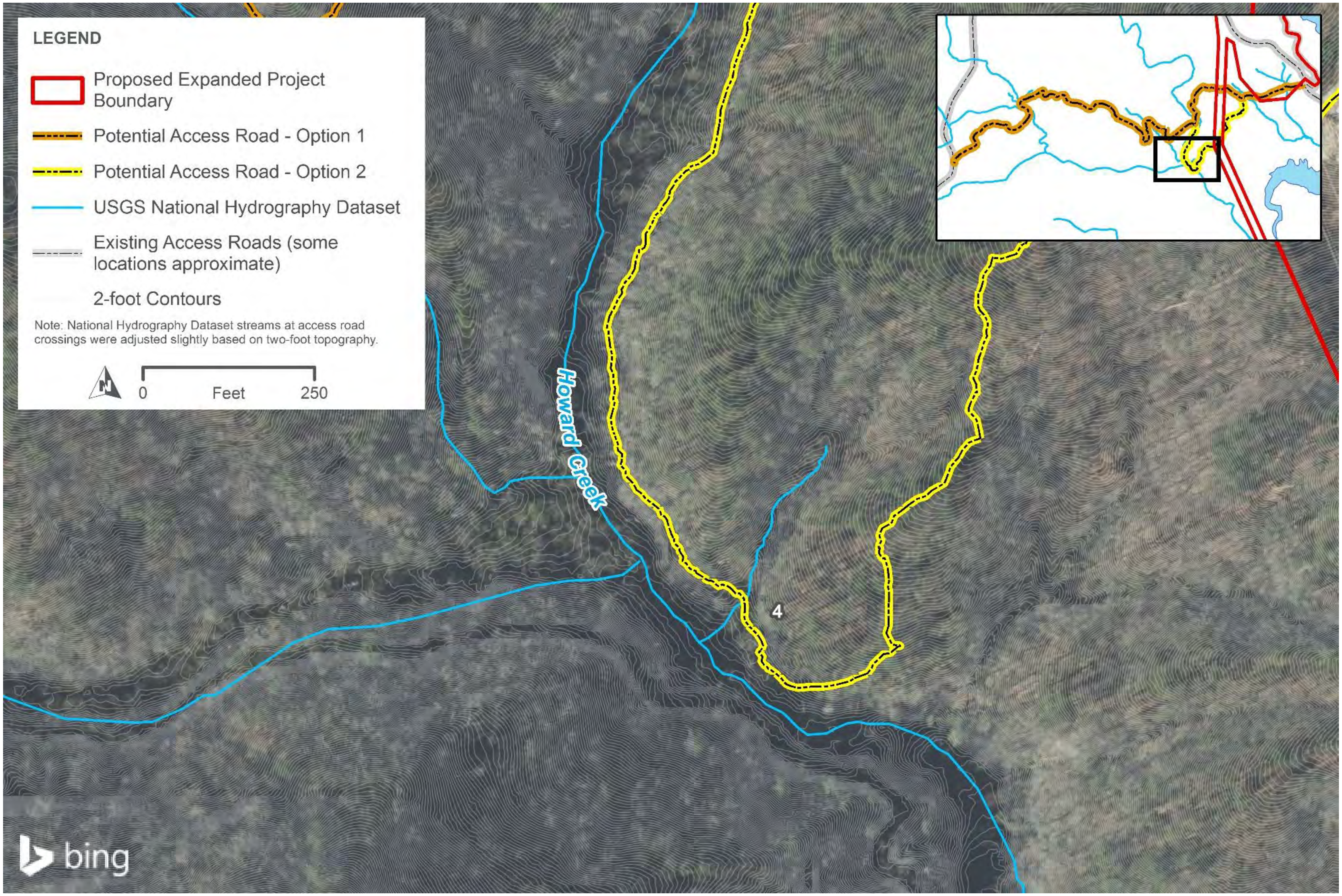
Attachment 2 – Potential Access Road Stream Crossings

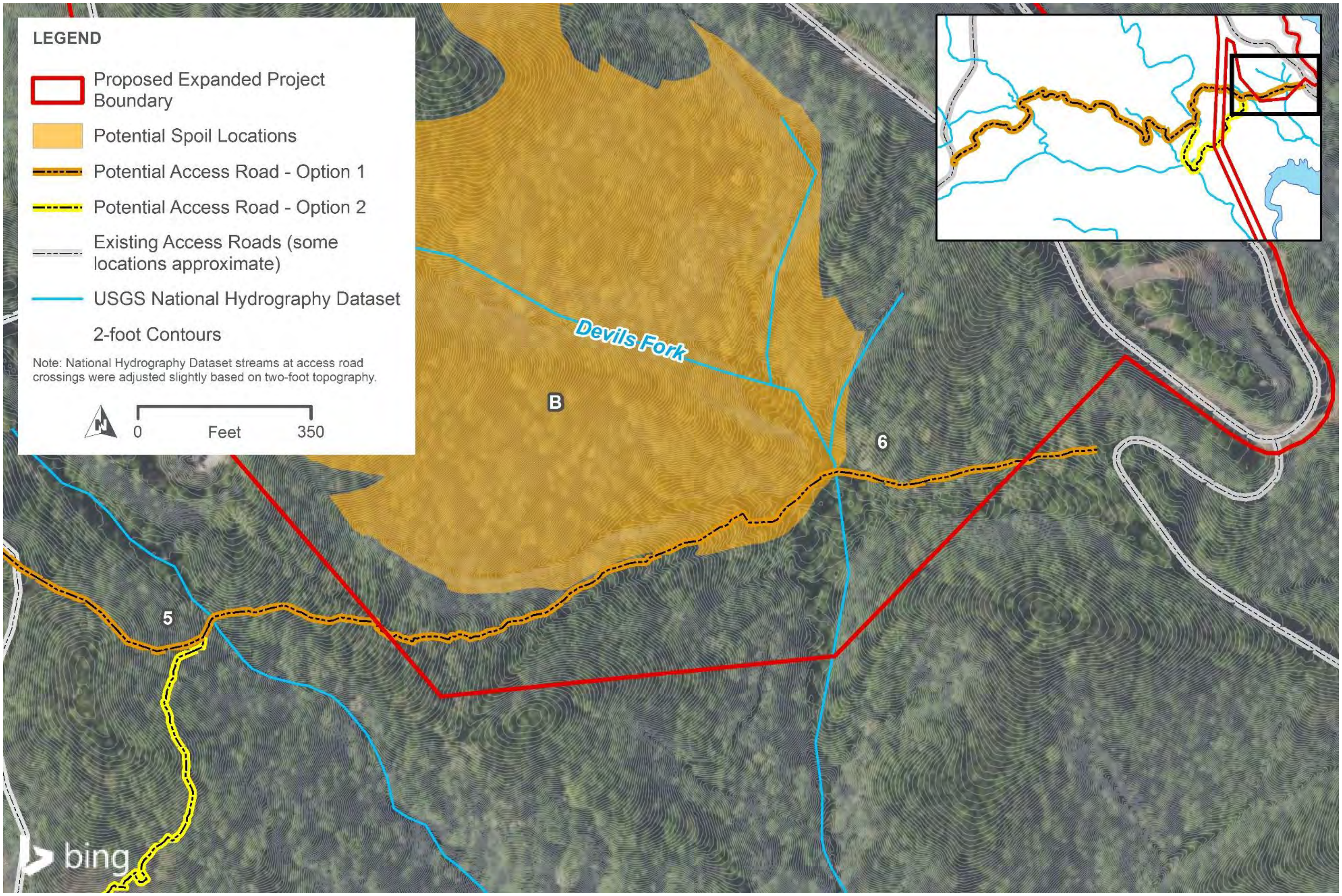

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Access Roads (some locations approximate)
Potential Access Road - Option
Potential Access Road - Option
Lake Jocassee
USGS National Hydrography Dataset
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
0
Miles
0.25
Howard Creek
Limber Pole Creek
Devils Fork
D
C
B
1
2
3a
3b
4
5
6
bing


LEGEND
Proposed Expanded Project Boundary
Potential Access Road - Option
Potential Access Road - Option
Existing Access Roads (some locations approximate)
USGS National Hydrography Dataset
2-foot Contours
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
0
Feet
250
1
Limber Pole Creek
bing


LEGEND
Proposed Expanded Project Boundary
Potential Access Road - Option
Potential Access Road - Option
Existing Access Roads (some locations approximate)
USGS National Hydrography Dataset
2-foot Contours
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
N
0
Feet
250
2
bing


LEGEND
Proposed Expanded Project Boundary
Potential Access Road - Option
Potential Access Road - Option
USGS National Hydrography Dataset
Existing Access Roads (some locations approximate)
2-foot Contours
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
0
Feet
250
Howard Creek
3a
3b
bing


LEGEND
Proposed Expanded Project Boundary
Potential Access Road - Option 1
Potential Access Road - Option 2
USGS National Hydrography Dataset
Existing Access Roads (some locations approximate)
2-foot Contours
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
N
0
Feet
250
Howard Creek
4
bing


LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Potential Access Road - Option 1
Potential Access Road - Option 2
Existing Access Roads (some locations approximate)
USGS National Hydrography Dataset
2-foot Contours
Note: National Hydrography Dataset streams at access road crossings were adjusted slightly based on two-foot topography.
0
Feet
350
Devils Fork
B
5
6
bing

Attachment B

Attachment B - Natural Resources Assessment Figures

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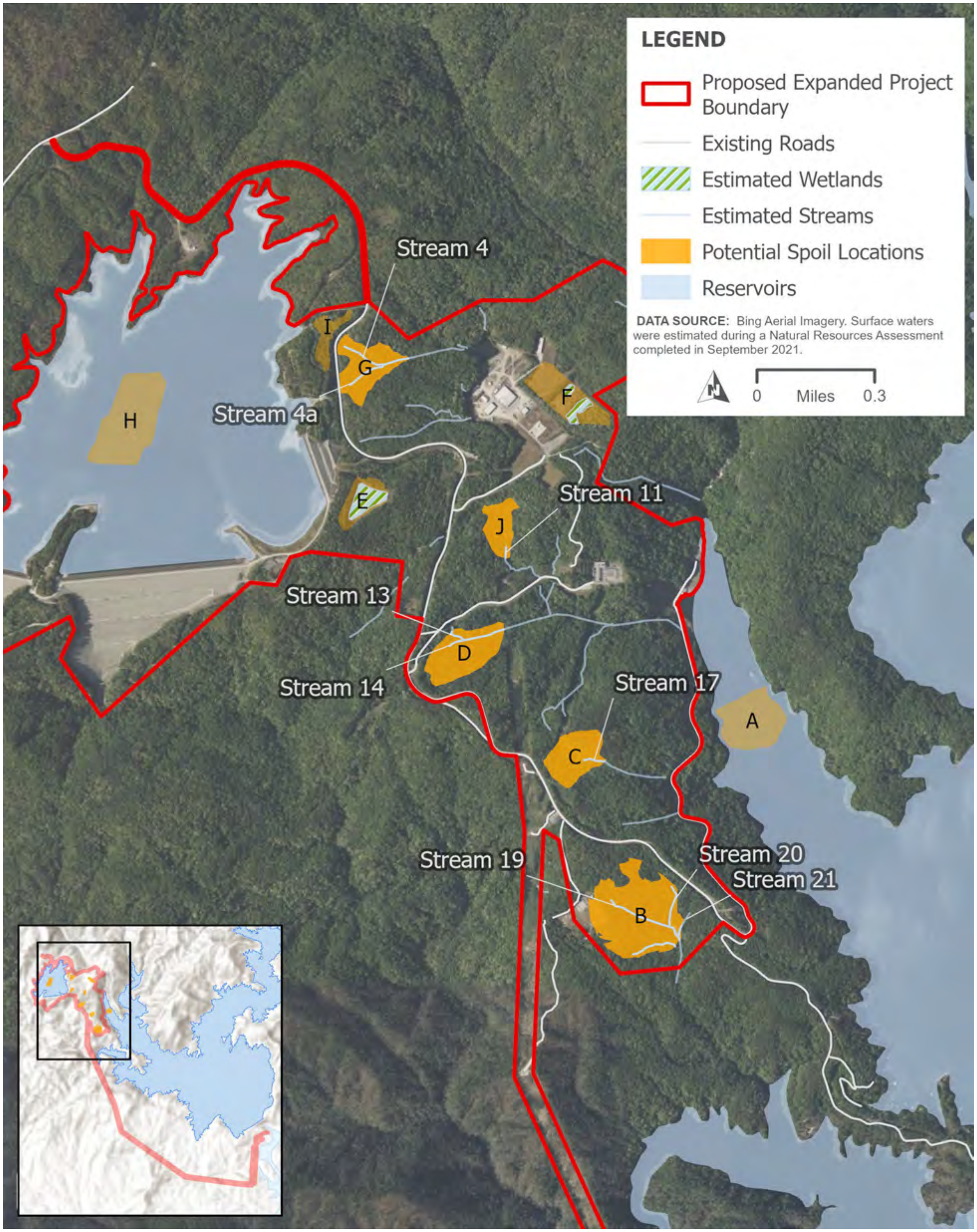

Figure 1. Estimated surface waters and wetlands within spoil locations

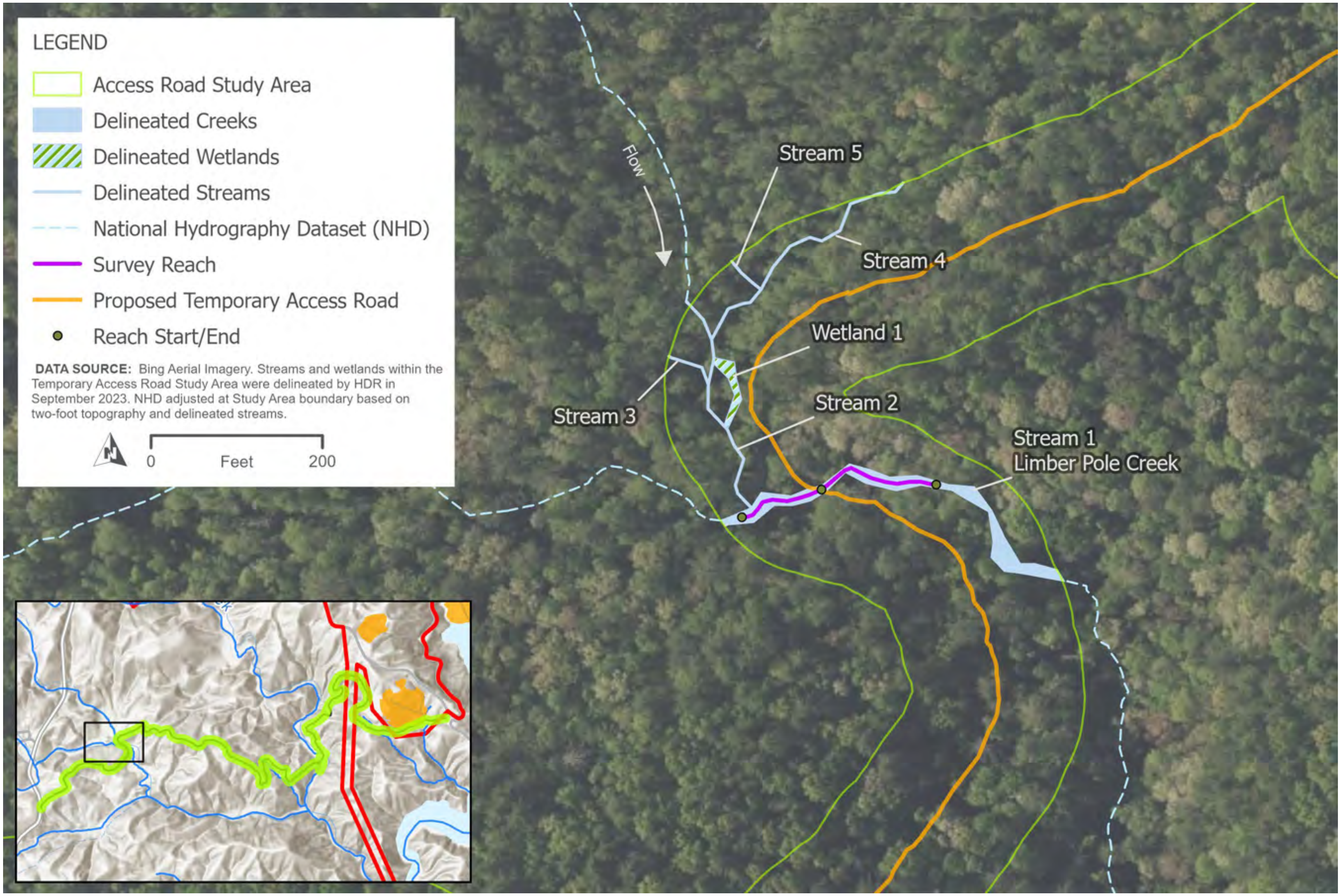

Figure 2. Streams and wetlands surveyed along the proposed temporary access road at the Stream 1 (Limber Pole Creek) crossing

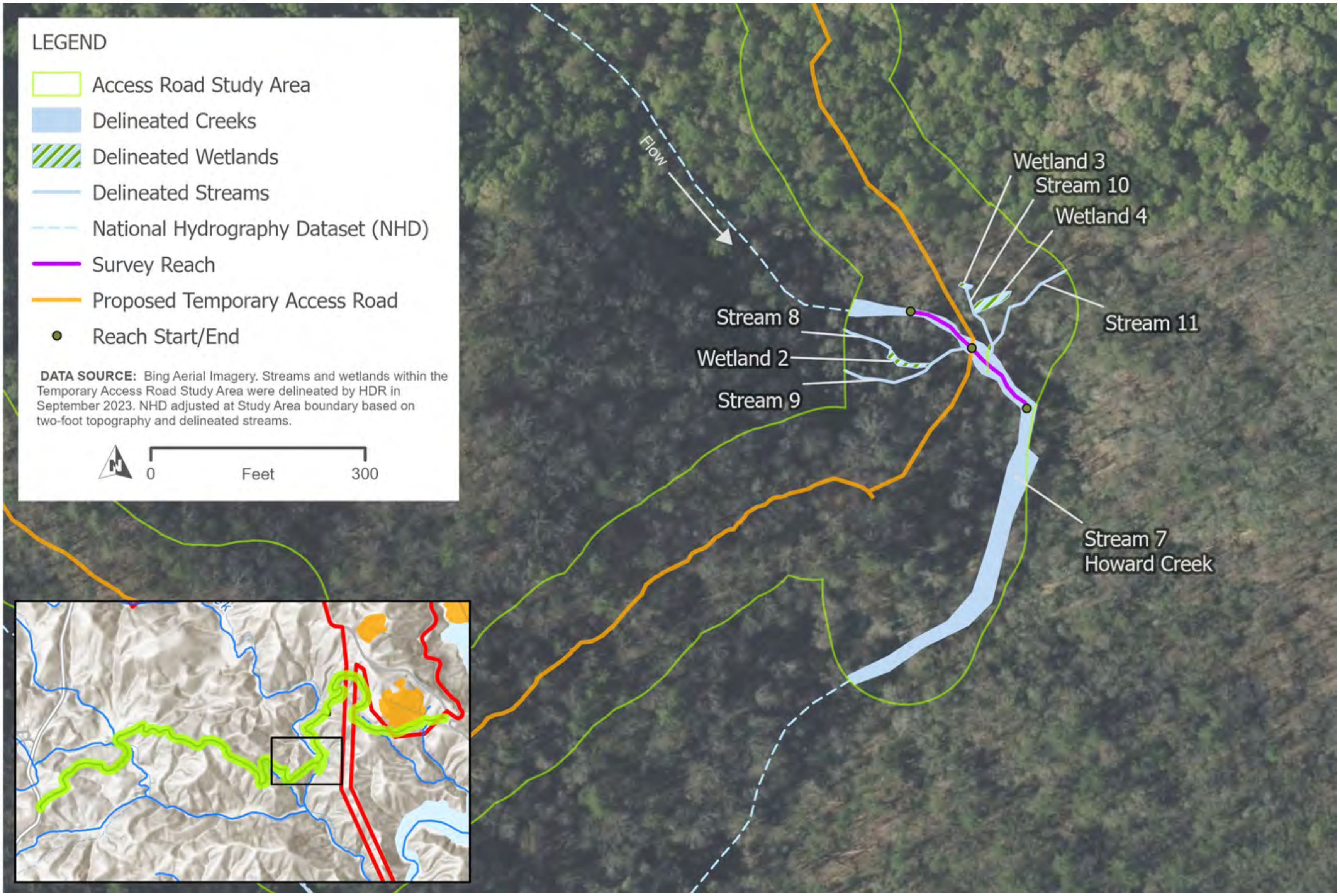

Figure 3. Streams and wetlands surveyed along the proposed temporary access road at the Stream 7 (Howard Creek) crossing

Figure 4. Streams and wetlands surveyed along the proposed temporary access road at the Stream 12 crossing

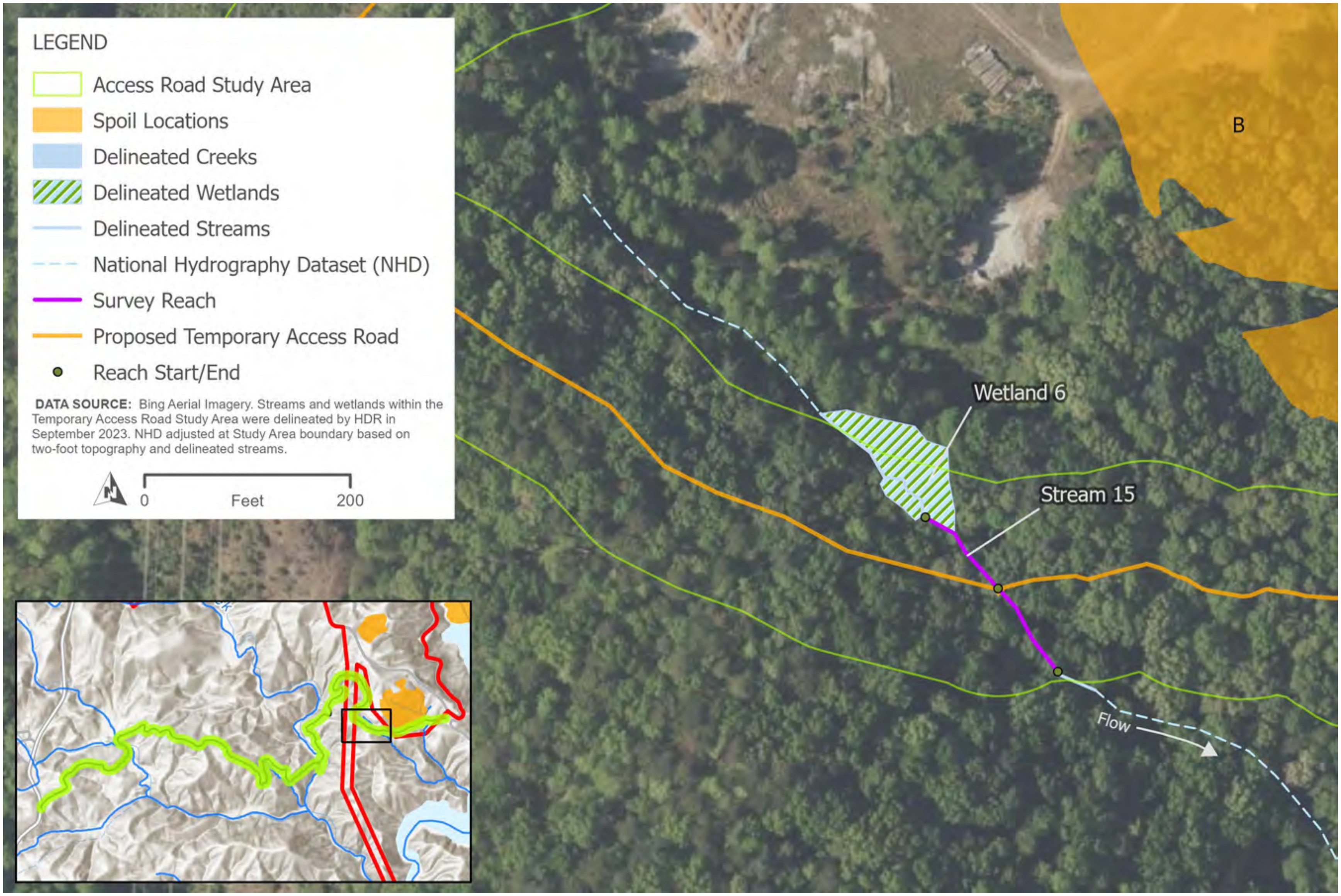

Figure 5. Streams and wetlands surveyed along the proposed temporary access road at the Stream 15 crossing

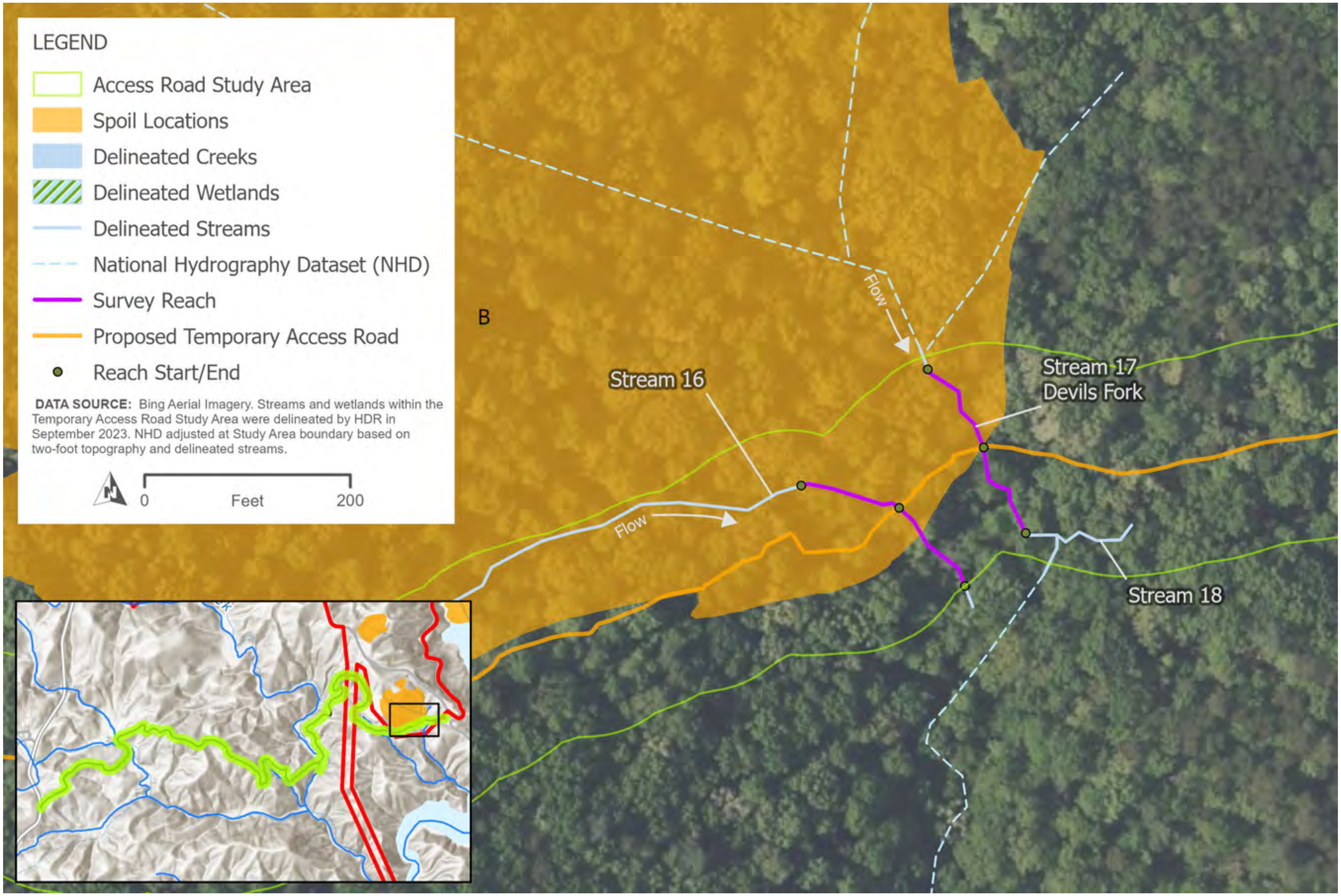

Figure 6. Streams and wetlands surveyed along the proposed temporary access road at the Stream 15 and 17 crossings

Attachment C

Attachment C - U.S. Environmental Protection Agency Rapid Bioassessment Protocol Data Forms

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Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 1 (Limber Pole)	LOCATION Bad Creek Pumped Storage Project
STATION #__________ RIVERMILE__________	STREAM CLASS Perennial
LAT _______________ LONG _______________	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS EBS	
FORM COMPLETED BY	DATE 10/2/2023 TIME ________ AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 170

Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 7 (Howard Creek)	LOCATION Oconee County, South Carolina
STATION #__________ RIVERMILE__________	STREAM CLASS Perennial
LAT 34.990481 LONG -83.00247	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS Paul Bright / Brett Boone	
FORM COMPLETED BY Paul Bright	DATE 10/18/23 TIME 9:00 AM PM — REASON FOR SURVEY Environmental survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 185

Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 12	LOCATION Oconee County, South Carolina
STATION #__________ RIVERMILE__________	STREAM CLASS Intermittent
LAT 34.995451 LONG -83.001330	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS Paul Bright / Brett Boone	
FORM COMPLETED BY Paul Bright	DATE 10/18/23 TIME 4:00 AM PM — REASON FOR SURVEY Environmental survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 13	20 19 18 17 16	15 14 $\boxed{13}$ 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 13	20 19 18 17 16	15 14 $\boxed{13}$ 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	$\boxed{8}$ 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	$\boxed{8}$ 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 $\boxed{9}$	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 $\boxed{9}$	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 $\boxed{9}$	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 $\boxed{9}$	8 7 6	5 4 3	2 1 0

Total Score 126

Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 15	LOCATION Oconee County, South Carolina
STATION #_________ RIVERMILE__________	STREAM CLASS Perennial
LAT 34.993024 LONG -82.997765	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS Paul Bright / Brett Boone	
FORM COMPLETED BY Paul Bright	DATE 10/19/23 TIME 10:00 AM PM — REASON FOR SURVEY Environmental survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 133

Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 16	LOCATION Oconee County, South Carolina
STATION #_________ RIVERMILE_________	STREAM CLASS Perennial
LAT 34.993518 LONG -82.994454	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS Paul Bright / Brett Boone	
FORM COMPLETED BY Paul Bright	DATE 10/19/23 TIME 3:00 AM PM — REASON FOR SURVEY Environmental survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 127

Temporary Access Road

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 17 (Devils Fork)	LOCATION Oconee County, South Carolina
STATION #_________ RIVERMILE__________	STREAM CLASS Perennial
LAT 34.993745 LONG -82.993409	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS Paul Bright / Brett Boone	
FORM COMPLETED BY Paul Bright	DATE 10/19/23 TIME 12:00 AM PM — REASON FOR SURVEY Environmental survey

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
15 **SCORE**	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
19 **SCORE**	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 144

Spoil Location G

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 4a	LOCATION Bad Creek Pumped Storage Project - Spoil Location G
STATION #__________ RIVERMILE__________	STREAM CLASS Intermittent
LAT _______________ LONG _______________	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS JK, MI	
FORM COMPLETED BY	DATE 09/12/203 TIME ________ AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 137

Spoil Location G

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 4	LOCATION Bad Creek Pumped Storage Project - Spoil Location G
STATION #__________ RIVERMILE__________	STREAM CLASS Perennial
LAT _______________ LONG _______________	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS JK, MI	
FORM COMPLETED BY	DATE 09/12/203 TIME ________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 117

Spoil Location C

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 17	LOCATION Bad Creek Pumped Storage Project - Spoil Location C
STATION #__________ RIVERMILE__________	STREAM CLASS Perennial
LAT _______________ LONG _______________	RIVER BASIN Savannah
STORET #	AGENCY
INVESTIGATORS JK, MI	
FORM COMPLETED BY	DATE 09/12/203 TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 143

Spoil Location B

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Stream 19 (Devils Fork)	LOCATION Bad Creek Pumped Storage Project - Spoil Location B
STATION #__________ RIVERMILE__________	STREAM CLASS Perennial
LAT _______________ LONG _______________	RIVER BASIN Savannah
STOREET #	AGENCY
INVESTIGATORS JK, MI	
FORM COMPLETED BY	DATE 09/12/203 TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 155

Attachment D

Attachment D - North Carolina Stream Assessment Method Data Forms

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NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 9/12/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: JK, MI (HDR)
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Whitewater River
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.0150578, -83.0064250

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Stream 4
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1.5 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 5
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A 
(more sinuous stream, flatter valley slope)

☒B 
(less sinuous stream, steeper valley slope)

17. Watershed size: **(skip for Tidal Marsh Stream)** ☒Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.

☐Section 10 water ☐Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☒B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. **Streamside Area Interaction – streamside area metric**
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. **Water Quality Stressors – assessment reach/intertidal zone metric**
Check all that apply.
- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: ____________________ (explain in "Notes/Sketch" section)
- ☒J Little to no stressors

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. **Large or Dangerous Stream – assessment reach metric**
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. **Natural In-stream Habitat Types – assessment reach metric**
10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only
- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

**********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. **Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☒	☐	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☒	☐	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☐	☐	☐	☒	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. **Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)**

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to “individuals” for Size 1 and 2 streams and “taxa” for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☒	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. **Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)**
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☒A	☒A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. **Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)**
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C	☒C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. **Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)**
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. **Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)**
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☐A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☒F None of the above

17. **Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)**
Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☒B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☐F None of the above

18. **Shading – assessment reach metric (skip for Tidal Marsh Streams)**
Consider aspect. Consider “leaf-on” condition.

☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 4

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	9/12/2023
Stream Category	Mb1	Assessor Name/Organization	JK, MI (HDR)

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Intermittent

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**MEDIUM**	**MEDIUM**
(2) Baseflow	**LOW**	**LOW**
(2) Flood Flow	**HIGH**	**HIGH**
(3) Streamside Area Attenuation	**HIGH**	**HIGH**
(4) Floodplain Access	**HIGH**	**HIGH**
(4) Wooded Riparian Buffer	**HIGH**	**HIGH**
(4) Microtopography	NA	NA
(3) Stream Stability	**HIGH**	**HIGH**
(4) Channel Stability	**HIGH**	**HIGH**
(4) Sediment Transport	**HIGH**	**HIGH**
(4) Stream Geomorphology	**HIGH**	**HIGH**
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**LOW**	**LOW**
(2) Baseflow	**LOW**	**LOW**
(2) Streamside Area Vegetation	**HIGH**	**HIGH**
(3) Upland Pollutant Filtration	**HIGH**	**HIGH**
(3) Thermoregulation	**HIGH**	**HIGH**
(2) Indicators of Stressors	**NO**	**NO**
(2) Aquatic Life Tolerance	**LOW**	**NA**
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**MEDIUM**	**MEDIUM**
(2) In-stream Habitat	**LOW**	**LOW**
(3) Baseflow	**LOW**	**LOW**
(3) Substrate	**LOW**	**LOW**
(3) Stream Stability	**HIGH**	**HIGH**
(3) In-stream Habitat	**HIGH**	**HIGH**
(2) Stream-side Habitat	**HIGH**	**HIGH**
(3) Stream-side Habitat	**HIGH**	**HIGH**
(3) Thermoregulation	**HIGH**	**HIGH**
(2) Tidal Marsh In-stream Habitat	NA	NA
(3) Flow Restriction	NA	NA
(3) Tidal Marsh Stream Stability	NA	NA
(4) Tidal Marsh Channel Stability	NA	NA
(4) Tidal Marsh Stream Geomorphology	NA	NA
(3) Tidal Marsh In-stream Habitat	NA	NA
(2) Intertidal Zone	NA	NA
Overall	**MEDIUM**	**MEDIUM**

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 9/12/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: JK / HDR
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Lake Jocassee
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.0145516, -83.0080285

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Stream 4a - spoil G
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 4 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 8
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☐Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.

☐Section 10 water ☐Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

☒A Water throughout assessment reach.
☐B No flow, water in pools only.
☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

☒A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction <u>or</u> fill to the point of obstructing flow <u>or</u> a channel choked with aquatic macrophytes <u>or</u> ponded water <u>or</u> impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
☐B Not A

3. Feature Pattern – assessment reach metric

☒A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
☐B Not A

4. Feature Longitudinal Profile – assessment reach metric

☒A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
☐B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

☒A < 10% of channel unstable
☐B 10 to 25% of channel unstable
☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB RB
☐A ☐A Little or no evidence of conditions that adversely affect reference interaction
☒B ☒B Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C ☐C Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
☐D Odor (not including natural sulfide odors)
☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
☐F Livestock with access to stream or intertidal zone
☐G Excessive algae in stream or intertidal zone
☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
☐I Other: ____________________ (explain in “Notes/Sketch” section)
☒J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric

10a. ☒Yes ☐No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

☒A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☒B Multiple sticks and/or leaf packs and/or emergent vegetation
☒C Multiple snags and logs (including lap trees)
☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
☐E Little or no habitat

Check for Tidal Marsh Streams Only

☐F 5% oysters or other natural hard bottoms
☐G Submerged aquatic vegetation
☐H Low-tide refugia (pools)
☐I Sand bottom
☐J 5% vertical bank along the marsh
☐K Little or no habitat

**********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

☒A Riffle-run section **(evaluate 11c)**
☒B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☐	☒	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☐	☒	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☒	☐	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☐	☐	☒	☐	☐	Detritus
☐	☐	☒	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☒	Salamanders/tadpoles
☐	☐	Snails
☐	☒	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☒B	☒B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☒B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☐A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☒F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☒B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☐F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. **Buffer Width – streamside area metric (skip for Tidal Marsh Streams)**
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☐A	☐A	☒A	☒A	≥ 100 feet wide <u>or</u> extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☒E	☒E	☐E	☐E	< 10 feet wide <u>or</u> no trees

20. **Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)**
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation <u>or</u> modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. **Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)**
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. **Stem Density – streamside area metric (skip for Tidal Marsh Streams)**
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer <u>or</u> predominantly herbaceous species <u>or</u> bare ground

23. **Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)**
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. **Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)**
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing <u>or</u> communities with non-native invasive species present, but not dominant, over a large portion of the expected strata <u>or</u> communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent <u>or</u> communities with non-native invasive species dominant over a large portion of expected strata <u>or</u> communities composed of planted stands of non-characteristic species <u>or</u> communities inappropriately composed of a single species <u>or</u> no vegetation.

25. **Conductivity – assessment reach metric (skip for all Coastal Plain streams)**
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 4a

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	9/12/2023
Stream Category	Mb1	Assessor Name/Organization	JK / HDR

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**LOW**	
(2) Baseflow	**LOW**	
(2) Flood Flow	**MEDIUM**	
(3) Streamside Area Attenuation	**MEDIUM**	
(4) Floodplain Access	**MEDIUM**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**MEDIUM**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**LOW**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**LOW**	
(2) Streamside Area Vegetation	**MEDIUM**	
(3) Upland Pollutant Filtration	**LOW**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**MEDIUM**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**MEDIUM**	
(3) Baseflow	**LOW**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**MEDIUM**	
(3) In-stream Habitat	**MEDIUM**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**MEDIUM**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 9/12/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: JK, MI (HDR)
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.9999817, -82.9961129

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Stream 17 spoil C
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 5
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☐Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.
    - ☐Section 10 water
    - ☐Classified Trout Waters
    - ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
    - ☐Essential Fish Habitat
    - ☐Primary Nursery Area
    - ☐ High Quality Waters/Outstanding Resource Waters
    - ☐Publicly owned property
    - ☐NCDWR Riparian buffer rule in effect
    - ☐Nutrient Sensitive Waters
    - ☐Anadromous fish
    - ☐303(d) List
    - ☐CAMA Area of Environmental Concern (AEC)
    - ☐Documented presence of a federal and/or state listed protected species within the assessment area.
      List species:
    - ☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☒B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
☐D Odor (not including natural sulfide odors)
☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
☐F Livestock with access to stream or intertidal zone
☐G Excessive algae in stream or intertidal zone
☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
☐I Other: ____________________ (explain in "Notes/Sketch" section)
☒J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric
10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☒B Multiple sticks and/or leaf packs and/or emergent vegetation
☒C Multiple snags and logs (including lap trees)
☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
☐E Little or no habitat

Check for Tidal Marsh Streams Only

☐F 5% oysters or other natural hard bottoms
☐G Submerged aquatic vegetation
☐H Low-tide refugia (pools)
☐I Sand bottom
☐J 5% vertical bank along the marsh
☐K Little or no habitat

***********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS*******************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
☒A Riffle-run section **(evaluate 11c)**
☒B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but $\leq$ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☐	☒	☐	☐	Silt/clay (< 0.062 mm)
☐	☒	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1 >1 Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.

☐ ☐Adult frogs
☐ ☐Aquatic reptiles
☐ ☐Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐ ☐Beetles
☐ ☐Caddisfly larvae (T)
☐ ☐Asian clam (*Corbicula*)
☐ ☐Crustacean (isopod/amphipod/crayfish/shrimp)
☐ ☐Damselfly and dragonfly larvae
☐ ☐Dipterans
☐ ☐Mayfly larvae (E)
☐ ☐Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐ ☐Midges/mosquito larvae
☐ ☐Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐ ☐Mussels/Clams (not *Corbicula*)
☐ ☐Other fish
☐ ☒Salamanders/tadpoles
☐ ☐Snails
☐ ☐Stonefly larvae (P)
☐ ☐Tipulid larvae
☐ ☐Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB RB
☒A ☒A Little or no alteration to water storage capacity over a majority of the streamside area
☐B ☐B Moderate alteration to water storage capacity over a majority of the streamside area
☐C ☐C Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB RB
☐A ☐A Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B ☐B Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C ☒C Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB RB
☐Y ☐Y Are wetlands present in the streamside area?
☒N ☒N

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☐A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☒F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated		Wooded		
LB	RB	LB	RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts		< 30 feet		30-50 feet		
LB	RB	LB	RB	LB	RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)

25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 17

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	9/12/2023
Stream Category	Mb1	Assessor Name/Organization	JK, MI (HDR)

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**HIGH**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**MEDIUM**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**LOW**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**HIGH**	
(3) Baseflow	**HIGH**	
(3) Substrate	**MEDIUM**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**HIGH**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 9/12/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: JK, MI
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.9945859, -82.9951158

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Devils Fork
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 5
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):
☐A  (more sinuous stream, flatter valley slope)
☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☐Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.
   - ☐Section 10 water ☐Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
   - ☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
   - ☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
   - ☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
   - ☐Documented presence of a federal and/or state listed protected species within the assessment area.
     List species:
   - ☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☒B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
☐B Excessive sedimentation (burying of stream features or intertidal zone)
☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
☐D Odor (not including natural sulfide odors)
☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
☐F Livestock with access to stream or intertidal zone
☐G Excessive algae in stream or intertidal zone
☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
☐I Other: ____________________ (explain in "Notes/Sketch" section)
☒J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric

10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐B Multiple sticks and/or leaf packs and/or emergent vegetation
☒C Multiple snags and logs (including lap trees)
☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
☐E Little or no habitat

Check for Tidal Marsh Streams Only

☐F 5% oysters or other natural hard bottoms
☐G Submerged aquatic vegetation
☐H Low-tide refugia (pools)
☐I Sand bottom
☐J 5% vertical bank along the marsh
☐K Little or no habitat

**********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS*****************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

☒A Riffle-run section **(evaluate 11c)**
☒B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☒	☐	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☐	☒	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☒	☐	☐	☐	Sand (.062 – 2 mm)
☐	☐	☒	☐	☐	Silt/clay (< 0.062 mm)
☐	☐	☒	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☐Yes ☒No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1 >1 Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.

☐ ☐Adult frogs
☐ ☐Aquatic reptiles
☐ ☐Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐ ☐Beetles
☐ ☐Caddisfly larvae (T)
☐ ☐Asian clam (*Corbicula*)
☐ ☐Crustacean (isopod/amphipod/crayfish/shrimp)
☐ ☐Damselfly and dragonfly larvae
☐ ☐Dipterans
☐ ☐Mayfly larvae (E)
☐ ☐Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐ ☐Midges/mosquito larvae
☐ ☐Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐ ☐Mussels/Clams (not *Corbicula*)
☐ ☐Other fish
☐ ☐Salamanders/tadpoles
☐ ☐Snails
☐ ☐Stonefly larvae (P)
☐ ☐Tipulid larvae
☐ ☐Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB RB
☒A ☒A Little or no alteration to water storage capacity over a majority of the streamside area
☐B ☐B Moderate alteration to water storage capacity over a majority of the streamside area
☐C ☐C Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB RB
☐A ☐A Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B ☐B Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C ☒C Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB RB
☐Y ☐Y Are wetlands present in the streamside area?
☒N ☒N

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☐A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☒F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Devils Fork

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	9/12/2023
Stream Category	Mb1	Assessor Name/Organization	JK, MI

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**HIGH**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**MEDIUM**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**LOW**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**MEDIUM**	
(3) Baseflow	**HIGH**	
(3) Substrate	**MEDIUM**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**MEDIUM**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the “Notes/Sketch” section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 10/2/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: EBS / HDR
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.991628, -83.0200869

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Limber Pole
10. Length of assessment reach evaluated (feet): 200
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 4 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 20
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A 
(more sinuous stream, flatter valley slope)

☒B 
(less sinuous stream, steeper valley slope)

17. Watershed size: **(skip for Tidal Marsh Stream)** ☐Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☒Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.

☐Section 10 water	☐Classified Trout Waters	☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat	☐Primary Nursery Area	☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property	☐NCDWR Riparian buffer rule in effect	☐Nutrient Sensitive Waters
☐Anadromous fish	☐303(d) List	☐CAMA Area of Environmental Concern (AEC)

☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in “Notes/Sketch” section or attached? ☐Yes ☒No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☒B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B Excessive sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: ____________________ (explain in “Notes/Sketch” section)
- ☒J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric

10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only

- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

***********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS*******************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☒	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☐	☒	☐	☐	Cobble (64 – 256 mm)
☐	☐	☐	☒	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ______________________

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☒	Beetles
☐	☒	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☒	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☒	Damselfly and dragonfly larvae
☐	☒	Dipterans
☐	☒	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☒	Salamanders/tadpoles
☐	☐	Snails
☐	☒	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☒A	☒A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☒A	☒A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

- ☒A Streams and/or springs (jurisdictional discharges)
- ☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
- ☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
- ☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
- ☒E Stream bed or bank soil reduced (dig through deposited sediment if present)
- ☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

- ☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
- ☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
- ☐C Urban stream (≥ 24% impervious surface for watershed)
- ☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
- ☐E Assessment reach relocated to valley edge
- ☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

- ☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
- ☐B Degraded (example: scattered trees)
- ☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)

25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Limber Pole

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	10/2/2023
Stream Category	Mb3	Assessor Name/Organization	EBS / HDR

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**HIGH**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**HIGH**	
(3) Baseflow	**HIGH**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**HIGH**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 10/2/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: EBS / HDR
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.991628, -83.0200869

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Howard Creek
10. Length of assessment reach evaluated (feet): 200
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 28
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A 
(more sinuous stream, flatter valley slope)

☒B 
(less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☒Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.
    - ☐Section 10 water
    - ☐Classified Trout Waters
    - ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
    - ☐Essential Fish Habitat
    - ☐Primary Nursery Area
    - ☐ High Quality Waters/Outstanding Resource Waters
    - ☐Publicly owned property
    - ☐NCDWR Riparian buffer rule in effect
    - ☐Nutrient Sensitive Waters
    - ☐Anadromous fish
    - ☐303(d) List
    - ☐CAMA Area of Environmental Concern (AEC)
    - ☐Documented presence of a federal and/or state listed protected species within the assessment area.
      List species:
    - ☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

- ☒A Water throughout assessment reach.
- ☐B No flow, water in pools only.
- ☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

- ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
- ☒B Not A

3. Feature Pattern – assessment reach metric

- ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
- ☒B Not A

4. Feature Longitudinal Profile – assessment reach metric

- ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
- ☒B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

- ☒A < 10% of channel unstable
- ☐B 10 to 25% of channel unstable
- ☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: _____________________ (explain in “Notes/Sketch” section)
- ☒J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric

10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only

- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

**************************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS********************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☐	☒	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☐	☒	☐	☐	Cobble (64 – 256 mm)
☐	☐	☐	☒	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ______

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to “individuals” for Size 1 and 2 streams and “taxa” for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☒	Beetles
☐	☒	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☒	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☒	Damselfly and dragonfly larvae
☐	☒	Dipterans
☐	☒	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☒	Other fish
☐	☒	Salamanders/tadpoles
☐	☐	Snails
☐	☒	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☒	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☒A	☒A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☒A	☒A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☒Y	☒Y	Are wetlands present in the streamside area?
☐N	☐N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

- ☒A Streams and/or springs (jurisdictional discharges)
- ☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
- ☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
- ☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
- ☒E Stream bed or bank soil reduced (dig through deposited sediment if present)
- ☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

- ☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
- ☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
- ☐C Urban stream (≥ 24% impervious surface for watershed)
- ☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
- ☐E Assessment reach relocated to valley edge
- ☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider “leaf-on” condition.

- ☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
- ☐B Degraded (example: scattered trees)
- ☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide <u>or</u> extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide <u>or</u> no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation <u>or</u> modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer <u>or</u> predominantly herbaceous species <u>or</u> bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing <u>or</u> communities with non-native invasive species present, but not dominant, over a large portion of the expected strata <u>or</u> communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent <u>or</u> communities with non-native invasive species dominant over a large portion of expected strata <u>or</u> communities composed of planted stands of non-characteristic species <u>or</u> communities inappropriately composed of a single species <u>or</u> no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Howard Creek

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	10/2/2023
Stream Category	Mb3	Assessor Name/Organization	EBS / HDR

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**HIGH**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**HIGH**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**HIGH**	
(3) Baseflow	**HIGH**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**HIGH**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek II Power Complex Project
2. Date of evaluation: 10/18/23
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: Paul Bright / HDR
5. County: Oconee
6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.995706, -83.000461

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): S12
10. Length of assessment reach evaluated (feet): 300
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1-3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 5-8
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☒Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.

☐Section 10 water ☒Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☒Yes ☐No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☐A Water throughout assessment reach.
   - ☒B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☒A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☐B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. **Streamside Area Interaction – streamside area metric**
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☐A	☐A	Little or no evidence of conditions that adversely affect reference interaction
☒B	☒B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. **Water Quality Stressors – assessment reach/intertidal zone metric**
Check all that apply.
- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☒I Other: ______________________ (explain in "Notes/Sketch" section)
- ☐J Little to no stressors

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. **Large or Dangerous Stream – assessment reach metric**
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. **Natural In-stream Habitat Types – assessment reach metric**

10a. ☒Yes ☐No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only
- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

************************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS********************************

11. **Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**

11a. ☒Yes ☐No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but $\leq$ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☒	☐	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☐Yes ☒No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to “individuals” for Size 1 and 2 streams and “taxa” for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☒A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider “leaf-on” condition.

☐A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☒B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☐A	☐A	☐A	☐A	≥ 100 feet wide <u>or</u> extends to the edge of the watershed
☒B	☒B	☒B	☒B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide <u>or</u> no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation <u>or</u> modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer <u>or</u> predominantly herbaceous species <u>or</u> bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☐A	☐A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☒B	☒B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing <u>or</u> communities with non-native invasive species present, but not dominant, over a large portion of the expected strata <u>or</u> communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent <u>or</u> communities with non-native invasive species dominant over a large portion of expected strata <u>or</u> communities composed of planted stands of non-characteristic species <u>or</u> communities inappropriately composed of a single species <u>or</u> no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ____________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:
Clearing of vegetation and ATV trail crossing was observed.

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 12

Stream Site Name	Bad Creek II Power Complex Project	Date of Assessment	10/18/23
Stream Category	Mb3	Assessor Name/Organization	Paul Bright / HDR

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Intermittent

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**MEDIUM**	
(2) Baseflow	**LOW**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**MEDIUM**	
(4) Floodplain Access	**MEDIUM**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	NA
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**LOW**	
(2) Baseflow	**LOW**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**MEDIUM**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**LOW**	
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**MEDIUM**	
(3) Baseflow	**LOW**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**MEDIUM**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	NA
(3) Flow Restriction	NA	NA
(3) Tidal Marsh Stream Stability	NA	NA
(4) Tidal Marsh Channel Stability	NA	NA
(4) Tidal Marsh Stream Geomorphology	NA	NA
(3) Tidal Marsh In-stream Habitat	NA	NA
(2) Intertidal Zone	NA	NA
Overall	**MEDIUM**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek II Power Complex Project 2. Date of evaluation: 10/18/23
3. Applicant/owner name: Duke Energy 4. Assessor name/organization: Paul Bright / HDR
5. County: Oconee 6. Nearest named water body on USGS 7.5-minute quad: Howard Creek
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.993024, -82.997765

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): S15 10. Length of assessment reach evaluated (feet): 175
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1-2 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 12-15 13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☒Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.

☐Section 10 water	☒Classified Trout Waters	☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat	☐Primary Nursery Area	☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property	☐NCDWR Riparian buffer rule in effect	☐Nutrient Sensitive Waters
☐Anadromous fish	☐303(d) List	☐CAMA Area of Environmental Concern (AEC)

☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☒Yes ☐No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

☒A Water throughout assessment reach.
☐B No flow, water in pools only.
☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction <u>or</u> fill to the point of obstructing flow <u>or</u> a channel choked with aquatic macrophytes <u>or</u> ponded water <u>or</u> impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
☒B Not A

3. Feature Pattern – assessment reach metric

☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
☒B Not A

4. Feature Longitudinal Profile – assessment reach metric

☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
☒B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

☒A < 10% of channel unstable
☐B 10 to 25% of channel unstable
☐C > 25% of channel unstable

6. **Streamside Area Interaction – streamside area metric**
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☐A	☐A	Little or no evidence of conditions that adversely affect reference interaction
☒B	☒B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. **Water Quality Stressors – assessment reach/intertidal zone metric**
Check all that apply.
- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: ____________________ (explain in “Notes/Sketch” section)
- ☒J Little to no stressors

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. **Large or Dangerous Stream – assessment reach metric**
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. **Natural In-stream Habitat Types – assessment reach metric**
10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☒A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☐D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only
- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

*********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. **Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☐	☐	☐	☒	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☒	☐	☐	☐	Gravel (2 – 64 mm)
☐	☒	☐	☐	☐	Sand (.062 – 2 mm)
☐	☐	☒	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ______

12b. ☐Yes ☒No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☒Y	☒Y	Are wetlands present in the streamside area?
☐N	☐N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

- ☒A Streams and/or springs (jurisdictional discharges)
- ☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
- ☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
- ☒D Evidence of bank seepage or sweating (iron in water indicates seepage)
- ☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
- ☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

- ☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
- ☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
- ☐C Urban stream (≥ 24% impervious surface for watershed)
- ☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
- ☐E Assessment reach relocated to valley edge
- ☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

- ☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
- ☐B Degraded (example: scattered trees)
- ☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☐A	☐A	The total length of buffer breaks is < 25 percent.
☒B	☒B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:
One ATV trail crossing was observed at Stream 15. Small areas of vegetation along the stream have been removed.

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 15

Stream Site Name	Bad Creek II Power Complex Project	Date of Assessment	10/18/23
Stream Category	Mb3	Assessor Name/Organization	Paul Bright / HDR

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**HIGH**	
(2) Baseflow	**MEDIUM**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**MEDIUM**	
(4) Floodplain Access	**MEDIUM**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**LOW**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**LOW**	
(2) Baseflow	**MEDIUM**	
(2) Streamside Area Vegetation	**MEDIUM**	
(3) Upland Pollutant Filtration	**MEDIUM**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**LOW**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**MEDIUM**	
(3) Baseflow	**MEDIUM**	
(3) Substrate	**LOW**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**HIGH**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek Pumped Storage Project
2. Date of evaluation: 10/18/2023
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: Paul Bright / HDR
5. County:
6. Nearest named water body on USGS 7.5-minute quad: Devils Fork
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.993519, -82.994454

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Stream 16
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 2-4 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 6-12
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: **(skip for Tidal Marsh Stream)** ☒Size 1 (< 0.1 mi²) ☐Size 2 (0.1 to < 0.5 mi²) ☐Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.
   - ☐Section 10 water ☒Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
   - ☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
   - ☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
   - ☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
   - ☐Documented presence of a federal and/or state listed protected species within the assessment area.
     List species:
   - ☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

- ☒A Water throughout assessment reach.
- ☐B No flow, water in pools only.
- ☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

- ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction <u>or</u> fill to the point of obstructing flow <u>or</u> a channel choked with aquatic macrophytes <u>or</u> ponded water <u>or</u> impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
- ☒B Not A

3. Feature Pattern – assessment reach metric

- ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
- ☒B Not A

4. Feature Longitudinal Profile – assessment reach metric

- ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
- ☒B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

- ☒A < 10% of channel unstable
- ☐B 10 to 25% of channel unstable
- ☐C > 25% of channel unstable

6. **Streamside Area Interaction – streamside area metric**
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☐A	☐A	Little or no evidence of conditions that adversely affect reference interaction
☒B	☒B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. **Water Quality Stressors – assessment reach/intertidal zone metric**
Check all that apply.
- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B Excessive sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: ____________________ (explain in “Notes/Sketch” section)
- ☒J Little to no stressors

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. **Large or Dangerous Stream – assessment reach metric**
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. **Natural In-stream Habitat Types – assessment reach metric**
10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☐C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only
- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

**********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS*****************************

11. **Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☐	☒	☐	☐	Cobble (64 – 256 mm)
☐	☐	☐	☒	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________________

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☒	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)

Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☒A	☒A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)

Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C	☒C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)

Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)

Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☒A Streams and/or springs (jurisdictional discharges)
☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)

Check all that apply.

☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C Urban stream (≥ 24% impervious surface for watershed)
☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E Assessment reach relocated to valley edge
☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)

Consider aspect. Consider "leaf-on" condition.

☒A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B Degraded (example: scattered trees)
☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☒A	☒A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)

25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 16

Stream Site Name	Bad Creek Pumped Storage Project	Date of Assessment	10/18/2023
Stream Category	Mb1	Assessor Name/Organization	Paul Bright / HDR

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	NO
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Intermittent

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**HIGH**	**HIGH**
(2) Baseflow	**HIGH**	**HIGH**
(2) Flood Flow	**HIGH**	**HIGH**
(3) Streamside Area Attenuation	**MEDIUM**	**MEDIUM**
(4) Floodplain Access	**MEDIUM**	**MEDIUM**
(4) Wooded Riparian Buffer	**HIGH**	**HIGH**
(4) Microtopography	NA	NA
(3) Stream Stability	**HIGH**	**HIGH**
(4) Channel Stability	**HIGH**	**HIGH**
(4) Sediment Transport	**HIGH**	**HIGH**
(4) Stream Geomorphology	**HIGH**	**HIGH**
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**MEDIUM**	**MEDIUM**
(2) Baseflow	**HIGH**	**HIGH**
(2) Streamside Area Vegetation	**HIGH**	**HIGH**
(3) Upland Pollutant Filtration	**HIGH**	**HIGH**
(3) Thermoregulation	**HIGH**	**HIGH**
(2) Indicators of Stressors	**NO**	**NO**
(2) Aquatic Life Tolerance	**LOW**	**NA**
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**HIGH**	**HIGH**
(2) In-stream Habitat	**HIGH**	**HIGH**
(3) Baseflow	**HIGH**	**HIGH**
(3) Substrate	**HIGH**	**HIGH**
(3) Stream Stability	**HIGH**	**HIGH**
(3) In-stream Habitat	**HIGH**	**HIGH**
(2) Stream-side Habitat	**HIGH**	**HIGH**
(3) Stream-side Habitat	**HIGH**	**HIGH**
(3) Thermoregulation	**HIGH**	**HIGH**
(2) Tidal Marsh In-stream Habitat	NA	NA
(3) Flow Restriction	NA	NA
(3) Tidal Marsh Stream Stability	NA	NA
(4) Tidal Marsh Channel Stability	NA	NA
(4) Tidal Marsh Stream Geomorphology	NA	NA
(3) Tidal Marsh In-stream Habitat	NA	NA
(2) Intertidal Zone	NA	NA
Overall	**HIGH**	**HIGH**

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Bad Creek II Power Complex Project
2. Date of evaluation: 10/19/23
3. Applicant/owner name: Duke Energy
4. Assessor name/organization: Paul Bright / HDR
5. County: Oconee
6. Nearest named water body on USGS 7.5-minute quad: Devil's Fork
7. River basin: Savannah
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.993745, -82.993409

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): S17
10. Length of assessment reach evaluated (feet): 150
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 2-3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 6-12
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☒ Mountains (M) ☐ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☒Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.

☐Section 10 water ☒Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☒Yes ☐No

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

2. **Evidence of Flow Restriction – assessment reach metric**
   - ☒A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☐B Not A

3. **Feature Pattern – assessment reach metric**
   - ☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
   - ☒B Not A

4. **Feature Longitudinal Profile – assessment reach metric**
   - ☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
   - ☒B Not A

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

6. **Streamside Area Interaction – streamside area metric**
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☐A	☐A	Little or no evidence of conditions that adversely affect reference interaction
☒B	☒B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] <u>or</u> too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) <u>or</u> floodplain/intertidal zone unnaturally absent <u>or</u> assessment reach is a man-made feature on an interstream divide

7. **Water Quality Stressors – assessment reach/intertidal zone metric**
Check all that apply.
- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B <u>Excessive</u> sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in “Notes/Sketch” section.
- ☐F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☒I Other: ______________________ (explain in “Notes/Sketch” section)
- ☐J Little to no stressors

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. **Large or Dangerous Stream – assessment reach metric**
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. **Natural In-stream Habitat Types – assessment reach metric**

10a. ☐Yes ☒No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☐B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only
- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

**********************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. **Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☒B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but $\leq$ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☐	☒	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☐	☒	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☒	☐	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☐Yes ☒No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: ____________

12b. ☐Yes ☒No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☐	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☐Y	Are wetlands present in the streamside area?
☒N	☒N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

- ☒A Streams and/or springs (jurisdictional discharges)
- ☐B Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
- ☐C Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
- ☐D Evidence of bank seepage or sweating (iron in water indicates seepage)
- ☐E Stream bed or bank soil reduced (dig through deposited sediment if present)
- ☐F None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

- ☐A Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
- ☐B Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
- ☐C Urban stream (≥ 24% impervious surface for watershed)
- ☐D Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
- ☐E Assessment reach relocated to valley edge
- ☒F None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

- ☐A Stream shading is appropriate for stream category (may include gaps associated with natural processes)
- ☒B Degraded (example: scattered trees)
- ☐C Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☒A	☒A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☒

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☒A	☒A	Medium to high stem density
☐B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☐A	☐A	The total length of buffer breaks is < 25 percent.
☒B	☒B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☐A	☐A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☒B	☒B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☐C	☐C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: ______________________

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:
One ATV access road has been constructed across Stream 17 and has two, 6-inch plastic culverts. Areas of streambank vegetation has been removed near the confluence of Stream 16.

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream 17

Stream Site Name	Bad Creek II Power Complex Project	Date of Assessment	10/19/23
Stream Category	Mb3	Assessor Name/Organization	Paul Bright / HDR

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**HIGH**	
(2) Baseflow	**MEDIUM**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**MEDIUM**	
(4) Floodplain Access	**MEDIUM**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**LOW**	
(2) Baseflow	**MEDIUM**	
(2) Streamside Area Vegetation	**MEDIUM**	
(3) Upland Pollutant Filtration	**MEDIUM**	
(3) Thermoregulation	**MEDIUM**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**LOW**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**HIGH**	
(3) Baseflow	**MEDIUM**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**MEDIUM**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**HIGH**	
(3) Thermoregulation	**MEDIUM**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**HIGH**	

Attachment E

Attachment E - Riparian Vegetation Survey Plot Data and Photolog

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Stream 1 (Limber Pole Creek) – Upstream

Left Bank	DBH (cm)	Right Bank	DBH (cm)
Ilex opaca	7.6	Rhododendron	9.5
Rhododendron	5.1	Betula lenta	28.3
Rhododendron	7.6	Oxydendrum arboreum	12.7
Acer rubrum	26.7	Acer saccharum	14.0
Rhododendron	3.0	Rhododendron	10.5
Rhododendron	2.5	Liquidambar styraciflua	45.7
Rhododendron	7.6	Betula lenta	18.5
Rhododendron	7.6	Rhododendron	8.8
Rhododendron	5.1	Pinus strobus	94.9
Rhododendron	11.4	Rhododendron	9.8
Rhododendron	12.7	Betula lenta	21.3
Nyssa sylvatica	16.5	Rhododendron	13.6
Liquidambar styraciflua	33.0	Liquidambar styraciflua	21.4
Pinus strobus	42.4	Acer saccharum	10.4
Rhododendron	5.4	Betula lenta	13.1
Rhododendron	10.2	Oxydendrum arboreum	26.3
		Average DBH - trees >10 cm (cm)	**24.2**
		Average DBH - trees >10 cm (in)	**9.5**
		Average tree density (No. trees/acre)	**405**

Stream 1 (Limber Pole Creek) – Downstream

Left Bank	DBH (cm)	Right Bank	DBH (cm)
Rhododendron	7.0	Rhododendron	7.4
Rhododendron	14.9	Rhododendron	6.9
Sourwood	27.4	Acer rubrum	42.0
Rhododendron	12.0	Acer rubrum	29.9
Rhododendron	3.9	Acer rubrum	30.5
Nyssa sylvatica	13.6	Rhododendron	8.9
Rhododendron	9.5	Rhododendron	8.9
Rhododendron	7.0	Betula papyrifera	48.6
Rhododendron	3.5	Liriodendron tulipifera	43.0
		Rhododendron	8.5
		Rhododendron	17.0
		Rhododendron	14.0
		Average DBH - trees >10 cm (cm)	**26.6**
		Average DBH - trees >10 cm (in)	**10.5**
		Average tree density (No. trees/acre)	**223**

Stream 7 (Howard Creek) – Upstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**
Carpinus caroliniana	22.0	Fagus grandifolia	17.4
Tsuga canadensis	9.7	Betula lenta	28.3
Liriodendron tulipifera	45.9	Liriodendron tulipifera	27.5
		Rhododendron	7.5
		Rhododendron	9.6
		Rhododendron	6.1
		Carpinus caroliniana	7.0
		Liriodendron tulipifera	43.5
		Acer rubrum	6.4
		Fagus grandifolia	34.1
		Average DBH - trees >10 cm (cm)	**31.2**
		Average DBH - trees >10 cm (in)	**12.3**
		Average tree density (No. trees/acre)	**142**

Stream 7 (Howard Creek) – Downstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**	**Right Bank (cont.)**	**DBH (cm)**
Tsuga canadensis	3.9	Acer rubrum	21.7	Tsuga canadensis	4
Tsuga canadensis	4.2	Liriodendron tulipifera	42.2	Tsuga canadensis	3
Fagus grandifolia	15.2	Ilex opaca	10.4	Carpinus caroliniana	2.5
Tsuga canadensis	3.5	Tsuga canadensis	7.6	Tsuga canadensis	3.5
Tsuga canadensis	3.5	Tsuga canadensis	2.5	Kalmia latifolia	4.2
Tsuga canadensis	3.5	Tsuga canadensis	4.2	Tsuga canadensis	3.5
Tsuga canadensis	4.1	Tsuga canadensis	4.0	Tsuga canadensis	2.8
Tsuga canadensis	4.0	Tsuga canadensis	3.5	Liquidambar styraciflua	4.5
Tsuga canadensis	3.5	Tsuga canadensis	5.4	Liriodendron tulipifera	20.3
Tsuga canadensis	4.0	Tsuga canadensis	3.5	Liquidambar styraciflua	2.8
Ilex opaca	2.1	Tsuga canadensis	3.5	Liquidambar styraciflua	2.8
Halesia carolina	19.5	Tsuga canadensis	3.5	Tsuga canadensis	8
Rhododendron	7.5	Tsuga canadensis	3.5	Tsuga canadensis	4
		Tsuga canadensis	2.9	Tsuga canadensis	4
		Tsuga canadensis	2.9	Tsuga canadensis	4
		Average DBH - trees >10 cm (cm)			**21.6**
		Average DBH - trees >10 cm (in)			**8.5**
		Average tree density (No. trees/acre)			**121**

Stream 12 – Upstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**
Liriodendron tulipifera	28.0	Liquidambar styraciflua	76.0
Nyssa sylvatica	3.5	Tsuga canadensis	12.0
Nyssa sylvatica	5.4	Tsuga canadensis	22.0
Liriodendron tulipifera	12.8	Tsuga canadensis	8.0
Acer rubrum	8.9	Nyssa sylvatica	20.5
Carya tomentosa	27.5	Ilex opaca	19.0
Nyssa sylvatica	3.5	Kalmia latifolia	14.0
Liriodendron tulipifera	56.5	Quercus falcata	68.0
		Carya tomentosa	210.0
		Fraxinus pennsylvanica	8.0
		Average DBH - trees >10 cm (cm)	**47.2**
		Average DBH - trees >10 cm (in)	**18.6**
		Average tree density (No. trees/acre)	**243**

Stream 12 – Downstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**
Liriodendron tulipifera	15.1	Liriodendron tulipifera	70.6
Nyssa sylvatica	1.9	Ilex opaca	4.7
Nyssa sylvatica	1.9	Cornus amomum	7.0
Liriodendron tulipifera	45.9	Quercus alba	4.9
Liquidambar styraciflua	12.0	Liriodendron tulipifera	48.4
Liriodendron tulipifera	24.5	Tsuga canadensis	12.4
Liquidambar styraciflua	7.9	Tsuga canadensis	7.3
Acer rubrum	4.4	Acer rubrum	48.0
Liriodendron tulipifera	7.6		
Liquidambar styraciflua	9.8		
Liriodendron tulipifera	34.0		
		Average DBH - trees >10 cm (cm)	**37.4**
		Average DBH - trees >10 cm (in)	**14.7**
		Average tree density (No. trees/acre)	**162**

Stream 15 – Upstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**
Liriodendron tulipifera	12.2	Quercus montana	29.0
Acer rubrum	3.2	Kalmia latifolia	4.0
		Pinus strobus	21.8
		Nyssa sylvatica	4.5
		Nyssa sylvatica	28.6
		Kalmia latifolia	6.6
		Oxydendrum arboreum	12.4
		Nyssa sylvatica	5.5
		Nyssa sylvatica	3.8
		Average DBH - trees >10 cm (cm)	**20.8**
		Average DBH - trees >10 cm (in)	**8.2**
		Average tree density (No. trees/acre)	**101**

Stream 15 – Downstream

Left Bank	**DBH (cm)**	**Right Bank**	**DBH (cm)**
Acer rubrum	10.7	Quercus alba	28.3
Kalmia latifolia	6.7	Kalmia latifolia	7.0
Acer rubrum	12.0	Kalmia latifolia	4.7
Oxydendrum arboreum	28.4	Acer rubrum	23.7
Acer rubrum	20.0	Quercus alba	37.2
Quercus montana	31.0	Oxydendrum arboreum	18.0
Kalmia latifolia	5.0	Kalmia latifolia	7.6
		Acer rubrum	9.3
		Acer rubrum	17.5
		Pinus strobus	3.0
		Acer rubrum	7.4
		Quercus alba	41.5
		Average DBH - trees >10 cm (cm)	**24.4**
		Average DBH - trees >10 cm (in)	**9.6**
		Average tree density (No. trees/acre)	**223**

Stream 16 – Upstream

Right Bank	DBH (cm)	Left Bank	DBH (cm)
Acer rubrum	11.1	Liriodendron tulipifera	44.3
Liriodendron tulipifera	15.4	Liriodendron tulipifera	16.9
Liriodendron tulipifera	27.5	Nyssa sylvatica	3.8
Acer rubrum	16.5	Acer rubrum	12.2
Oxydendrum arboreum	12.1	Liriodendron tulipifera	13.3
Acer rubrum	5.6	Liriodendron tulipifera	34.8
Magnolia tripetala	5	Oxydendrum arboreum	6
Quercus alba	46	Liriodendron tulipifera	12.4
Pinus strobus	1	Robinia pseudoacacia	21.4
Kalmia latifolia	5.6		
		Average DBH - trees >10 cm (cm)	**21.8**
		Average DBH - trees >10 cm (in)	**8.6**
		Average tree density (No. trees/acre)	**263**

Stream 16 – Downstream

Right Bank	DBH (cm)	Left Bank	DBH (cm)
Acer rubrum	55	Fagus grandifolia	2.1
Tilia americana	11.6	Liriodendron tulipifera	19.4
		Liriodendron tulipifera	25.5
		Liriodendron tulipifera	15
		Liriodendron tulipifera	19
		Oxydendrum arboreum	4.6
		Liriodendron tulipifera	6.8
		Oxydendrum arboreum	7.5
		Oxydendrum arboreum	3.4
		Oxydendrum arboreum	2.2
		Kalmia latifolia	4
		Liriodendron tulipifera	37
		Average DBH - trees >10 cm (cm)	**26.1**
		Average DBH - trees >10 cm (in)	**10.3**
		Average tree density (No. trees/acre)	**142**

Stream 17 (Devils Fork) – Upstream

Right Bank	DBH (cm)	Left Bank	DBH (cm)
Liriodendron tulipifera	44.3	Nyssa sylvatica	21.3
Liriodendron tulipifera	16.9	Quercus alba	53.1
Nyssa sylvatica	3.8	Kalmia latifolia	3.5
Acer rubrum	12.2	Acer rubrum	13.4
Liriodendron tulipifera	13.3	Oxydendrum arboreum	3
Liriodendron tulipifera	34.8	Liriodendron tulipifera	3.3
Oxydendrum arboreum	6	Asimina triloba	3.3
Liriodendron tulipifera	12.4	Kalmia latifolia	2.4
Robinia pseudoacacia	21.4	Kalmia latifolia	4
		Asimina triloba	2.5
		Average DBH - trees >10 cm (cm)	**24.3**
		Average DBH - trees >10 cm (in)	**9.6**
		Average tree density (No. trees/acre)	**202**

Stream 17 (Devils Fork) – Downstream

Right Bank	DBH (cm)	Left Bank	DBH (cm)
Fagus grandifolia	2.1	Robinia pseudoacacia	48
Liriodendron tulipifera	19.4	Ilex opaca	32
Liriodendron tulipifera	25.5	Nyssa sylvatica	4
Liriodendron tulipifera	15	Cornus florida	9.6
Liriodendron tulipifera	19	Ilex opaca	6.2
Oxydendrum arboreum	4.6	Liriodendron tulipifera	32
Liriodendron tulipifera	6.8	Ilex opaca	11.2
Oxydendrum arboreum	7.5	Liriodendron tulipifera	34
Oxydendrum arboreum	3.4	Acer rubrum	5
Oxydendrum arboreum	2.2	Fagus grandifolia	2.5
Kalmia latifolia	4	Fagus grandifolia	3.4
Liriodendron tulipifera	37	Liriodendron tulipifera	28.2
		Liriodendron tulipifera	27.5
		Liriodendron tulipifera	32
		Rhododendron	4
		Rhododendron	4.5
		Rhododendron	7.5
		Rhododendron	2.4
		Rhododendron	4.7
		Average DBH - trees >10 cm (cm)	**27.8**
		Average DBH - trees >10 cm (in)	**10.9**
		Average tree density (No. trees/acre)	**263**

Photo 1. View of vegetation plot on left bank of upstream reach at Stream 1 (Limber Pole Creek

Photo 2. View of vegetation plot on right bank of upstream reach at Stream 1 (Limber Pole Creek), facing southeast

Photo 3. View of vegetation plot on left bank of downstream reach at Stream 1 (Limber Pole Creek), facing southwest

Photo 4. View of vegetation plot on right bank of downstream reach at Stream 1 (Limber Pole Creek), facing southeast

Photo 5. View of vegetation plot on left bank of upstream reach at Stream 7 (Howard Creek), facing southeast

Photo 6. View of vegetation plot on right bank of upstream reach at Stream 7 (Howard Creek), facing southeast

Photo 7. View of vegetation plot on left bank of downstream reach at Stream 7 (Howard Creek), facing southwest

Photo 8. View of vegetation plot on right bank of downstream reach at Stream 7 (Howard Creek), facing northeast


Photo 9. View of vegetation plot on left bank of upstream reach at Stream 12, facing southeast


Photo 10. View of vegetation plot on right bank of upstream reach at Stream 12, facing northwest

Photo 11. View of vegetation plot on left bank of downstream reach at Stream 12, facing southwest

Photo 12. View of vegetation plot on right bank of downstream reach at Stream 12, facing south

Photo 13. View of vegetation plot on left bank of upstream reach at Stream 15, facing northwest

Photo 14. View of vegetation plot on left bank of upstream reach at Stream 15, facing northwest

Photo 15. View of vegetation plot on left bank of downstream reach at Stream 15, facing west

Photo 16. View of vegetation plot on right bank of upstream reach at Stream 16

Photo 17. View of vegetation plot on right bank of downstream reach at Stream 15, facing southeast

Photo 18. View of vegetation plot on left bank of upstream reach of Stream 16 and right bank of upstream reach of Stream 17 (Devils Fork), facing northeast

Photo 19. View of vegetation plot on left bank of upstream reach of Stream 17 (Devils Fork), facing northwest

Photo 20. View of vegetation plot on left bank of downstream reach of Stream 16 and right bank of downstream reach of Stream 17 (Devils Fork), facing north

Photo 21. View of vegetation plot on left bank of downstream reach of Stream 17 (Devils Fork), facing east

Photo 22. View of vegetation plot on right bank of downstream reach of Stream 16, facing west

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Attachment F

Attachment F - Stream Quantification Tool Rapid Method Forms

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Limber Pole Creek - Upstream
Upstream Latitude:	34.991512
Upstream Longitude:	-83.02083761
Downstream Latitude:	34.991604
Downstream Longitude:	-83.02053397
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	1.780579
Strahler Stream Order:	3
Flow Type:	Perennial
Buffer Valley Slope (%):	7.5
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank armoring

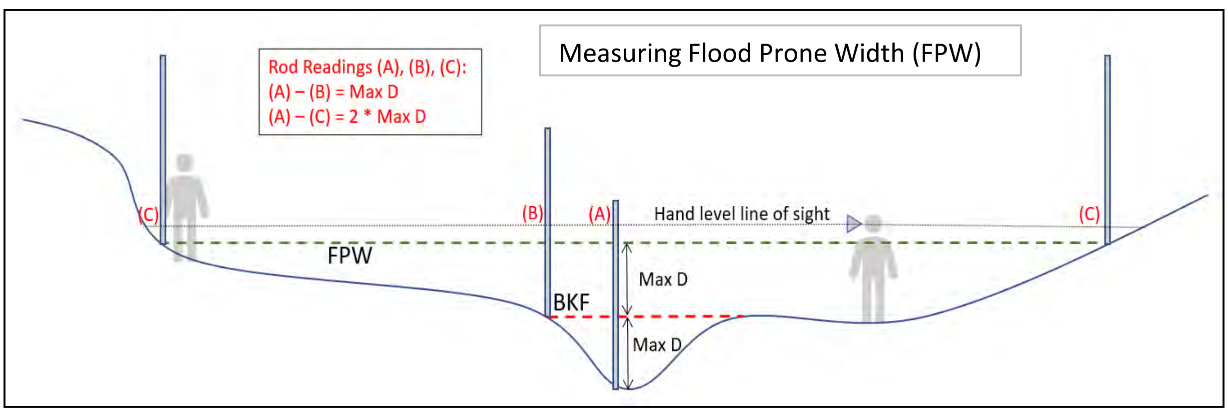
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.82	Back of depositional feature

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.82
B.	Bankfull Width (ft)	14.4
E.	Regional Curve Bankfull Width (ft)	22.295
F.	Regional Curve Bankfull Mean Depth (ft)	1.3404
G.	Regional Curve Bankfull Area (sq. ft.)	29.998
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63
I.	Flood Prone Width (FPW; ft)	16.08

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0	13	1.08
0.1	0.22	14	0.18
1	0.5	14.4	0
2	0.88		
3	0.9		
4.9	1.05		
5.5	1.4		
6	1.52		
7	1.5		
8	1.35		
9	1.28		
10	1		
11	1.12		
12	1.1		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	288

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	3.8	85						
End Station (Distance along tape)	34.9	102.5						
Low Bank Height (ft)	4.15	3.11						
Bankfull Max Depth (ft)	1.52	1.9						
Bankfull Width (ft)	14.4	22.3						
Flood Prone Width (ft)	16.1	66.2						
Bankfull Mean Depth (ft)	1.2	1.2						

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G							
Station At maximum pool depth	43.8							
Geomorphic P-P Spacing (ft)								
Pool Depth (ft) Measured from Bankfull	1.81							

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	103.2	103.2	0.039
Stadia Rod Reading (ft)	1694	1690	4.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	103.2
Valley Length (ft)	93.27
Sinuosity	1.11

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	15
Assessment length (ft)	100
# of LWD Pieces/100 m	49.2

Date: 10/2/2023
Investigators: EBS, KC, SP (HDR)

Stream 1 (Limber Pole Creek) - Upstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Limber Pole Creek - Upstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 11.3 mm, medium gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
25	12	20	1.17	5	75	75	75	silt- N/A	N/A	31.65 / High	1.0 / Low

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Limber Pole Creek - Downstream
Upstream Latitude:	34.991604
Upstream Longitude:	-83.02053397
Downstream Latitude:	34.991628
Downstream Longitude:	-83.0200869
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	146
Valley Type:	Colluvial
Drainage Area (sq. mi.):	1.780579
Strahler Stream Order:	3
Flow Type:	Perennial
Buffer Valley Slope (%):	2.5
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank armoring

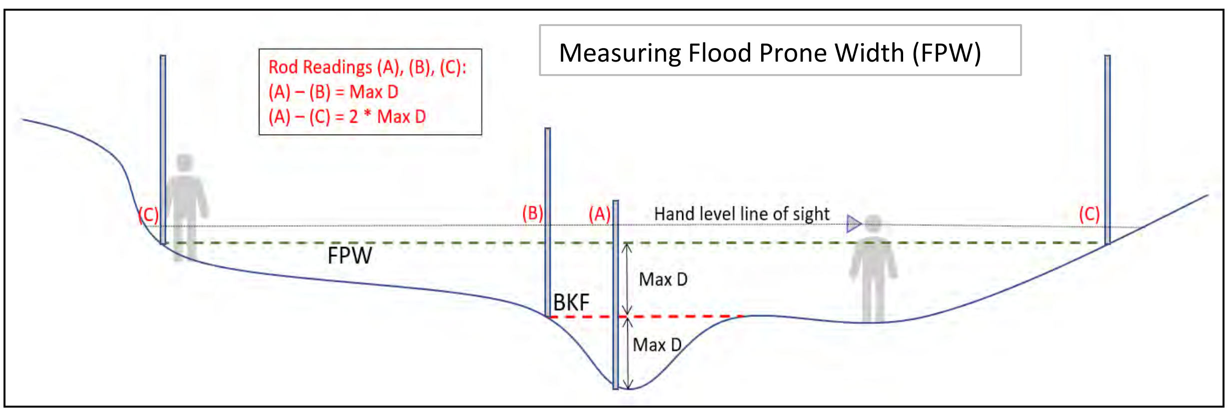
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.83	bottom of undercut, top of mid-channel depositional bar

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.83
B.	Bankfull Width (ft)	18.2
E.	Regional Curve Bankfull Width (ft)	22.295
F.	Regional Curve Bankfull Mean Depth (ft)	1.3404
G.	Regional Curve Bankfull Area (sq. ft.)	29.998
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	21.1

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0	13	0.64
0.1	1.3	14	0.54
1	1.28	15	0.84
2	1.18	16	0.88
3	1.28	17	0.84
4	1.16	18	0.84
5	0.88	18.2	0
6	0.62		
7	0.5		
8	0.4		
9	0.4		
10	0.48		
11	0.54		
12	0.54		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	364

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	107							
End Station (Distance along tape)	146							
Low Bank Height (ft)	4.7							
Bankfull Max Depth (ft)	1.28							
Bankfull Width (ft)	18.2							
Flood Prone Width (ft)	38.0							
Bankfull Mean Depth (ft)	0.8							

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?		G						
Station At maximum pool depth	24.1	66.6						
Geomorphic P-P Spacing (ft)								
Pool Depth (ft) Measured from Bankfull	1.84	2.58						

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	146.83	146.8	0.014
Stadia Rod Reading (ft)	1692	1690	2.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	146.83
Valley Length (ft)	136.04
Sinuosity	1.08

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	12
Assessment length (ft)	146.83
# of LWD Pieces/100 m	26.8

Date: 10/2/2023
Investigators: EBS, KC, SP (HDR)

Stream 1 (Limber Pole Creek) - Downstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Limber Pole Creek - Downstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 14.55 mm, medium gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
All streambanks stable											

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Howard Creek - Upstream
Upstream Latitude:	34.991168
Upstream Longitude:	-83.00275748
Downstream Latitude:	34.991031
Downstream Longitude:	-83.0024676
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	4.13202
Strahler Stream Order:	2
Flow Type:	Perennial
Buffer Valley Slope (%):	6.1
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No armored banks

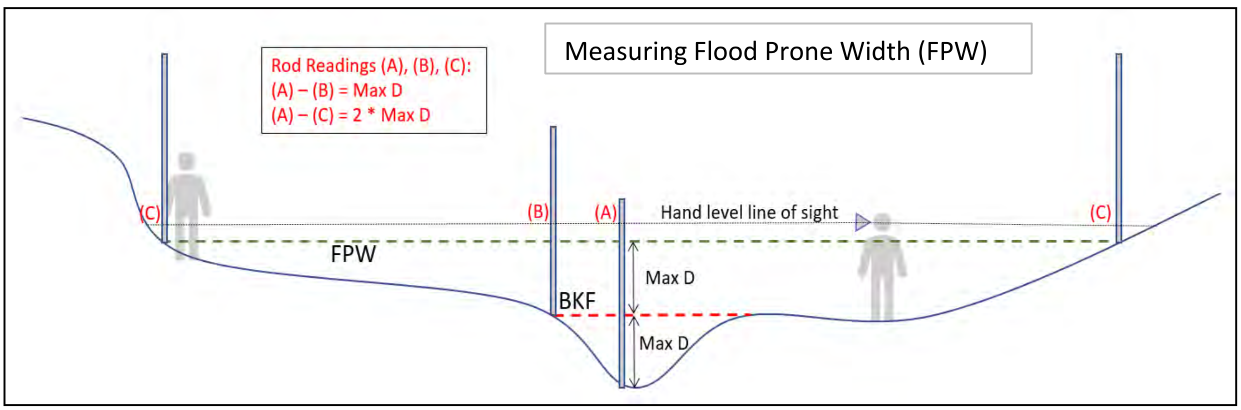
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.02	undercut bank, moss lines

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.02
B.	Bankfull Width (ft)	19.2
E.	Regional Curve Bankfull Width (ft)	31.22
F.	Regional Curve Bankfull Mean Depth (ft)	1.7197
G.	Regional Curve Bankfull Area (sq. ft.)	53.804
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	20.8

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0	13	0.82
0.1	0.7	14	1
1	0.71	15	0.7
2	0.68	16	1.02
3	0.48	17	1.02
4	0.4	18	1.02
5	0.52	19	0.9
6	0.48	19.2	0
7	0.1		
8	0.42		
9	0.5		
10	0.88		
11	1.2		
12	0.68		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	384

B. Riffle Data

	R1	R2	R3 *	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	1	23.5	46	84.2				
End Station (Distance along tape)	19	31.1	66.5	100				
Low Bank Height (ft)	3.92	3.33	1.83	1.83				
Bankfull Max Depth (ft)	0.62	1.2	1.02	1.46				
Bankfull Width (ft)	12.7	12.1	19.2	17.1				
Flood Prone Width (ft)	13	12.9	20.8	27.8				
Bankfull Mean Depth (ft)	0.8	0.8	0.8	0.8				

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G					
Station At maximum pool depth	23.2	40.5	72					
Geomorphic P-P Spacing (ft)		17.3	31.5					
Pool Depth (ft) Measured from Bankfull	1.18	1.36	1.42					

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	102.95	103.0	0.019
Stadia Rod Reading (ft)	1320	1318	2.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	102.95
Valley Length (ft)	95.14
Sinuosity	1.08

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	6
Assessment length (ft)	100
# of LWD Pieces/100 m	19.7

Date: 10/2/2023
Investigators: EBS, KC, SP (HDR)

Stream 7 (Howard Creek) - Upstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Howard Creek - Upstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 34.6 mm, very coarse gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
12	15	3	0.68	2	60	125	40	NA- silt	NA	33.3 / High	0.52 / Very Low
25	10	3.33	1.2	2.5	50	130	40	NA- silt	NA	32.05 / High	1.0 / Low
30	8	4	1.2	2	40	145	30	NA- silt	NA	37.02 / High	1.0 / Low

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Howard Creek - Downstream
Upstream Latitude:	34.991031
Upstream Longitude:	-83.0024676
Downstream Latitude:	34.990804
Downstream Longitude:	-83.00220504
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	114
Valley Type:	Confined Alluvial
Drainage Area (sq. mi.):	4.13202
Strahler Stream Order:	2
Flow Type:	Perennial
Buffer Valley Slope (%):	6.1
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No armored banks

C.

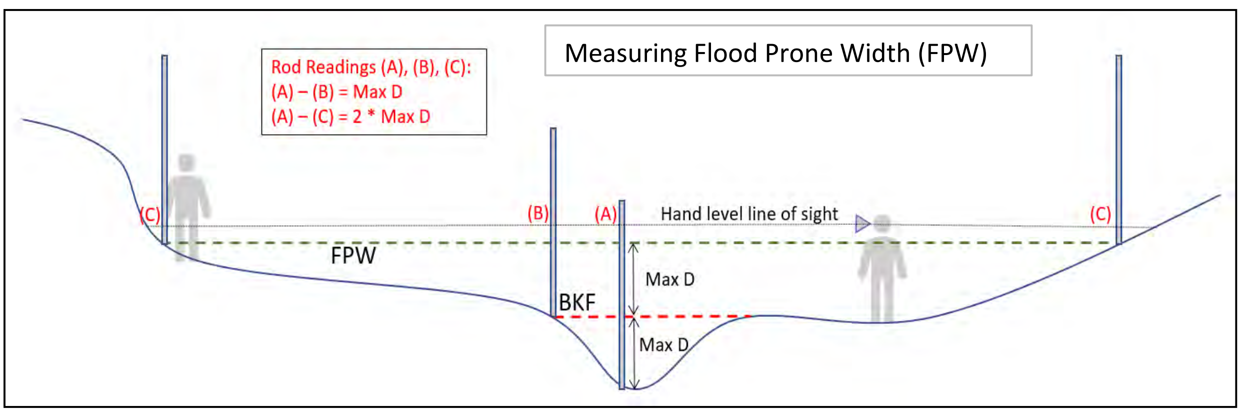
Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.48	depositional bench w/veg - top

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.48
B.	Bankfull Width (ft)	25.2
E.	Regional Curve Bankfull Width (ft)	31.22
F.	Regional Curve Bankfull Mean Depth (ft)	1.7197
G.	Regional Curve Bankfull Area (sq. ft.)	53.804
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63
I.	Flood Prone Width (FPW; ft)	29.5

Cross Section Measurements
Depth measured from bankfull

Station	Depth	Station	Depth
0	0	14	0.78
0.1	0.4	15	1.16
1	0.62	16	1.18
2	0.78	17	0.88
3	0.88	18	1.18
4	0.8	19	1.4
5	0.58	20	0.86
6	0.54	21	0.88
7	1.24	22	0.58
8	1.28	23	0.36
10	1.16	24	0.25
11	0.48	25.2	0
12	0.52		
13	0.74		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	504

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	33							
End Station (Distance along tape)	96.5							
Low Bank Height (ft)	2.67							
Bankfull Max Depth (ft)	1.28							
Bankfull Width (ft)	25.2							
Flood Prone Width (ft)	29.5							
Bankfull Mean Depth (ft)	0.9							

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?								
Station At maximum pool depth	8.7							
Geomorphic P-P Spacing (ft)								
Pool Depth (ft) Measured from Bankfull	2.64							

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	116.7	116.7	0.051
Stadia Rod Reading (ft)	1318	1312	6.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	116.74
Valley Length (ft)	110.97
Sinuosity	1.05

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	15
Assessment length (ft)	114
# of LWD Pieces/100 m	43.2

Date: 10/2/2023
Investigators: EBS, KC, SP (HDR)

Stream 7 (Howard Creek) - Downstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Howard Creek - Downstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 56.69 mm, very coarse gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
98	8	6	1.3	0	0	85	100	Bedrock	NA	2.69 / Very Low	1.44 / Low

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 12 - Upstream
Upstream Latitude:	34.995613
Upstream Longitude:	-83.0064477
Downstream Latitude:	34995642
Downstream Longitude:	-83.00094113
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.031178
Strahler Stream Order:	1
Flow Type:	Intermittent
Buffer Valley Slope (%):	15.7
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank amoring

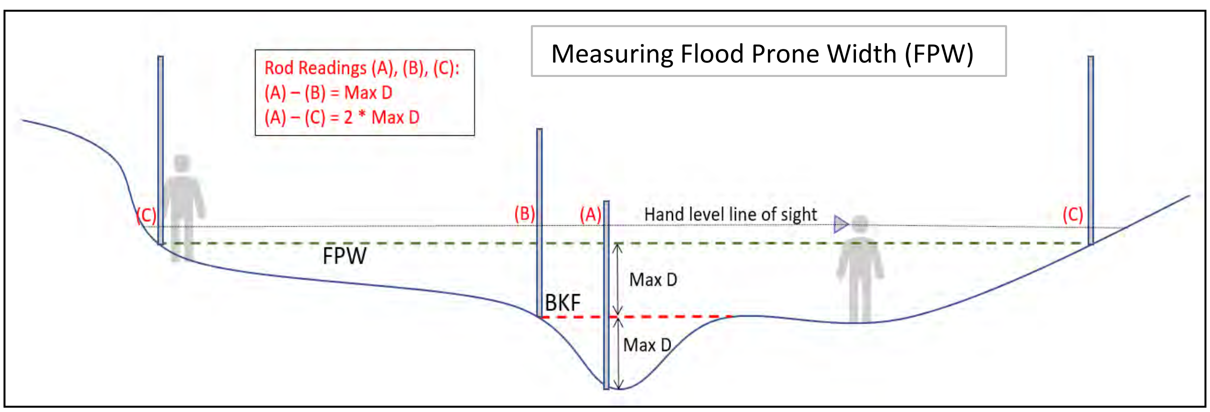
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.3	No water present. Veg/moss break.

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.3
B.	Bankfull Width (ft)	5
E.	Regional Curve Bankfull Width (ft)	4.4209
F.	Regional Curve Bankfull Mean Depth (ft)	0.4048
G.	Regional Curve Bankfull Area (sq. ft.)	1.811
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	5.7

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0		
0.1	0.42		
1	0.38		
2	0.36		
3	0.28		
4	0.18		
5	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100		20*Bankfull Width	100

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	12	32.5	46					
End Station (Distance along tape)	31	42.7	56					
Low Bank Height (ft)	2.9	1.62	1.62					
Bankfull Max Depth (ft)	0.42	0.5	0.68					
Bankfull Width (ft)	5	5.6	4.2					
Flood Prone Width (ft)	5.7	7.8	5.4					
Bankfull Mean Depth (ft)	0.3	0.3	0.3					

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G					
Station At maximum pool depth	10.9	31	44.1					
Geomorphic P-P Spacing (ft)		20.1	13.1					
Pool Depth (ft) Measured from Bankfull	0.9	0.38	0.78					

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	99.88	99.9	0.100
Stadia Rod Reading (ft)	1542	1532	10.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	99.88
Valley Length (ft)	87.71
Sinuosity	1.14

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	3
Assessment length (ft)	100
# of LWD Pieces/100 m	9.8

Date: 10/2/2023

Investigators: EBS, KC, SP (HDR)

Stream 12 - Upstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Stream 12 - Upstream**

Valley Type: **Colluvial**

Bed Material: **D50 = 14.29, medium gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
All banks stable											

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 12 - Downstream
Upstream Latitude:	34.995642
Upstream Longitude:	-83.00094113
Downstream Latitude:	34.995534
Downstream Longitude:	-83.00115561
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.031178
Strahler Stream Order:	1
Flow Type:	Intermittent
Buffer Valley Slope (%):	15.7
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	NA

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank amoring

C.

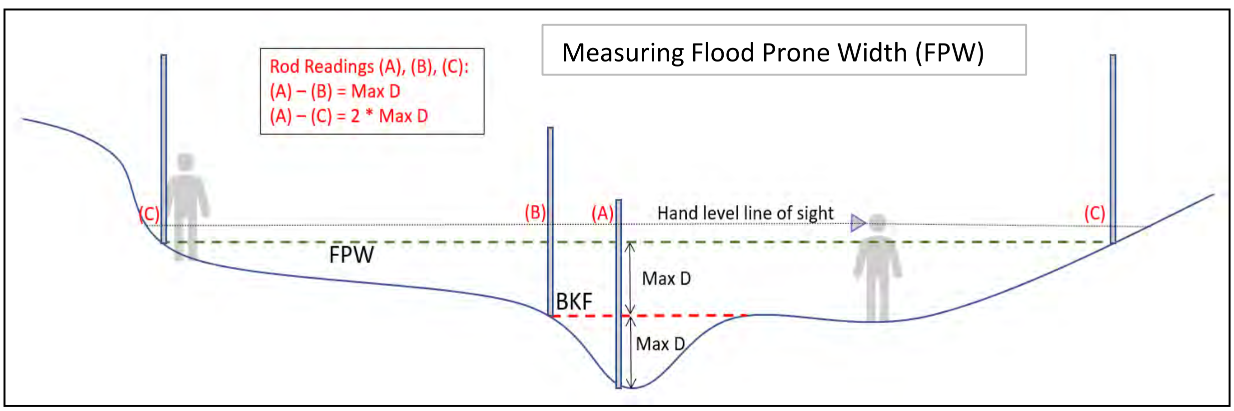
Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.75	Back of bench

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.75
B.	Bankfull Width (ft)	8.1
E.	Regional Curve Bankfull Width (ft)	4.4209
F.	Regional Curve Bankfull Mean Depth (ft)	0.4048
G.	Regional Curve Bankfull Area (sq. ft.)	1.811
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63
I.	Flood Prone Width (FPW; ft)	9.5

Cross Section Measurements
Depth measured from bankfull

Station	Depth	Station	Depth
0	0		
0	0.12		
1	0.16		
2	0.46		
3	0		
3.5	0.38		
4	0.66		
5	0.58		
6	0.68		
7	0.82		
8	0.82		
8.1	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	162

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	18	30.9	77.6					
End Station (Distance along tape)	28.8	73.5	100					
Low Bank Height (ft)	1.46	3.2	1.85					
Bankfull Max Depth (ft)	0.82	0.8	0.8					
Bankfull Width (ft)	8.1	5.2	8.7					
Flood Prone Width (ft)	9.6	10.5	10.3					
Bankfull Mean Depth (ft)	0.5	0.5	0.5					

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G					
Station At maximum pool depth	6.5	13	16.8	30.2	76.7			
Geomorphic P-P Spacing (ft)		6.5	3.8					
Pool Depth (ft) Measured from Bankfull	0.56	0.58	0.52	0.7	0.8			

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	100.7	100.7	0.079
Stadia Rod Reading (ft)	1530	1522	8.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	100.69
Valley Length (ft)	75.8
Sinuosity	1.33

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	16
Assessment length (ft)	100
# of LWD Pieces/100 m	52.5

Date: 10/2/2023 Stream 12 - Downstream **SC SQT**

Investigators: EBS, KC, SP (HDR) **BEHI/NBS Field Form**

Reach ID: **Stream 12 - Downstream**

Valley Type: **Colluvial**

Bed Material: **D50 = 3.13, very fine gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
20	10	7	0.5	6	60	60	40	silt	NA	25.37 / Moderate	1.6 / Moderate

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 15 Upstream
Upstream Latitude:	34.99311
Upstream Longitude:	-82.99787492
Downstream Latitude:	34.992924
Downstream Longitude:	-82.99763355
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.018879
Strahler Stream Order:	First
Flow Type:	Perennial
Buffer Valley Slope (%):	8.1
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank amoring

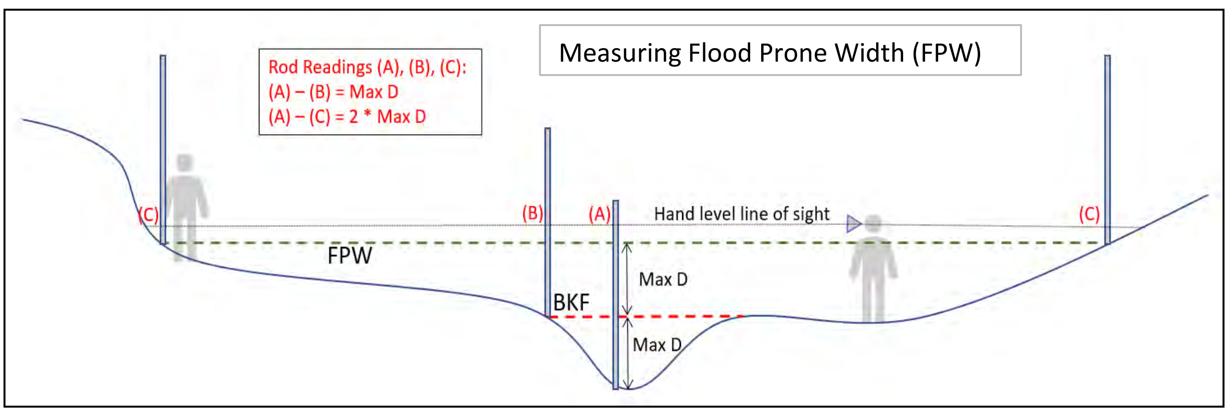
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.72	undercut
0.47	back of depositional bar
0.31	back of depositional bar

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.5
B.	Bankfull Width (ft)	3.1
E.	Regional Curve Bankfull Width (ft)	3.6171
F.	Regional Curve Bankfull Mean Depth (ft)	0.349
G.	Regional Curve Bankfull Area (sq. ft.)	1.2786
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	4.3

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0		
0.1	0.54		
1	0.62		
1.5	0.74		
2	0.62		
3	0.42		
3.1	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	62

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	27.2	42.3	48.8	65				
End Station (Distance along tape)	33.8	45.6	51	65.5				
Low Bank Height (ft)	1.42	1.32	1.46	1.18				
Bankfull Max Depth (ft)	0.74	0.48	0.58	0.32				
Bankfull Width (ft)	3.1	3.2	5.3	5.3				
Flood Prone Width (ft)	4.3	4.55	5.6	6.7				
Bankfull Mean Depth (ft)	0.6	0.6	0.6	0.6				

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G	G	G			
Station At maximum pool depth	15.7	38	46.7	54.7	74.7			
Geomorphic P-P Spacing (ft)		22.3	8.7	8.0	20.0			
Pool Depth (ft) Measured from Bankfull	0.86	1.24	0.68	0.72	0.68			

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	101.07	101.1	0.059
Stadia Rod Reading (ft)	1746	1740	6.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	100.2
Valley Length (ft)	99.62
Sinuosity	1.01

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	3
Assessment length (ft)	100
# of LWD Pieces/100 m	9.8

Date: 10/3/2023 Stream 15 - Upstream **SC SQT**

Investigators: EBS, KC, SP (HDR) **BEHI/NBS Field Form**

Reach ID: **Stream 15 - Upstream**

Valley Type: **Colluvial**

Bed Material: **D50 = 1.36, very coarse sand**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
7	10	4	0.9	4	30	120	20	10 - Fine san	NA	44.12 / Very High	1.43 / Low
50	6	1.5	0.7	1	15	110	20	Silt	NA	35.49 / High	0.97 / Very Low
55	25	1.5	0.7	0.5	10	90	10	10 - Fine san	NA	49.53 / Extreme	1.2 / Low
80	12	2	0.5	0.5	10	45	20	Silt	NA	36.93 / High	1.13 / Low

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 15 Downstream
Upstream Latitude:	34.992924
Upstream Longitude:	-82.99763355
Downstream Latitude:	344.992705
Downstream Longitude:	-82.997434
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.018879
Strahler Stream Order:	1
Flow Type:	Perennial
Buffer Valley Slope (%):	30.1
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: no CFPs

B. Armored Bank Lengths (ft):

Notes: no bank armoring

C.

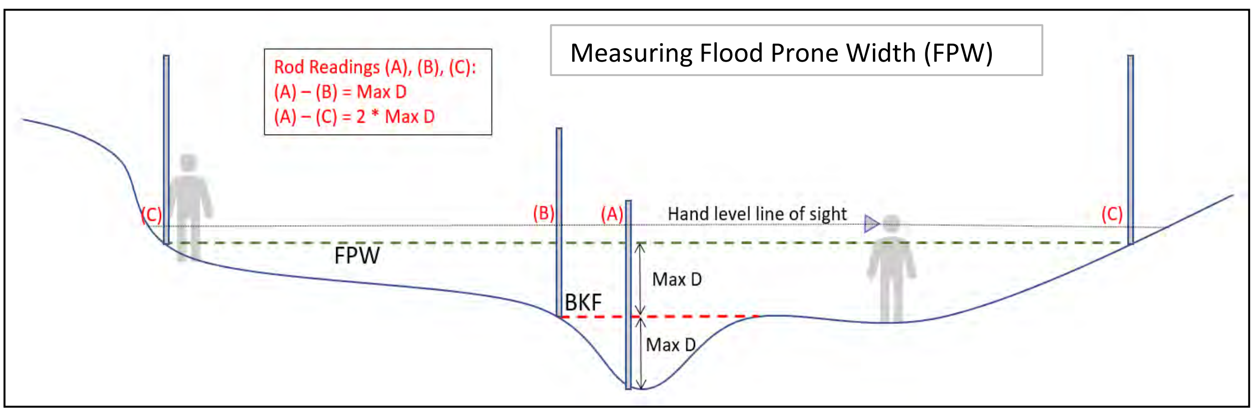
Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.58	No great indicators - wide bedrock area, sheet flow

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.58
B.	Bankfull Width (ft)	3.2
E.	Regional Curve Bankfull Width (ft)	3.6171
F.	Regional Curve Bankfull Mean Depth (ft)	0.349
G.	Regional Curve Bankfull Area (sq. ft.)	1.2786
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	3.9

Cross Section Measurements
Depth measured from bankfull

Station	Depth	Station	Depth
0	0.44		
1	0.54		
2	0.52		
3	0.7		
3.1	0.7		
3.2	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	64

B. Riffle Data

	R1	R2 *	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	42	55.8						
End Station (Distance along tape)	44	59						
Low Bank Height (ft)	1.12	1.32						
Bankfull Max Depth (ft)	0.22	0.7						
Bankfull Width (ft)	1.4	3.2						
Flood Prone Width (ft)	4.5	3.9						
Bankfull Mean Depth (ft)	0.5	0.5						

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G	G				
Station At maximum pool depth	23.1	41.2	52.6	60.5				
Geomorphic P-P Spacing (ft)		18.1	11.4	7.9				
Pool Depth (ft) Measured from Bankfull	0.72	0.58	0.92	0.72				

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	100.2	100.2	0.299
Stadia Rod Reading (ft)	1736	1706	30.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	100.24
Valley Length (ft)	98.49
Sinuosity	1.02

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	2
Assessment length (ft)	100
# of LWD Pieces/100 m	6.6

Reach ID: **Stream 15 - Downstream**
Valley Type: **Colluvial**
Bed Material: **Bedrock**

Station ID	Bank Length (Ft)	Study Bank Height (ft)	Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS): BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
All banks stable, no meanders											

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 16 - Upstream
Upstream Latitude:	34.993683
Upstream Longitude:	-82.99403219
Downstream Latitude:	34.993628
Downstream Longitude:	-82.99371234
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.019919
Strahler Stream Order:	First
Flow Type:	Perennial
Buffer Valley Slope (%):	8.2
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank amoring

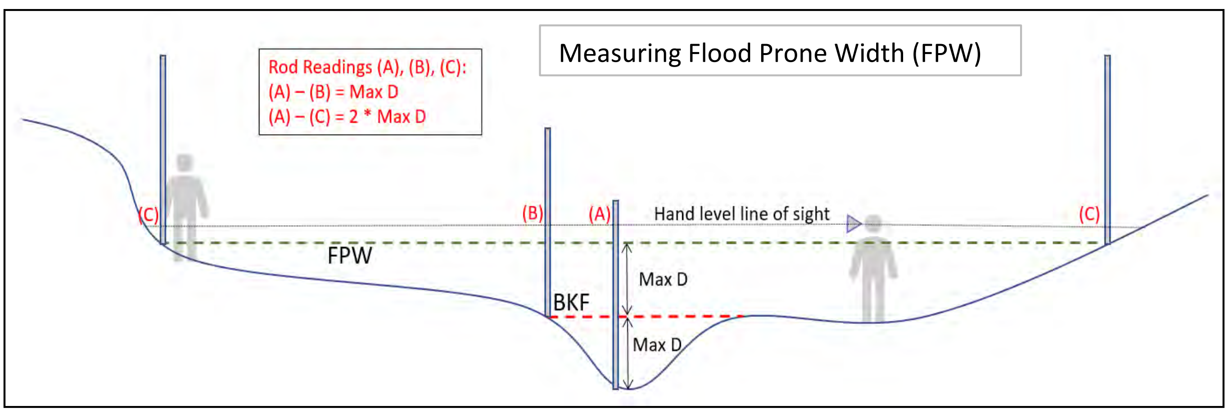
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.68	top of depositional bar
3.25	top of bench
0.14	top of depositional bar
0.5	mid depositional bar opposite undercut bank
0.56	undercut bank

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	1.026
B.	Bankfull Width (ft)	10.5
E.	Regional Curve Bankfull Width (ft)	3.6956
F.	Regional Curve Bankfull Mean Depth (ft)	0.3545
G.	Regional Curve Bankfull Area (sq. ft.)	1.3271
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63
I.	Flood Prone Width (FPW; ft)	11.8

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0		
0.1	0.38		
1	0.46		
2	0.4		
3	0.68		
4	0.78		
5	0.62		
6	0.4		
7	0.62		
8	0.58		
9	0.64		
10	0.66		
10.5	0		



D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	100.2	100.2	0.080
Stadia Rod Reading (ft)	1496	1488	8.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	100.21
Valley Length (ft)	97.11
Sinuosity	1.03

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	4
Assessment length (ft)	100
# of LWD Pieces/100 m	13.1

IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100		20*Bankfull Width	210

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	7	31	37	45.5	56	60	66	88.5
End Station (Distance along tape)	29	34.5	39.5	53.2	58.2	65	85	93
Low Bank Height (ft)	1.96	1.87	1.12	1.48	0.9	0.64	1.42	1.42
Bankfull Max Depth (ft)	0.78	0.32	0.56	0.6	0.24	0.3	0.6	0.6
Bankfull Width (ft)	10.5	3	3.3	4.3	3.9	3.6	4.7	4.9
Flood Prone Width (ft)	11.8	4.5	5.7	6.1	5.3	8	7.6	6.8
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Geomorphic Pool?	G	G	G	G	G	G	G	G	G	G
Station At maximum pool depth	4	19.7	30	35.3	43	54.4	58.6	65.4	86.8	95
Geomorphic P-P Spacing (ft)		15.7	10.3	5.3	7.7	11.4	4.2	6.8	21.4	8.2
Pool Depth (ft) Measured from Bankfull	0.78	0.66	0.5	0.56	1.08	0.66	0.76	0.44	0.78	0.78

Reach ID: **Stream 16 - Upstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 10.2 mm, medium gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
92	10	1.6	0.6	1	60	145	20	Silt	N/A	34.63 / High	1.56 / Moderate

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 16 - Downstream
Upstream Latitude:	34.993628
Upstream Longitude:	-82.99371234
Downstream Latitude:	34.993423
Downstream Longitude:	-82.99349421
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.049116
Strahler Stream Order:	First
Flow Type:	Perennial
Buffer Valley Slope (%):	10.1
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points: 1

Notes: Double HDPE culvert

B. Armored Bank Lengths (ft):

Notes: No bank amoring

C.

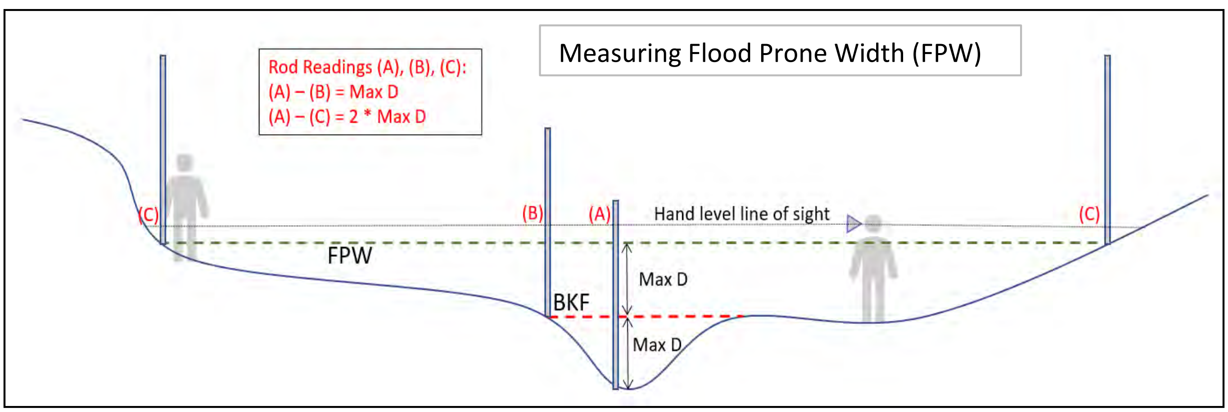
Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.74	Veg break
1.06	undercut bank/eroded
0.86	undercut bank/eroded

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.89
B.	Bankfull Width (ft)	6.2
E.	Regional Curve Bankfull Width (ft)	5.3023
F.	Regional Curve Bankfull Mean Depth (ft)	0.4631
G.	Regional Curve Bankfull Area (sq. ft.)	2.4826
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63
I.	Flood Prone Width (FPW; ft)	7.1

Cross Section Measurements
Depth measured from bankfull

Station	Depth	Station	Depth
0	0		
0.1	0.3		
1	0.82		
2	0.86		
3	1		
4	1.02		
5	1.02		
6	1		
6.2	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	124

B. Riffle Data

	R1	R2	R3 *	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	0	35	41.5	58				
End Station (Distance along tape)	29.2	38	54	83				
Low Bank Height (ft)	1.42	2.2	2.1	2.32				
Bankfull Max Depth (ft)	0.8	0.82	1.02	0.9				
Bankfull Width (ft)	5.8	4.1	6.2	4.9				
Flood Prone Width (ft)	9.6	5.5	7.1	5.8				
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9				

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G	G	G					
Station At maximum pool depth	31.5	41	56.4					
Geomorphic P-P Spacing (ft)		9.5	15.4					
Pool Depth (ft) Measured from Bankfull	0.8	0.72	1.42					

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	101.7	101.7	0.079
Stadia Rod Reading (ft)	1486	1478	8.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	101.7
Valley Length (ft)	99.61
Sinuosity	1.02

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	2
Assessment length (ft)	100
# of LWD Pieces/100 m	6.6

Date: 10/3/2023
Investigators: EBS, KC, SP (HDR)

Stream 16 - Downstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Stream 16 - Downstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 20.13 mm, coarse gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)								
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking
41	20	3	1	2	30	75	30	silt	NA	31.61 / High	1.1 / Low
46	15	2.5	1	2	50	130	30	silt	NA	32.02 / High	1.1 / Low
61	12	3.5	1	2.5	50	110	20	silt	NA	34.20 / High	1.0 / Low

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Devils Fork - Upstream
Upstream Latitude:	34.994000
Upstream Longitude:	-82.99362823
Downstream Latitude:	34.993794
Downstream Longitude:	-82.99344255
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.049116
Strahler Stream Order:	Second
Flow Type:	Perennial
Buffer Valley Slope (%):	6.4
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank armoring

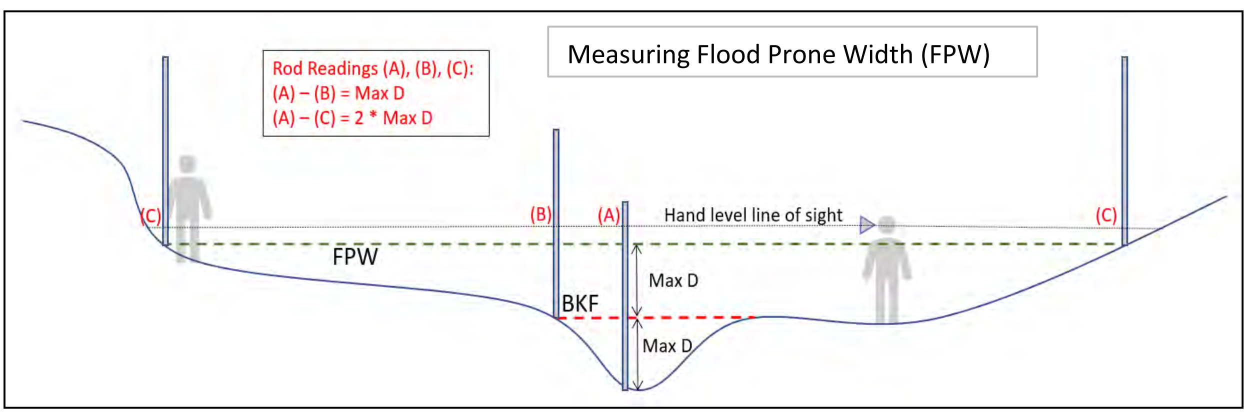
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.58	undercut
0.44	bench

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.51
B.	Bankfull Width (ft)	5.1
E.	Regional Curve Bankfull Width (ft)	5.3023
F.	Regional Curve Bankfull Mean Depth (ft)	0.4631
G.	Regional Curve Bankfull Area (sq. ft.)	2.4826
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	6.05

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0		
0.1	0.5		
1	0.48		
2	0.48		
3	0.48		
4	0.58		
5	0.38		
5.1	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100		20*Bankfull Width	102

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	4	24.5	95					
End Station (Distance along tape)	23	69	100					
Low Bank Height (ft)	1.24	1.38	2.1					
Bankfull Max Depth (ft)	0.58	0.72	0.46					
Bankfull Width (ft)	5.1	5.6	2.46					
Flood Prone Width (ft)	6.05	6.8	3.2					
Bankfull Mean Depth (ft)	0.5	0.5	0.5					

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?	G							
Station At maximum pool depth	3							
Geomorphic P-P Spacing (ft)								
Pool Depth (ft) Measured from Bankfull	0.32							

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	99.7	99.7	0.060
Stadia Rod Reading (ft)	1496	1490	6.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	99.86
Valley Length (ft)	93.55
Sinuosity	1.07

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	2
Assessment length (ft)	100
# of LWD Pieces/100 m	6.6

Date: 10/3/2023
Investigators: EBS, KC, SP (HDR)

Stream 17 (Devils Fork) - Upstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Devils Fork - Upstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 9.32 mm, medium gravel**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)									
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking	Notes
26	6	3	0.6	2	40	85	40	silt	NA	High	1.44 / Low	Outside bend; Bankfull Max Depth from Riffle

I. Reach Information and Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Devils Fork - Downstream
Upstream Latitude:	34.993568
Upstream Longitude:	-82.99330012
Downstream Latitude:	34.993794
Downstream Longitude:	-82.99344255
Ecoregion:	Blue Ridge
River Basin:	Savannah
Stream Reach Length (ft):	100
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.049116
Strahler Stream Order:	Second
Flow Type:	Perennial
Buffer Valley Slope (%):	6.6
Dominant Buffer Land Use:	Forested
Stream Temperature:	Coldwater
Macroinvertebrate Sampling Method:	N/A

Shading Key
Desktop Value
Field Value

II. Reach Walk

A. Number of concentrated flow points:

Notes: No CFPs

B. Armored Bank Lengths (ft):

Notes: No bank armoring

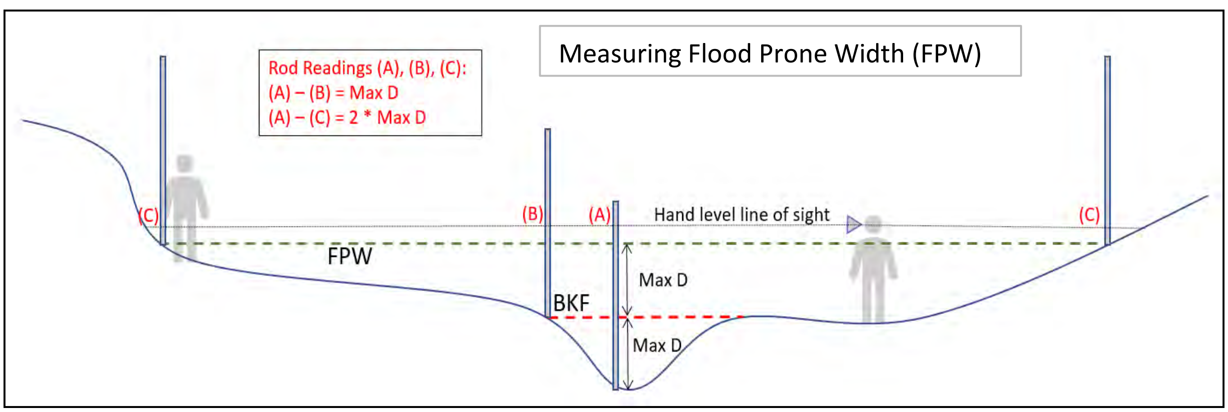
C.

Difference between BKF stage and WS (ft)	Describe the bankfull indicator
0.32	top of depositional bar
0.28	undercut bank

III. Bankfull Verification and Stable Riffle Cross Section

A.	Difference between BKF stage and WS (ft) *Average or consensus value from reach walk.*	0.3
B.	Bankfull Width (ft)	8.4
E.	Regional Curve Bankfull Width (ft)	5.3023
F.	Regional Curve Bankfull Mean Depth (ft)	0.4631
G.	Regional Curve Bankfull Area (sq. ft.)	2.4826
H.	Curve Used	SCDNR Stream Geomorphology and Data Colelction and Analysis South Carolina Ecoregions 66, 45, 65, 63 (SCDNR 2020)
I.	Flood Prone Width (FPW; ft)	8.8

Cross Section Measurements Depth measured from bankfull			
Station	Depth	Station	Depth
0	0		
0.1	0.3		
1	0.26		
2	0.14		
3	0.08		
4	0.18		
5	0.36		
6	0.3		
7	0.36		
8	0.38		
8.2	0.36		
8.4	0		



IV. Representative Sub-Reach

A.

Assessment Segment Length At least 20 x the Bankfull Width	100	20*Bankfull Width	168

B. Riffle Data

	R1 *	R2	R3	R4	R5	R6	R7	R8
Begin Station (Distance along tape)	32.5	80.2						
End Station (Distance along tape)	57	100						
Low Bank Height (ft)	2.02	2.04						
Bankfull Max Depth (ft)	0.38	0.52						
Bankfull Width (ft)	8.4	7.8						
Flood Prone Width (ft)	8.8	7.95						
Bankfull Mean Depth (ft)	0.3	0.3						

C. Pool Data

	P1	P2	P3	P4	P5	P6	P7	P8
Geomorphic Pool?								
Station At maximum pool depth	79							
Geomorphic P-P Spacing (ft)								
Pool Depth (ft) Measured from Bankfull	0.52							

D. Slope

Due to difficulty with dense vegetation, slope was calcluated using GIS and 2-foot topography

	Begin	End	Difference	Slope (ft/ft)
Station along tape (ft)	0	102	102.0	0.039
Stadia Rod Reading (ft)	1490	1486	4.0	

E. Sinuosity

Calculated in GIS using delineated boundaries

Stream Length (ft)	102
Valley Length (ft)	87.6
Sinuosity	1.16

F. LWD Piece Count *(find 328-feet segment within assessment sub-reach with the MOST LWD)*

Entire stream reach assessed for LWD

# of LWD Pieces	8
Assessment length (ft)	100
# of LWD Pieces/100 m	26.2

Date: 10/3/2023
Investigators: EBS, KC, SP (HDR)

Stream 17 (Devils Fork) - Downstream

SC SQT
BEHI/NBS Field Form

Reach ID: **Devils Fork - Downstream**
Valley Type: **Colluvial**
Bed Material: **D50 = 0.45 mm, medium sand**

			Bank Erosion Hazard Index (BEHI) & Near-bank Stress (NBS)									
Station ID	Bank Length (Ft)	Study Bank Height (ft)	BKF Height (ft)	Root Depth (ft)	Root Density (%)	Bank Angle (degrees)	Surface Protection (%)	Bank Material Adjustment	Stratification Adjustment	BEHI Total/ Category	NBS Ranking	Notes
No unstable banks												

Attachment G

Attachment G - Streams Photolog

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Photo 1. View of Stream 1 (Limber Pole Creek), facing upstream.

Photo 2. View of Stream 1 (Limber Pole Creek), facing downstream.

Photo 3. View of Stream 7 (Howard Creek), facing upstream.

Photo 4. View of Stream 7 (Howard Creek), facing downstream.

Photo 5. View of Stream 12, facing upstream.

Photo 6. View of Stream 12, facing downstream.

Photo 7. View of Stream 15, facing upstream.

Photo 8. View of Stream 15, facing downstream.

Photo 9. View of Stream 15, facing downstream.

Photo 10. View of Stream 16, facing upstream.

Photo 11. View of Stream 16, facing downstream.

Photo 12. View of concentrated flow point on Stream 16, beginning of downstream reach.

Photo 13. View of Stream 17 (Devils Fork), facing upstream.

Photo 14. View of Stream 17 (Devils Fork), facing downstream.

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Attachment H

Attachment H - Fish Community Sampling Data and Photo Vouchers

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Table 1. Stream reach widths, sample lengths, and shock times for each sampling event.

Stream reach	Sample date	Stream widths (m)						Sample length (m)	Effort (s)
		0	25	50	75	100	Mean		
Stream 1 (Limber Pole Creek) - Upstream	7/25/2023	2.9	3.1	2.7	2.7	2.8	2.8	100	721
	9/5/2023	2.9	2.8	3.2	4.1	3.3	3.3	100	829
	10/9/2023	2.7	2.8	3.3	4.0	2.9	3.1	100	957
Stream 1 (Limber Pole Creek)- Downstream	7/25/2023	4.0	3.5	4.2	2.7	4.1	3.7	111	1,304
	9/5/2023	3.7	5.3	4.7	2.6	4.6	4.2	125	1,093
	10/9/2023	3.9	5.0	4.2	2.6	3.8	3.9	117	1,397
Stream 7 (Howard Creek)- Upstream	7/25/2023	7.1	7.5	5.9	5.1	6.0	6.3	190	2,344
	9/6/2023	6.9	7.6	5.5	6.2	6.2	6.5	194	3,381
	10/10/2023	6.8	8.1	6.7	5.8	6.1	6.7	201	4,027
Stream 7 (Howard Creek) - Downstream	7/25/2023	6.5	5.3	8.7	7.4	7.0	7.0	209	2,695
	9/6/2023	7.1	6.0	7.4	8.4	5.7	6.9	208	3,581
	10/10/2023	5.1	8.6	4.2	5.0	4.6	5.5	165	3,978

Table 2. Water quality parameters for each sampling event.

Stream reach	Sample date	Temperature (°C)	Dissolved oxygen (mg/L)	Specific conductivity (µS/cm)	pH (units)	Salinity (ppt)	Turbidity (NTU)
Stream 1 (Limber Pole Creek) - Upstream	7/25/2023	19.4	8.6	15	6.6	0.01	7.5
	9/5/2023	20.4	8.4	18	7.0	0.01	4.0
	10/9/2023	11.6	9.9	16	6.9	0.01	1.1
Stream 1 (Limber Pole Creek)- Downstream	7/25/2023	19.4	8.6	15	6.6	0.01	7.5
	9/5/2023	20.4	8.4	18	7.0	0.01	4.0
	10/9/2023	11.6	9.9	16	6.9	0.01	1.1
Stream 7 (Howard Creek)- Upstream	7/25/2023	18.8	8.9	26	6.9	0.01	2.4
	9/6/2023	19.5	8.7	30	7.3	0.01	3.0
	10/10/2023	13.0	9.9	27	7.4	0.01	1.6
Stream 7 (Howard Creek) - Downstream	7/25/2023	18.8	8.9	26	6.9	0.01	2.4
	9/6/2023	20.8	7.9	28	7.1	0.01	3.0
	10/10/2023	13.9	9.7	21	6.9	0.01	1.6

Table 3. Fish collected within each stream reaches for each sampling event.

Stream reach	Sample date	Rainbow Trout	Western Blacknose Dace	Salamanders (*Desmognathus*)
Stream 1 (Limber Pole Creek) - Upstream	7/25/2023	0	0	10
	9/5/2023	0	0	15
	10/9/2023	0	0	15
Stream 1 (Limber Pole Creek)- Downstream	7/25/2023	0	0	9
	9/5/2023	0	0	8
	10/9/2023	0	0	5
Stream 7 (Howard Creek)- Upstream	7/25/2023	39	108	12
	9/6/2023	22	97	8
	10/10/2023	40	133	2
Stream 7 (Howard Creek) - Downstream	7/25/2023	30	130	5
	9/6/2023	3	39	10
	10/10/2023	31	136	3

Table 4. Catch rates and densities of fish each stream reaches for each sampling event.

Stream reach	Sample date	Catch rate (No./hr)			Density (No./100 m)		
		Rainbow Trout	Western Blacknose Dace	Total	Rainbow Trout	Western Blacknose Dace	Total
Stream 1 (Limber Pole Creek) - Upstream	7/25/2023	0	0	0	0	0	0
	9/5/2023	0	0	0	0	0	0
	10/9/2023	0	0	0	0	0	0
Stream 1 (Limber Pole Creek)- Downstream	7/25/2023	0	0	0	0	0	0
	9/5/2023	0	0	0	0	0	0
	10/9/2023	0	0	0	0	0	0
Stream 7 (Howard Creek)- Upstream	7/25/2023	59.9	165.9	225.8	20.5	56.8	77.4
	9/6/2023	23.4	103.3	126.7	11.3	50.0	61.3
	10/10/2023	35.8	118.9	154.7	19.9	66.2	86.1
Stream 7 (Howard Creek) - Downstream	7/25/2023	40.1	173.7	213.7	14.4	62.2	76.6
	9/6/2023	3.0	39.2	42.2	1.4	18.8	20.2
	10/10/2023	28.1	123.1	151.1	18.8	82.4	101.2

Photo 1. Stream 1 (Limber Pole Creek) - Upstream Fish Sampling Location

Photo 2. Stream 1 (Limber Pole Creek) - Downstream Fish Sampling Location

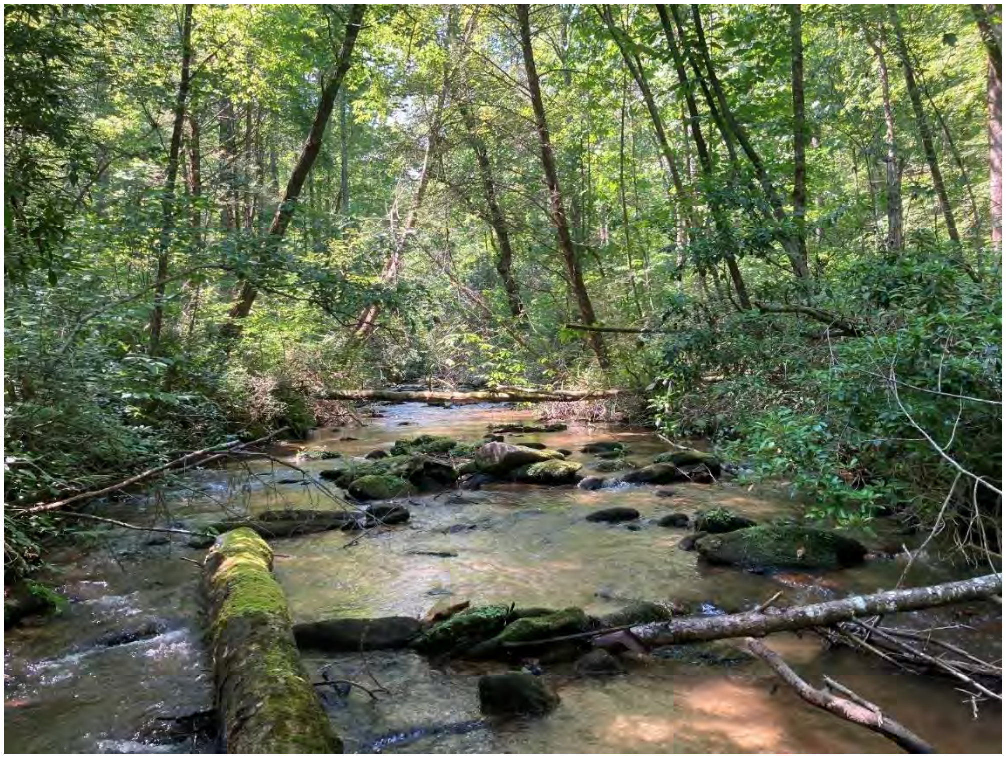

Photo 3. Stream 7 (Howard Creek) - Upstream Fish Sampling Location

Photo 4. Stream 7 (Howard Creek) - Downstream Fish Sampling Location

Photo 5. Rainbow Trout Collected from Stream 7 (Howard Creek)

Photo 6. Western Blacknose Dace Collected from Stream 7 (Howard Creek)

Photo 7. Salamanders collected from Stream 1 (Limber Pole Creek)

Photo 8. Salamanders collected from Stream 7 (Howard Creek)

Attachment I

Attachment I - Macroinvertebrate Sampling Data and Photolog

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Table 1. Summary of Organisms Collected during Macroinvertebrate Surveys

Taxon	Pollution Tolerance Value[1]	Functional Feeding Group[2]	Stream 1 (Limber Pole Creek)		Stream 7 (Howard Creek)	
			Upstream	Downstream	Upstream	Downstream
Annelida						
Class Clitellata						
Subclass Oligochaeta		CG				
Order Lumbriculida						
Lumbriculidae	7	CG			2	
Arthropoda						
Insecta						
Ephemeroptera						
Baetidae		CG				
Acentrella turbida	*2*	CG	6			2
Baetis flavistriga	*6.8*	CG	1		44	1
Baetis pluto	*3.4*		5	1	5	5
Plauditus sp.	*5.4*	CG		3	7	
Heterocloeon sp.	*3.7*	SC			2	
Ephemerillidae		CG				
Drunella tuberculata	*0*	SC	25	14	2	
Ephemerella sp.	*2.1*	SC	1			
Ephemerella catawba	*0*			1		
Serratella sp.	*1.7*	SC	2			
Serratella frisoni				2	7	
Teloganopsis deficiens	*2.6*	SC	2	1		2
Ephemeridae		CG				
Ephemera sp.	*2*	CG	1	3		
Heptageniidae		SC		2		21

Taxon	Pollution Tolerance Value[1]	Functional Feeding Group[2]	Stream 1 (Limber Pole Creek)		Stream 7 (Howard Creek)	
			Upstream	Downstream	Upstream	Downstream
Epeorus sp.	*1.6*	CG	6	2	10	30
Epeorus dispar	*1*	CG	13	7		
Epeorus vitreus	*1.2*	CG			2	2
Heptagenia sp.	*1.9*	SC		2		
Heptagenia marginalis gp.	*2.2*	SC	1			1
Leucrocuta sp.	*2*	SC	2	4	2	2
Stenonema sp.		SC	10	5	37	29
Stenonema meririvulanum	*0.5*	SC	3	2	4	5
Isonychiidae		CG				
Isonychia sp.	*3.6*	CG	2	8		
Odonata						
Cordulegastridae	5.7	P				
Cordulegaster sp.	*5.7*	P		1		
Gomphidae					1	
Lanthus sp.	*1.6*	P		2		3
Lanthus vernalis	*0.8*				2	
Plecoptera						
Leuctridae		SH				
Leuctra sp.	*1.5*	SH	3	3	5	3
Peltoperlidae		SH				
Peltoperla sp.			6	37		3
Perlidae		P			3	5
Acroneuria abnormis	*2.1*	P	10		1	5
Eccoptura xanthenes	*4.7*	P				1
Paragnetina sp.	*1.5*	P			5	6

Taxon	Pollution Tolerance Value[1]	Functional Feeding Group[2]	Stream 1 (Limber Pole Creek)		Stream 7 (Howard Creek)	
			Upstream	Downstream	Upstream	Downstream
Paragnetina immarginata	*1.1*	P			5	13
Perlesta sp.	*2.9*	P			1	1
Perlodidae		P			6	
Pteronarcidae	1.6	SH				
Pteronarcys (Allonarcys) sp.	*1.8*	SH	1	9		3
Pteronarcys dorsata	*2.4*	SH			1	
Pteronarcys scotti		SH	1	2		
Hemiptera						
Veliidae		P				
Rhagovelia obesa		P		1		
Trichoptera			1			
Glossosomatidae		SC				
Glossosoma sp.	*1.4*	SC	2			
Glossosoma nigrior		SC			20	14
Goeridae						
Goera calcarata	1				1	
Hydropsychidae		FC				
Cheumatopsyche sp.	*6.6*	FC			41	5
Diplectrona modesta	*2.3*	FC	33	30	3	4
Hydropsyche sparna	*2.5*	FC			18	32
Limnephilidae						
Pycnopsyche sp.	*2.5*	SH	1			2
Philopotamidae		FC				
Dolophilodes distinctus	*0.1*	FC	3		1	5
Psychomyiidae		CG				

Taxon	Pollution Tolerance Value[1]	Functional Feeding Group[2]	Stream 1 (Limber Pole Creek)		Stream 7 (Howard Creek)	
			Upstream	Downstream	Upstream	Downstream
Lype diversa	*3.9*	SC			2	
Psychomyia flavida	*3*	CG			3	
Rhyacophilidae		P				
Rhyacophila carolina	*0.4*	P	1			
Rhyacophila fuscula	*1.6*	P			1	4
Uenoidae						
Neophylax mitchelli	*0*		1	1	1	1
Neophylax oligius	*2.4*				1	
Coleoptera						
Dryopidae						
Helichus fastigiatus	4.6	SC		1		
Elmidae		CG				
Optioservus sp.	2.1	SC		1		
Optioservus ovalis	2.1	SC			1	
Optioservus tardella	0	SC	4		21	3
Stenelmis sp.	5.6	SC				1
Gyrinidae		P				
Dineutus sp.	5	P	2		1	
Psephenidae		SC				
Ectopria nervosa	4.3	SC				1
Psephenus herricki	2.4	SC	8	14	46	23
Diptera						
Athericidae						
Atherix lantha	1.8	P				1
Ceratopogonidae		P	1			

Taxon	Pollution Tolerance Value[1]	Functional Feeding Group[2]	Stream 1 (Limber Pole Creek)		Stream 7 (Howard Creek)	
			Upstream	Downstream	Upstream	Downstream
Chironomidae						
Parametriocnemus sp.	3.9	CG				1
Rheotanytarsus sp.	6.5	FC			1	
Rheotanytarsus exiguus gp.	5.9	FC				1
Dixidae		CG				
Dixa sp.	2.5	CG	1			
Limoniidae						
Antocha sp.	4.4	CG			3	
Dicranophragma sp.			1			
Hexatoma sp.	3.5	P	1			
Pediciidae						
Dicranota sp.	0	P		1		1
Simuliidae		FC				
Simulium sp.	4.9	FC				3
Tipulidae		SH				
Tipula sp.	7.5	SH	2	1		1
Total No. of Organisms	--	--	**163**	**161**	**319**	**246**
Total No. of Taxa	--	--	**35**	**29**	**39**	**39**
EPT Index	--	--	**27**	**21**	**30**	**28**
Biotic Index Assigned Values	--	--	**1.68**	**2.04**	**2.98**	**2.25**
EPT Score	--	--	**3.93**	**3.19**	**4.31**	**4.06**
Biotic Index Score	--	--	**9.04**	**8.57**	**7.31**	**8.29**
South Carolina Bioclassification	--	--	**6.49**	**5.88**	**5.81**	**6.17**

[1]South Carolina Department of Health and Environmental Control (SCDHEC). 2017. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling. Technical Report No. 0914-17. Bureau of Water. Columbia, South Carolina.
[2]Functional Feeding Groups: CG = collector-gatherer; FC = filterer-collector; P = predator; SC = scraper; SH = shredder

Photo 1. View of Upstream Reach of Stream 1 (Limber Pole Creek), facing upstream.

Photo 2. View of Downstream Reach of Stream 1 (Limber Pole Creek), facing upstream

Photo 3. View of Upstream Reach of Stream 7 (Howard Creek), facing downstream

Photo 4. View of Downstream Reach of Stream 7 (Howard Creek), facing upstream.

SC DHEC ABS

Macroinvertebrate Habitat Assessment

Station L4 Date 8/1/2023 Time 12:00pm Jars ______ Vials ______

Stream Limber Pole Creek Location Upstream reach County Oconee County

Collectors EM, JK, LA Field QC Logbook ______ Page# ______

pH (SU) 6.1 DO (mg/L) 8.31 H_2O Temp (C^o) 19.5 Cond (umhos/cm) 94.9

Aquatic Habitat Score: Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1 Nonexistent = 0

*Habitat	Score						Comments
Root Banks	5	$\boxed{4}$	3	2	1	0	
Logs, Sticks, Snags	5	$\boxed{4}$	3	2	1	0	
Rock/Gravel Riffle	5	$\boxed{4}$	3	2	1	0	
Mature Leaf Pack	5	4	3	2	$\boxed{1}$	0	
Aquatic Vegetation	5	4	$\boxed{3}$	2	1	0	

*If aufwuchs and/or sediment on the habitats appear to adversely affect colonization by macroinvertebrates, this impact is noted in the comments section; however, the habitat score does not change.

Braided channel:	5	4	3	2	1	$\boxed{0}$
	Multiple clear channels with water under most conditions. "Main" channel hard to distinguish.		Side channel(s) present but with less flow/water.		Islands or side channels only during high water.	Not braided
Stream detritus % pine needles:	0 %					
Amount of pine needles in stream:	5 more	4	3	2	1 less	$\boxed{0}$
Velocity/Flow:	5	$\boxed{4}$	3	2	1	0

Sedimentation: $\boxed{3 \text{ (Little or No)}}$ 2 (Moderate) 1 (Severe)

Species observed but not collected:

SC DHEC ABS

Macroinvertebrate Habitat Assessment

Station L3 Date 8/1/2023 Time 2:15pm Jars ______ Vials ______

Stream Limber Pole Creek Location Downstream reach County Oconee County

Collectors EM, JK, LA Field QC Logbook ______ Page# ______

pH (SU) 6.89 DO (mg/L) 824, 910% H_2O Temp (C°) 20.2 Cond (umhos/cm) 92.4

Aquatic Habitat Score: Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1 Nonexistent = 0

*Habitat	Score						Comments
Root Banks	5	4	$\boxed{3}$	2	1	0	
Logs, Sticks, Snags	5	4	$\boxed{3}$	2	1	0	
Rock/Gravel Riffle	$\boxed{5}$	4	3	2	1	0	
Mature Leaf Pack	5	4	3	2	$\boxed{1}$	0	
Aquatic Vegetation	5	4	3	2	1	$\boxed{0}$	

*If aufwuchs and/or sediment on the habitats appear to adversely affect colonization by macroinvertebrates, this impact is noted in the comments section; however, the habitat score does not change.

Braided channel:	5 Multiple clear channels with water under most conditions. "Main" channel hard to distinguish.	4	3 Side channel(s) present but with less flow/water.	2	1 Islands or side channels only during high water.	$\boxed{0}$ Not braided
Stream detritus % pine needles:	0 %					
Amount of pine needles in stream:	5 more	4	3	2	1 less	$\boxed{0}$
Velocity/Flow:	5	$\boxed{4}$	3	2	1	0

Sedimentation: 3 (Little or No) $\boxed{2}$ (Moderate) 1 (Severe)

Species observed but not collected:

Crayfish and salamanders

SC DHEC ABS

Macroinvertebrate Habitat Assessment

Station H5 Date 8/2/2023 Time ____ Jars ____ Vials ____

Stream Howard Creek Location Upstream Reach County Oconee County

Collectors EM, JK, LA Field QC Logbook ____ Page# ____

pH (SU) 7.42 DO (mg/L) 8.77, 94.9% H_2O Temp (C^o) 19.2 Cond (umhos/cm) 99.5

Aquatic Habitat Score: Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1 Nonexistent = 0

*Habitat	Score						Comments
Root Banks	5	4	$\boxed{3}$	2	1	0	
Logs, Sticks, Snags	5	4	$\boxed{3}$	2	1	0	
Rock/Gravel Riffle	$\boxed{5}$	4	3	2	1	0	
Mature Leaf Pack	5	4	3	2	$\boxed{1}$	0	
Aquatic Vegetation	5	4	3	2	$\boxed{1}$	0	

*If aufwuchs and/or sediment on the habitats appear to adversely affect colonization by macroinvertebrates, this impact is noted in the comments section; however, the habitat score does not change.

	5	4	3	2	1	0
Braided channel:	5 Multiple clear channels with water under most conditions. "Main" channel hard to distinguish.	4	3 Side channel(s) present but with less flow/water.	2	1 Islands or side channels only during high water.	$\boxed{0}$ Not braided
Stream detritus % pine needles:	0 %					
Amount of pine needles in stream:	5 more	4	3	2	1 less	$\boxed{0}$
Velocity/Flow:	5	$\boxed{4}$	3	2	1	0

Sedimentation: $\boxed{\text{3 (Little or No)}}$ 2 (Moderate) 1 (Severe)

Species observed but not collected:

Crayfish and fish

SC DHEC ABS

Macroinvertebrate Habitat Assessment

Station H4 Date 8/2/2023 Time 9:12am Jars ________ Vials ________

Stream Howard Creek Location Downstream reach County Oconee County

Collectors EM, JK, LA Field QC Logbook ________________ Page# ____________

pH (SU) 7.44 DO (mg/L) 8.87, 96% H_2O Temp (C^o) 19.2 Cond (umhos/cm) 100.7

Aquatic Habitat Score: Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1 Nonexistent = 0

*Habitat	Score						Comments
Root Banks	5	**[4]**	3	2	1	0	
Logs, Sticks, Snags	5	4	**[3]**	2	1	0	
Rock/Gravel Riffle	**[5]**	4	3	2	1	0	
Mature Leaf Pack	5	4	3	2	**[1]**	0	
Aquatic Vegetation	5	4	3	2	**[1]**	0	

*If aufwuchs and/or sediment on the habitats appear to adversely affect colonization by macroinvertebrates, this impact is noted in the comments section; however, the habitat score does not change.

Braided channel: 5 4 3 2 1 **[0]**
- 5: Multiple clear channels with water under most conditions. "Main" channel hard to distinguish.
- 3: Side channel(s) present but with less flow/water.
- 1: Islands or side channels only during high water.
- 0: Not braided

Stream detritus % pine needles: 0 %

Amount of pine needles in stream: 5 (more) 4 3 2 1 (less) **[0]**

Velocity/Flow: 5 **[4]** 3 2 1 0

Sedimentation: **[3 (Little or No)]** 2 (Moderate) 1 (Severe)

Species observed but not collected:

1 dusky salamander
Several crayfish

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Attachment J

Attachment J - SQT Catchment Assessment and Matrix Summaries

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Version 1.1		**Notes**
Version Last Updated:	7-Dec-22	1. Users input values that are highlighted based on restoration potential
		2. Users select values from a pull-down menu
		3. Leave values blank for field values that were not measured

Programmatic Goals

Select:	Other	

Expand on the programmatic goals of this project:

The goals for this Limber Pole Creek are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed. Little restoration potential exists for this surface water; the surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 97.4 percent of the drainage area to Limber Pole Creek is classified as forested based on the NLCD, with a completely intact riparian buffer.

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	10261671 - EEOC1 Bad Creek Relicensing
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	Reach ID	Reach Description	Reach Break Criteria	ECS	PCS	ΔFF
Quantification_Tool_US	er Pole Creek - Upst	Upstream of temp access rd crossi	Single reach upstream to	0.48	0.48	
Quantification_Tool_DS	r Pole Creek - Downs	Downstream of temp access rd cro	Single reach from temporary access road, downstream	0.5	0.5	

Applicable Reach(es):		Limber Pole Upstream and Downstream Reaches			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): None - stream is in natural condition with only 0.3% of impervious area in drainage area and 97.4% forested.		

Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	G
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	G
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	G
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	G
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification	
Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Limber Pole Creek - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	B
Reference Stream Type:	B
Valley Type:	Colluvial
Drainage Area (sq. mi.):	1.78
Stream Slope (%):	3.9
Strahler Stream Order:	Third
Flow Type:	Perennial
Proposed Bed Material:	
Buffer Valley Slope (%):	5 - 20 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	2 - Upland Savannah

Notes
1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Existing Condition Score (ECS)	0.48
Proposed Condition Score (PCS)	0.48
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (ΔFF)	
Functional Yield (ΔFF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

Little restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 97.4 percent of the drainage area to Limber Pole Creek is classified as forested based on the NLCD. Limber Pole Creek is in stable condition with conditions typical of B-type streams.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55	1.00	1.00	1.00				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	2.3	0.00	0.45	0.64				
		Entrenchment Ratio (ft/ft)	1.8	0.9						
	Flow Dynamics	Width/Depth Ratio State (O/E)	0.864334	0.83	0.83					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.74				
		LWD Piece Count (#/100m)	49.2	1.00						
	Lateral Migration	Erosion Rate (ft/yr)			0.58					
		Dominant BEHI/NBS	H/L	0.20						
		Percent Streambank Erosion (%)	6	0.95						
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	0.83					
		Average DBH (in)	9.519488	1.00						
		Tree Density (#/acre)	405	0.50						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)			0.55					
		Pool Depth Ratio (ft/ft)	1.6	0.18						
		Percent Riffle (%)	49	0.92						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

Version 1.1	**Notes**
Version Last Updated: 7-Dec-22	1. Users input values that are highlighted based on restoration potential
	2. Users select values from a pull-down menu
	3. Leave values blank for field values that were not measured

Programmatic Goals

Select:	Other

Expand on the programmatic goals of this project:

The goals for this project are to preserve the current condition of Howard Creek by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed. Little restoration potential exists for this surface water; the surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Only 0.4 percent of the drainage area to Howard Creek is classified as impervious area based on the 2019 NLCD. Both, upstream and downstream reaches exhibit a completely intact, forested riparian buffer.

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	Howard Creek
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	Reach ID	Reach Description	Reach Break Criteria	ECS	PCS	ΔFF
Quantification_Tool_US	ward Creek - Upstre	Upstream of temporary access road cr	Single reach upstream to access	0.45	0.45	
Quantification_Tool_DS	ard Creek - Downstr	Downstream of temporary access road	Single reach from temporary access road, downstream	0.44	0.44	

Applicable Reach(es):		Howard Creek Upstream and Downstream reaches			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): None - stream is in natural condition with only 0.4% impervious area within drainage area.		

Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately upstream of the project reach, but measures are in place to protect resources.	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	G
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May consist of single family homes/suburban.	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	G
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	G
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	G
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management plan addressing deficiencies.	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated within the project reach.	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile of the project reach.	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment, but proximate stream reaches support desirable aquatic communities.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification	
Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Howard Creek - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	Bc
Reference Stream Type:	Bc
Valley Type:	Colluvial
Drainage Area (sq. mi.):	4.16
Stream Slope (%):	1.9
Strahler Stream Order:	Second
Flow Type:	Perennial
Proposed Bed Material:	
Buffer Valley Slope (%):	5 - 20 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	2 - Upland Savannah

Notes
1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Existing Condition Score (ECS)	0.45
Proposed Condition Score (PCS)	0.45
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (ΔFF)	
Functional Yield (ΔFF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

No restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Only 0.4 percent of the drainage area to Howard Creek is classified as impervious area based on the 2019 NLCD. Howard Creek is in stable condition with conditions typical of B-type streams.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55	1.00	1.00	1.00				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	3.1	0.00	0.18	0.53				
		Entrenchment Ratio (ft/ft)	1.2	0.35						
	Flow Dynamics	Width/Depth Ratio State (O/E)	1.095508	0.88	0.88					
Geomorphology	Large Woody Debris	LWD Index			0.79	0.73				
		LWD Piece Count (#/100m)	19.7	0.79						
	Lateral Migration	Erosion Rate (ft/yr)			0.40					
		Dominant BEHI/NBS	H/L	0.20						
		Percent Streambank Erosion (%)	16.5	0.60						
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	1.00					
		Average DBH (in)	12.30034	1.00						
		Tree Density (#/acre)	142	1.00						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)	1.3	1.00	0.73					
		Pool Depth Ratio (ft/ft)	1.7	0.21						
		Percent Riffle (%)	62	0.97						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

Version 1.1	**Notes**
Version Last Updated: 7-Dec-22	1. Users input values that are highlighted based on restoration potential
	2. Users select values from a pull-down menu
	3. Leave values blank for field values that were not measured

Programmatic Goals

Select:	Other	

Expand on the programmatic goals of this project:

The goals for this project are to preserve the current condition of Stream 12 by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed. Little restoration potential exists for this surface water; the surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. 89.9 percent of the drainage area is classified as forested and only 0.9 percent is classified as impervious according to the 2019 NLCD.

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	Stream 12
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	Reach ID	Reach Description	Reach Break Criteria	ECS	PCS	ΔFF
Quantification_Tool_US	Stream 12 - Upstream	Upstream of temporary access road cr	Single reach upstream to access	0.39	0.39	
Quantification_Tool_DS	tream 12 Downstrea	Downstream of temporary access road	Single reach from temporary access road, downstream	0.48	0.48	

Applicable Reach(es):		Stream 12 upstream and downstream			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): Overall catchment condition is good. An existing electric transmission ROW is located just east (upstream) of Stream 12.		

Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately upstream of the project reach, but measures are in place to protect resources.	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	G
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May consist of single family homes/suburban.	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	P
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	F
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	G
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management plan addressing deficiencies.	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated within the project reach.	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile of the project reach.	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment, but proximate stream reaches support desirable aquatic communities.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 12 - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	Ba
Reference Stream Type:	Ba
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.0311178
Stream Slope (%):	10
Strahler Stream Order:	First
Flow Type:	Intermittent
Proposed Bed Material:	
Buffer Valley Slope (%):	21 - 40 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	

Notes

1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY

Existing Condition Score (ECS)	0.39
Proposed Condition Score (PCS)	0.39
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (ΔFF)	
Functional Yield (ΔFF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

Little restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 89.9 percent of the drainage area to Stream 12 is classified as forested based on the NLCD, with only 0.9 percent impervious. Stream 12 is in stable condition with conditions typical of A-type streams.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55	1.00	1.00	1.00				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	4.8	0.00	0.18	0.20				
		Entrenchment Ratio (ft/ft)	1.2	0.35						
	Flow Dynamics	Width/Depth Ratio State (O/E)	1.621309	0.22	0.22					
Geomorphology	Large Woody Debris	LWD Index			0.43	0.76				
		LWD Piece Count (#/100m)	9.8	0.43						
	Lateral Migration	Erosion Rate (ft/yr)								
		Dominant BEHI/NBS								
		Percent Streambank Erosion (%)								
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	1.00					
		Average DBH (in)	18.5794	1.00						
		Tree Density (#/acre)	243	1.00						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)	3.3	1.00	0.85					
		Pool Depth Ratio (ft/ft)	2.5	0.80						
		Percent Riffle (%)	39	0.74						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

Version 1.1	**Notes**
Version Last Updated: 7-Dec-22	1. Users input values that are highlighted based on restoration potential
	2. Users select values from a pull-down menu
	3. Leave values blank for field values that were not measured

Programmatic Goals

Select:	Other	
Expand on the programmatic goals of this project:		

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	Stream 15
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	Reach ID	Reach Description	Reach Break Criteria	ECS	PCS	ΔFF
Quantification_Tool_US	tream 15 - Upstrean	Reach upstream of temporary access r	Upstream of access road	0.37	0.37	
Quantification_Tool_DS	eam 15 - Downstrea	Reach downstream of temporary acce	Downstream of access road	0.36	0.36	

Applicable Reach(es):		Stream 15 upstream and downstream			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): None were rated as poor. Catchment is in good condition with approximately 85.6 percent of classified as forested and 5 percent classified as impervious based on the NLCD.		
Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately upstream of the project reach, but measures are in place to protect resources.	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	G
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May consist of single family homes/suburban.	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	G
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	F
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	F
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management plan addressing deficiencies.	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated within the project reach.	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile of the project reach.	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment, but proximate stream reaches support desirable aquatic communities.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 15 - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	G
Reference Stream Type:	B
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.0016884
Stream Slope (%):	5.9
Strahler Stream Order:	First
Flow Type:	Perennial
Proposed Bed Material:	
Buffer Valley Slope (%):	5 - 20 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	2 - Upland Savannah

Notes

1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY

Existing Condition Score (ECS)	0.37
Proposed Condition Score (PCS)	0.37
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (∆FF)	
Functional Yield (∆FF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

Some restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 85.6 percent of the drainage area to Stream 15 is classified as forested and 5 percent classified as impervious based on the NLCD. Approximately 26.5 percent of the reach exhibited bank erosion.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55.95389925	0.96	0.98	0.98				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	2.3	0.00	0.27	0.37				
		Entrenchment Ratio (ft/ft)	1.3	0.53						
	Flow Dynamics	Width/Depth Ratio State (O/E)	0.578687	0.47	0.47					
Geomorphology	Large Woody Debris	LWD Index			0.43	0.48				
		LWD Piece Count (#/100m)	9.8	0.43						
	Lateral Migration	Erosion Rate (ft/yr)			0.21					
		Dominant BEHI/NBS	Ex/L	0.00						
		Percent Streambank Erosion (%)	26.5	0.42						
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	0.88					
		Average DBH (in)	8.188976	0.88						
		Tree Density (#/acre)	102	0.76						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)	4.6	0.82	0.40					
		Pool Depth Ratio (ft/ft)	1.4	0.12						
		Percent Riffle (%)	13	0.25						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

Version 1.1	**Notes**
Version Last Updated: 7-Dec-22	1. Users input values that are highlighted based on restoration potential
	2. Users select values from a pull-down menu
	3. Leave values blank for field values that were not measured

Programmatic Goals

Select:	Other	
Expand on the programmatic goals of this project:		

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	Stream 16
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	**Reach ID**	**Reach Description**	**Reach Break Criteria**	**ECS**	**PCS**	**ΔFF**
Quantification_Tool_US	;tream 16 - Upstrean	Upstream of temp access rd crossing	Single reach upstream to	0.45	0.45	
Quantification_Tool_DS	ream 16 - Downstrea	Downstream of temp access rd crossin	Single reach from temporary access road, downstream	0.37	0.37	

Applicable Reach(es):		Stream 16			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): double HDPE installed at the upper extent of project reach. Expected to be replaced by a spanning structure (bridge).		

Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately upstream of the project reach, but measures are in place to protect resources.	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	P
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May consist of single family homes/suburban.	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	F
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	G
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	G
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management plan addressing deficiencies.	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated within the project reach.	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile of the project reach.	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment, but proximate stream reaches support desirable aquatic communities.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification	
Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Stream 16 - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	Ba
Reference Stream Type:	Ba
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.017309
Stream Slope (%):	8
Strahler Stream Order:	First
Flow Type:	Intermittent
Proposed Bed Material:	
Buffer Valley Slope (%):	5 - 20 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	

Notes
1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Existing Condition Score (ECS)	0.45
Proposed Condition Score (PCS)	0.45
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (∆FF)	
Functional Yield (∆FF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

Little restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 87.6 percent of the drainage area to Stream 16 is classified as forested based on the NLCD. Stream 16 is in stable condition with conditions typical of A-type streams.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55	1.00	1.00	1.00				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	2.6	0.00	0.38	0.55				
		Entrenchment Ratio (ft/ft)	1.5	0.75						
	Flow Dynamics	Width/Depth Ratio State (O/E)	1.21579	0.73	0.73					
Geomorphology	Large Woody Debris	LWD Index			0.57	0.70				
		LWD Piece Count (#/100m)	13.1	0.57						
	Lateral Migration	Erosion Rate (ft/yr)			0.60					
		Dominant BEHI/NBS	H/M	0.20						
		Percent Streambank Erosion (%)	5	1.00						
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	0.97					
		Average DBH (in)	8.59782	0.92						
		Tree Density (#/acre)	264	0.99						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)	0.8	1.00	0.66					
		Pool Depth Ratio (ft/ft)	1.4	0.12						
		Percent Riffle (%)	66	0.87						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

Version 1.1		**Notes**	
Version Last Updated:	7-Dec-22	1. Users input values that are highlighted based on restoration potential	
		2. Users select values from a pull-down menu	
		3. Leave values blank for field values that were not measured	

Programmatic Goals

Select:	Other	
Expand on the programmatic goals of this project:		

Project Description

Project Name:	Bad Creek Pumped Storage Project
Project ID:	Devils Fork
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
12-digit HUC:	30601010104

Reach Summary

Worksheet Title	**Reach ID**	**Reach Description**	**Reach Break Criteria**	**ECS**	**PCS**	**ΔFF**
Quantification_Tool_US	)evils Fork - Upstrear	Upstream of temporary access road cr	Single reach upstream to access	0.4	0.4	
Quantification_Tool_DS	vils Fork - Downstre	Downstream of temporary access road	Single reach from temporary access road, downstream	0.37	0.37	

Applicable Reach(es):		Devils Fork upstream and downstream			
Overall Catchment Condition (select:)		**Good**	Describe how any categories rated as poor were considered in the selection of the restoration potential of the reach(es): None - all categories rated Good.		

Categories		**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow	Existing concentrated flow/impairments immediately upstream of the project reach with no treatments in place.	Potential for concentrated flow/impairments from adjacent land use or channel immediately upstream of the project reach, but measures are in place to protect resources.	No potential for concentrated flow/impairments from adjacent land use and/or channel immediately upstream of project reach.	G
2	Impervious cover	≥ 25%	>10% and <25%	≤ 10%	G
3	Urbanization	Rapidly urbanizing/urban.	Some urban growth potential, or uncertain growth potential. May consist of single family homes/suburban.	Rural communities/slow growth potential, or primarily forested.	G
4	Development Activities (e.g. utility rights-of-way, pipeline, mining, silviculture, roads)	High development or potential for impacts in contributing watershed or within 1 mile of project reach, or high potential of impacts >1 mile away from project reach.	Moderate development or moderate potential for impacts, but none within 1 mile of project reach.	No development or no potential for impacts.	G
5	Percent Forested	≤ 20%	>20% and <70%	≥ 70%	G
6	Riparian Vegetation	<50% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	50-80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	>80% of contributing stream length (project reach and upstream channel) has >25-m (~82 ft) corridor width.	G
7	Sediment Supply	Multiple, large anthropogenic-caused sources of sediment supply from upstream bank erosion and surface runoff.	Moderate anthropogenic-caused sediment supply from upstream bank erosion and surface runoff.	A few small anthropogenic-caused sediment supply sources. Upstream bank erosion and surface runoff is minimal, as sediment supply is low.	G
8	Proximity to 303(d) or TMDL listed waters	Project reach on, upstream, or downstream of a 303(d) waterway without a TMDL/watershed management plan to address deficiencies.	Project reach on, upstream, or downstream of a 303(d) waterway with a TMDL/ watershed management plan addressing deficiencies.	Project reach is not on the 303(d) list.	G
9	Agricultural Land Use	Livestock access to stream and/or intensive cropland immediately upstream of the project reach.	Agricultural land uses are present in the catchment, but impacts are likely attenuated within the project reach.	There is little to no agricultural land uses or forested buffers exist between the receiving waters and the agriculture land and/or livestock.	G
10	NPDES Permits	Many NPDES permits within the catchment or some within 1 mile of the project reach.	A few NPDES permits within the catchment and none within 1 mile of the project reach.	No NPDES permits within the catchment and none within 1 mile of the project reach.	G
11	Inline Watershed Impoundments	Impoundment(s) are located near the project area (within 1 mile upstream or downstream), and/or impoundment(s) within the catchment have a negative effect on project area (e.g., flow alteration or reduced sediment supply) and fish passage.	A few small impoundments within the catchment and none within one mile of the project reach.	No impoundment (including farm ponds) upstream or downstream of project area OR only natural impoundments that allow for fish passage.	G
12	Organism Recruitment	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) is concrete, piped, or hardened.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material that is highly embedded by fine sediment, but proximate stream reaches support desirable aquatic communities.	Channel immediately upstream or downstream of the project reach (i.e., within 1 km or 0.62 mi) has native bed and bank material.	G
13	Other				

Site Information and Reference Curve Stratification

Project Name:	Bad Creek Pumped Storage Project
Reach ID:	Devils Fork - Upstream
Restoration Potential:	Partial
Preservation (Y/N):	Yes
Ecoregion:	Blue Ridge Mountains
River Basin:	Savannah
Existing Stream Length (ft):	100
Proposed Stream Length (ft):	
Existing Stream Type:	Ba
Reference Stream Type:	Ba
Valley Type:	Colluvial
Drainage Area (sq. mi.):	0.048813
Stream Slope (%):	6
Strahler Stream Order:	Second
Flow Type:	Perennial
Proposed Bed Material:	
Buffer Valley Slope (%):	5 - 20 %
Dominant Buffer Land Use:	Single Family Residential
Proposed Canopy Cover (%) at project closeout:	
Stream Temperature:	Coldwater
Fish Bioassessment Class:	

Notes

1. Users input values that are highlighted
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY

Existing Condition Score (ECS)	0.40
Proposed Condition Score (PCS)	0.40
Change in Functional Condition (PCS - ECS)	0.00
Percent Condition Change	0%
Existing Stream Length (ft)	100.0
Proposed Stream Length (ft)	
Additional Stream Length (ft)	
Existing Functional Foot Score (FFS)	
Proposed Functional Foot Score (FFS)	
Proposed FFS - Existing FFS (∆FF)	
Functional Yield (∆FF/LF)	

Explain the restoration potential of this reach based on the programmatic goals and catchment assessment results:

Little restoration potential. Surrounding landscape and watershed exhibit little anthropogenic influence or degradation on the stream. Approximately 87.6 percent of the drainage area to Devils Fork is classified as forested and 2.2 percent classified as impervious based on the NLCD. Devils Fork is in stable condition with conditions typical of A-type streams.

Explain the goals and objectives for this reach:

The goals for this reach are to preserve its current condition by implementing Best Management Practices and avoidance and minimization measures to the maximum extent practicable if Bad Creek II is pursued and if the proposed temporary acess road is constructed.

Functional Category	Function-Based Parameters	Metric	EXISTING CONDITION ASSESSMENT				PROPOSED CONDITION ASSESSMENT			
			Field Value	Index Value	Parameter	Category	Field Value	Index Value	Parameter	Category
Hydrology	Reach Runoff	Land Use Coefficient	55	1.00	1.00	1.00				
		Concentrated Flow Points (#/1000 LF)	0	1.00						
Hydraulics	Floodplain Connectivity	Bank Height Ratio (ft/ft)	2.2	0.00	0.18	0.48				
		Entrenchment Ratio (ft/ft)	1.2	0.35						
	Flow Dynamics	Width/Depth Ratio State (O/E)	0.831366	0.79	0.79					
Geomorphology	Large Woody Debris	LWD Index			0.29	0.53				
		LWD Piece Count (#/100m)	6.6	0.29						
	Lateral Migration	Erosion Rate (ft/yr)			0.60					
		Dominant BEHI/NBS	H/L	0.20						
		Percent Streambank Erosion (%)	3	1.00						
		Percent Streambank Armoring (%)								
	Riparian Vegetation	Buffer Width (ft)	300	1.00	1.00					
		Average DBH (in)	9.570866	1.00						
		Tree Density (#/acre)	203	1.00						
		Native Shrub Density (#/acre)								
		Native Herbaceous Cover (%)								
		Monoculture Area (%)								
	Bed Form Diversity	Pool Spacing Ratio (ft/ft)			0.22					
		Pool Depth Ratio (ft/ft)	0.7	0.00						
		Percent Riffle (%)	83	0.44						
Physicochemical	Temperature	Summer Daily Maximum (°F)								
	Bacteria	E. Coli (MPN/100 ml)								
	Nitrogen	Total Nitrogen (mg/L)								
	Phosphorus	Total Phosphorus (mg/L)								
	Suspended Sediment	Total Suspended Solids (mg/L)								
		Turbidity (NTU)								
Biology	Macroinvertebrates	EPT Taxa Present								
	Fish	South Carolina Biotic Index								

CUI/Privileged

Attachment B: Cultural Resource Investigations at the Bad Creek Hydroelectric Project
(Final Report Filed Separately)