INITIAL STUDY REPORT

Bad Creek Pumped Storage Project
FERC Project No. 2740

Oconee County, South Carolina

Prepared by: HDR Engineering, Inc.

Prepared for: Duke Energy Carolinas, LLC

January 4, 2024

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BAD CREEK PUMPED STORAGE PROJECT
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ACRONYMS AND ABBREVIATIONS

APE	Area of Potential Effect
Bad Creek or Project	Bad Creek Pumped Storage Project
Bad Creek II Complex (Bad Creek II)	Bad Creek II Power Complex
CFD	Computational fluid dynamics
CFR	Code of Federal Regulations
CHEOPS	Computer Hydro-Electric Operations and Planning Software™
CUI // PRIV	Controlled Unclassified Information // Privileged
CWA	Clean Water Act
DEM	digital elevation model
DLA	Draft License Application
DO	dissolved oxygen
Duke Energy or Licensee	Duke Energy Carolinas, LLC
EJ	Environmental Justice
FERC or Commission	Federal Energy Regulatory Commission
FLA	Final License Application
HDR	HDR Engineering, Inc.
ILP	Integrated Licensing Process
ISR	Initial Study Report
KT Project	Keowee-Toxaway Hydroelectric Project
LPDA	Landscape Planning and Design Associates, Inc.
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRHP	National Register for Historic Preservation
PAD	Pre-Application Document
PLP	Preliminary License Proposal
PSP	Proposed Study Plan
RSP	Revised Study Plan
RUN	Recreation Use and Needs
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SD1	Scoping Document 1
SD2	Scoping Document 2
SHPO	State Historic Preservation Office
SPD	Study Plan Determination
SQT	Stream Quantification Tool
USEPA	U.S. Environmental Protection Agency
USR	Updated Study Report

1 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) (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 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 expires 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 (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

Given the need for additional significant energy storage and renewable energy generation across Duke Energy's service territories over the Project's new 40 to 50-year license term, Duke Energy is evaluating opportunities to add pumping and generating capacity at the Project. Additional energy storage and generation capacity would be developed by constructing a new power complex (including a new underground powerhouse) adjacent to the existing Bad Creek powerhouse. Therefore, construction of the 1,400-megawatt Bad Creek II Power Complex (Bad Creek II Complex) is an alternative relicensing proposal presently being evaluated by Duke Energy. The proposed expanded Project boundary for the Bad Creek II Complex is shown on Figure 1.

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

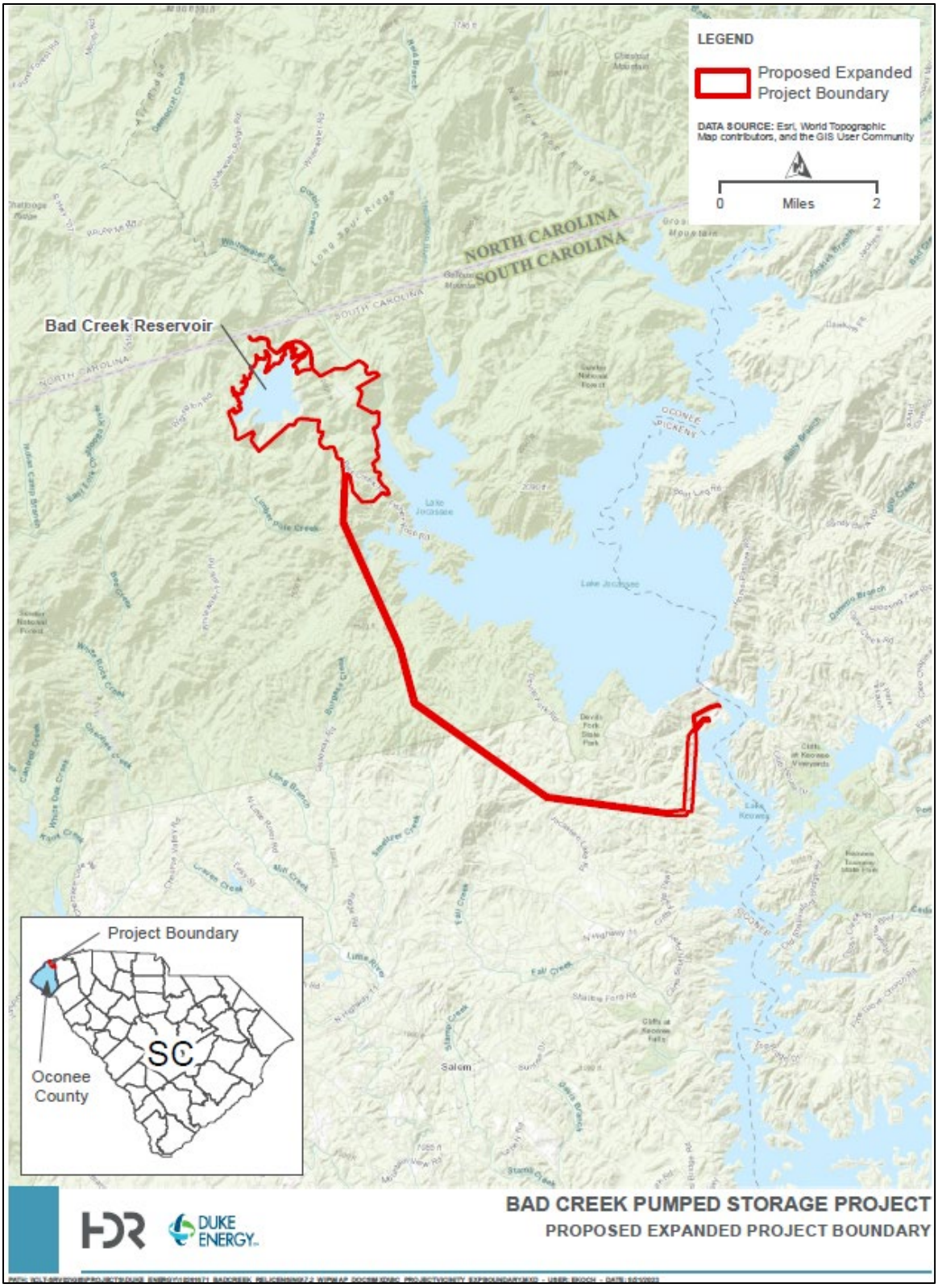

Figure 1. Bad Creek Pumped Storage Project Location and Proposed Expanded Project Boundary

Duke Energy filed a Pre-Application Document (PAD) and associated Notice of Intent (NOI) with the Commission on February 23, 2022 to initiate the ILP. The PAD provides a description of the Project and summarizes the existing, relevant, and reasonably available information to assist the Commission, resource agencies, Indian Tribes, non-governmental organizations, and other stakeholders in identifying issues, determining information needs, and preparing study requests. Based on stakeholder comments on the PAD, NOI, and Proposed Study Plan (PSP) filed August 5, 2022 and in consideration of FERC criteria for study requests under the ILP, Duke Energy proposed a total of six resource studies in the Revised Study Plan (RSP) in accordance with 18 CFR §5.11, which was filed with the Commission and made available to stakeholders on December 5, 2022. FERC issued its Study Plan Determination (SPD) on January 4, 2023, which included modifications to one of the six proposed studies (Recreational Resources Study); the Commission's SPD is included in **Attachment 1**. These six studies 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.

- Water Resources Study
- Aquatic Resources Study
- Cultural Resources Study
- Visual Resources Study
- Recreational Resources Study
- Environmental Justice Study

Duke Energy has completed its first year of studies (January-December 2023) with stakeholder consultation as required by the Commission's SPD. In accordance with the schedule presented in the RSP, Duke Energy has also provided all relicensing stakeholders with Quarterly ILP Study Progress Reports that include a description of study activities conducted during the previous quarter, activities expected to occur in the next quarter, and identified variances from the approved study plan. Study Progress Reports from 2023 are included in **Attachment 2**. The next quarterly progress report is expected to be filed with FERC in April 2024. This Initial Study Report (ISR) describes the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.

The Commission's regulations at 18 CFR §5.15(c) require Duke Energy to hold a meeting with participants and FERC staff within 15 days of filing the ISR. Accordingly, **Duke Energy will hold an ISR Meeting on January 17, 2024.**

Additional details regarding the meeting are presented below. A Microsoft Teams® meeting link will be provided upon request.

Date:	Wednesday, January 17, 2024
Time:	9:00 a.m. (until 5:00 p.m., if necessary; lunch will be provided)
Location:	Duke Energy's Wenwood Operations Center 425 Fairforest Way Greenville, SC 29607

To provide an RSVP for the meeting for Duke Energy's planning purposes, or for additional information, please contact:

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An agenda for the ISR Meeting is provided in **Attachment 3**. Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

1.1 Study Implementation

Duke Energy conducted studies in 2023 in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. Major ILP milestones to-date are presented in Table 1. Duke Energy will submit all study documents that must be filed with the Commission via FERC's eFiling system.

Table 1. Major ILP Milestones Completed

Date	Milestone
February 23, 2022	Duke Energy Filed NOI and PAD (18 CFR §5.5, 5.6)
April 22, 2022	FERC Issued Notice of PAD/NOI and Scoping Document 1 (SD1) (18 CFR §5.8(a) and §5.8(c))
May 16 & 17, 2022[1]	FERC Conducted Scoping Meetings (18 CFR §5.8(**d)**)
June 23, 2022	Stakeholders Submitted Comments on the PAD, SD1, and Study Requests (18 CFR §5.9)
August 5, 2022	FERC Issued Scoping Document 2 (SD2) (18 CFR §5.10)
August 5, 2022	Duke Energy Filed Proposed Study Plan (PSP) (18 CFR §5.11(a))
September 7, 2022	Duke Energy Held Study Plan Meeting (18 CFR §5.11(e))
September 9, 2019	Stakeholders Submitted Comments on the PSP (18 CFR §5.12)
December 5, 2022	Duke Energy Filed RSP (18 CFR §5.13(a))
December 20, 2022	Stakeholders Submitted Comments on the RSP (18 CFR §5.13(b))
January 4, 2023	FERC Issued the SPD (18 CFR §5.13(c))
March 30, 2023	Duke Energy Submitted First Quarterly Report and ILP Study Update
May - November 2023	Duke Energy Conducted First Season of Field Studies (18 CFR §5.15(a))
July 28, 2023	Duke Energy Submitted Second Quarterly Progress Report (18 CFR §5.15(b))
September 28, 2023	Duke Energy Submitted Third Quarterly Progress Report (18 CFR §5.15(b))
January 4, 2024	Duke Energy Submitted ISR (18 CFR §5.15(c)(1))

[1] Due to the ongoing construction upgrade activities at the Project, the remote location of the Project, and COVID-19 conditions in early 2022, Duke Energy prepared an overview video orientation of the Project for general viewing by interested parties in lieu of an on-site environmental review site visit. The virtual environmental site review presentation was given by Duke Energy one hour prior to each scoping meeting, pursuant to 18 CFR §5.8(d). A site visit was later held with the relicensing Resource Committees in August 2022, and a site visit is planned for FERC staff on January 16, 2024.

In addition to the major ILP milestones listed above, Duke Energy has conducted additional stakeholder consultation since the PSP through the relicensing Resource Committees voluntarily convened by Duke Energy. Resource Committee participation is open to all stakeholders. The following Resource Committees have been established to facilitate implementation of the relicensing studies and development of Duke Energy's relicensing proposal in the future draft and final license application:

- Aquatic Resources
- Water Resources
- Recreation & Visual Resources
- Wildlife & Botanical Resources
- Cultural Resources
- Operations

Resource Committee consultation activities (not including review and comment periods for draft study reports) completed since the filing of the PSP are listed in Table 2.

Table 2. Relicensing Resource Committee Consultation Completed

Date	Consultation Activity
August 16, 2022	Project site visit and tour of the powerhouse and upper reservoir
November 17, 2022	Virtual meeting with all Resource Committees to review and discuss comments received on the PSP.
February 22, 2023	Hybrid in-person/virtual meeting with all Resource Committees to discuss implementation of the studies in accordance with the SPD.
March 28, 2023	Meeting with the Recreation & Visual Resources Resource Committee to discuss the Recreational Resources study methodology and schedule.
April 6, 2023	Aquatic Resources Resource Committee meeting to discuss initial results of the Aquatic Resources Task 1 Entrainment Study.
May 16, 2023	Virtual meeting with Water Resources Resource Committee to discuss results of Task 1 of the Water Resources Study.
July 27, 2023	Hybrid in-person/virtual meeting with Water and Aquatic Resources Resource Committees to discuss study progress and results to-date.
July 27, 2023	Hybrid in-person/virtual meeting with the Recreation & Visual Resources Resource Committee to discuss and select Key Views for the Visual Resources Study and provide update on the Recreational Resources Study.
July 31, 2023	Virtual meeting with the Wildlife and Botanical Resource Committee to discuss updates regarding listed species, proposed temporary access road, avian protection along the transmission line corridor, and Clean Water Act (CWA) Section 404/401 permitting.

In addition to the Resource Committee consultation described above, in the summer and fall of 2023, Duke Energy also consulted directly with the South Carolina Department of Natural Resources (SCDNR) on multiple occasions, as described in the study summaries that follow in Section 2. Duke Energy notes that additional consultation with SCDNR and fieldwork were performed in support of the future application to be filed pursuant to Section 404/401 permitting under the CWA for construction of the Bad Creek II Complex. Additionally, in support of future Section 404/401 permitting, a herptile survey was conducted in areas that could be impacted by proposed spoil placement; these results are provided in **Attachment 4**.

1.2 ISR Document Road Map

The ISR consists of six individual study reports; technical reports for studies that have been completed or partially completed are included as appendices to this ISR. Table 3 lists the study reports (i.e., appendices) and associated attachments, as well the timeframe for the study as approved by the Commission and status of the individual study reports [by task]. Reports listed

as Final have undergone draft report review by the relevant relicensing Resource Committee[s] and incorporate Committee feedback and suggested revisions. Reports listed as Draft have undergone initial Resource Committee review or will undergo review in 2024 and will be provided in the USR, which will be filed with the Commission by January 3, 2025.

The Cultural Resources Draft Study Report (**Appendix E**) is being filed separately as Controlled Unclassified Information // Privileged (CUI // PRIV)[2] pursuant to 18 CFR § 388.112, as this report contains information regarding the specific location and nature of historic and archaeological resources, which is not for public disclosure.

[2] Classified Uncontrolled Information // Privileged (CUI // PRIV) - Denotes information that section 388.112 of the Commission's regulations, 18 CFR §388.112, recognizes as privileged. The term 'privileged' includes any work-product privilege, attorney-client privilege, governmental privilege, or other privilege recognized under Federal, State, or foreign law. FERC CUI Processes | Federal Energy Regulatory Commission

Table 3. Study Report Organization and Status

Study Appendix	Study Task	Attachment	Included in ISR	Approved Timeframe for Completion (RSP and SPD)	Status / Notes
Appendix A - Water Resources Study	Task 1 – Summary of Existing Water Quality Data and Standards	1	**Yes**	Jan 2023 – April 2023	Complete; Final report included.
	Task 2 – Water Quality Monitoring in Whitewater River Arm	2	**Yes**	June 2023 – Sept 2023 June 2024 – Sept 2024	Ongoing; Interim draft report included.
	Task 3 – Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse	3	**Yes**	April 2023 – Oct 2023	Complete; Final report included.
	Task 4 – Water Exchange Rates and Lake Jocassee Reservoir Levels	4 *[placeholder for USR]*	No	April 2023 – Oct 2023	Ongoing; Final report will be submitted with USR.
	Task 5 – Future Water Quality Monitoring Plan Development	5 *[placeholder for USR]*	No	Jan 2024 – Dec 2024	Future work (January 2024 – December 2024).
	Consultation Documentation	6			
Appendix B – Aquatic Resources Study	Task 1 – Consultation on Entrainment	1	**Yes**	Jan – June 2023	Complete; Final report included.
	Task 2 – Desktop Studies on Pelagic and Littoral Habitat Effects	2 *[placeholder for USR]*	No	Spring – Fall 2023	Ongoing; Final report will be submitted with USR.
	Task 3 – Mussel Surveys and Stream Habitat Quality Surveys	3	**Yes**	Summer 2023	Ongoing; Draft report included. Final report will be submitted with USR.
	Consultation Documentation	4			

Study Appendix	Study Task	Attachment	Included in ISR	Approved Timeframe for Completion (RSP and SPD)	Status / Notes
Appendix C – Visual Resources Study	Task 1 – Existing Landscape Description Task 3 – Field Investigation Task 5 – Existing Visual Quality Assessment Task 6 -Visual Analysis Task 7 -Visual Management Consistency Review Task 8 – Mitigation Assessment Task 9 – Conceptual Design of Bad Creek II Complex	*Placeholder for USR*	No	January 2023 – Summer 2024	Ongoing; Final study report will be submitted with USR.
	Task 2 – Seen Area Analysis	1	**Yes**	2023	Task results included. Final study report will be submitted with USR.
	Task 4 – Key Views	2	**Yes**	2023	Task results included. Final study report will be submitted with USR.
	Consultation Documentation	3			
Appendix D - Recreational Resources Study	Task 1 – Foothills Trail Corridor Recreation Use and Needs Methodology	1 *[placeholder for USR]*	No	Jan 2023 – November 2023	Ongoing; Final report will be submitted with USR.
	Task 2 – Foothills Trail Corridor Conditions Assessment	2	**Yes**	Jan 2023 – November 2023	Ongoing; Draft report included. Final report will be submitted with USR.
	Task 3 – Whitewater River Cove Existing Recreational Use Evaluation	3	**Yes**	Jan 2023 – November 2023	Complete; Final report included.
	Task 4 – Whitewater River Cove Recreational Public Safety Evaluation	4 *[placeholder for USR]*	No	Jan 2023 – November 2023	Future work; January 2024 – December 2024
	Correspondence	5			
Appendix E – Cultural Resources Study	Task 1 – APE Determination Task 2 – Cultural Resources Survey of the APE	1 [Filed Separately CUI // PRIV]	**Yes**	December 2022 – Fall 2023	Complete; Draft report included. Final report will be submitted with USR.
	Consultation Documentation	2 [Filed Separately CUI // PRIV]			

Study Appendix	Study Task	Attachment	Included in ISR	Approved Timeframe for Completion (RSP and SPD)	Status / Notes
Appendix F – Environmental Justice Study	Environmental Justice Study (Consultation documentation included)	1	**Yes**	Spring 2023-Fall 2023	Complete; Final report included.

1.3 Proposals to Modify Ongoing Studies or for New Studies

Duke Energy does not propose any substantive modifications to ongoing studies or new studies to be performed in support of development of the draft and final license applications and FERC staff's future environmental analysis. Adjustments to the study boundaries and field activities have been made as described in the previously filed quarterly progress reports and below in Section 2 in support of pursuit of other environmental (i.e., CWA 404/401) and local land disturbance approvals. Study boundary and field activity adjustments have been made to accommodate the following:

- **Temporary Access Road**: Duke Energy is evaluating the development of a temporary access road to the Fisher Knob community for use during the Bad Creek II Complex construction; this has warranted additional effort and expanded area of work in several of the studies. The gravel service road would be approximately 3.7 miles long, primarily follow an existing unmaintained logging road on property owned by Duke Energy and would only be maintained during construction of Bad Creek II (see **Appendix B**, **Attachment 3** for maps of proposed access road). The temporary access road would necessarily be constructed in advance of the start of construction for Bad Creek II and prior to the new license issuance and would not be part of the expanded FERC Project boundary.

  The study areas for the Water Resources, Aquatic Resources, Visual Resources, and Cultural Resources studies have been modified to assess the potential effects of the temporary access road. In addition, Duke Energy has conducted a natural resources assessment of the proposed route to identify potential terrestrial and aquatic resources that may require additional evaluation.

- **Additional Spoil Area**: In addition to spoil areas shown in the PAD, PSP, and RSP, a new spoil pile area is being considered. The area encompassed by the additional spoil area was previously evaluated during the 2021 Natural Resources Assessment (report attached to the PAD as Appendix E). While this does not affect the current Aquatic or Water Resources studies, it will be considered in the work carried out for CWA Section 404/401 water quality permitting.

- **Additional Stream Surveys**: In consultation with SCDNR, additional activities were carried out to support the Aquatic Resources Study by implementing the SCDNR Stream Quantification Tool (SQT) on streams associated with the temporary access road. More details are provided in the Aquatic Resources Draft Study Report (**Appendix B**).

2 Status and Summaries of Studies

This section describes Duke Energy's overall progress in implementing the study plan and schedule, data collected, and any variances from the study plan and schedule. Study methods and available study results are summarized for each of the six studies approved in the Commission's SPD (**Attachment 1**). A summary of study task status is included above in Table 3.

2.1 Water Resources Study

The Water Resources Study is intended to provide sufficient information to support an analysis of the potential Project-related effects on water resources, as well as any potential effects or impacts due to the construction and operation of the proposed Bad Creek II Complex, using existing and new information. The main objectives of this study are:

- To evaluate water resources and water quality impacts of current Project operations using existing data.
- To evaluate water resources and water quality impacts potentially resulting from the construction and operation of the Bad Creek II Complex.
- To address stakeholder concerns regarding water resources in the Project boundary with clear nexus to the Project and the proposed Bad Creek II Complex.

The five main tasks of this study are described below in Section 2.1.1 through Section 2.1.5. Individual reports documenting methods and results of completed study tasks are included in **Appendix A**. All stakeholder consultation documentation for the Water Resources Study since the time of RSP filing is also provided in **Appendix A.**

2.1.1 Task 1 – Summary of Existing Water Quality Data and Standards

2.1.1.1 Overview

Duke Energy performed a literature and desktop review of available water quality data collected in Lake Jocassee and Howard Creek. The main goal of this desktop review was to compile previously collected water quality data and provide a summary of existing data from Lake Jocassee and Howard Creek under current Project operations and prior to Project operations while addressing stakeholder concerns. Data were also evaluated against current designated uses

and water quality standards applicable to the Project set forth by the South Carolina Department of Health and Environment (SCDHEC).

Summaries of methods and results are provided below, and the final report is included in **Appendix A, Attachment 1**. The study report was reviewed by relicensing stakeholders (Water Resources Resource Committee) and a meeting was held in May 2023 to discuss Task 1 findings; the final report addresses committee feedback and suggested revisions.

2.1.1.2 Methods Summary

The study area for the desktop review of existing water quality data includes Lake Jocassee and Howard Creek. Water quality datasets for the 12 existing Duke Energy water quality monitoring stations in Lake Jocassee were provided by Duke Energy's Environmental Science Group in July 2022 and include values for dissolved oxygen (DO), temperature, pH, conductivity, turbidity, and nutrients. To satisfy the objective of summarizing existing water quality conditions and comparing them to conditions that existed prior to Project construction, Lake Jocassee water quality data were pooled and separated into two time periods: pre operations (prior to 1991) and post operations (1991 to 2020). For the Whitewater River cove (also referred to as Whitewater River arm) analysis, a third time period covering the years during Project construction (1985-1991) was evaluated in addition to pre and post construction. Additionally, turbidity values (vertical profiles) were assessed at the three Whitewater River cove locations.

Historic water quality data from Howard Creek were summarized from Abernathy et al. (1994), which are considered representative under existing (i.e., operational) conditions, with the goal of identifying and assessing changes observed in water quality between pre construction and post construction data.

2.1.1.3 Results Summary

Detailed comparisons of pre and post construction data at each station, as well as minimum, maximum, and average values are included in **Appendix A**, **Attachment 1**. Overall, the effect of Project operations on Lake Jocassee water quality is negligible downstream of the submerged weir in Whitewater River cove (Station 564.1). Upstream of the weir, the water column undergoes vertical mixing due to proximity of the Project discharge and there is no indication of stratification (post 1991), regardless of season. At Station 564.0 (downstream of the weir),

stratification is observed and is consistent between pre and post operation conditions. These results suggest that the submerged weir limits water column mixing downstream of the weir structure (i.e., mixing is confined to the portion of the Whitewater River cove upstream of the submerged weir). Tables of water quality data at the three stations in the Whitewater River cove over the three construction periods are included in **Appendix A, Attachment 1**. All Project operational impacts are limited to monitoring Station 564.1 located between the inlet/outlet structure and submerged weir. All water quality parameters with assigned SCDHEC numeric water quality standards (i.e., DO, pH, phosphorus, nitrogen, chlorophyll *a*, and turbidity) fully support designated use classifications. For those parameters that do not have numeric standard or threshold (i.e., DO saturation, conductivity) or have narrative criteria instead of numeric criteria, values are consistent with historic data and since Lake Jocassee supports a diverse, healthy fish community, it is assumed criteria are suitable for aquatic resources. Similarly, Howard Creek water quality was assessed pre and post Project construction and under current conditions, average water quality parameters for temperature, DO, pH, and turbidity are within designated SCDHEC criteria.

Detailed results from Task 1 of the Water Resources Study are included in **Appendix A, Attachment 1**.

2.1.2 Task 2 – Water Quality Monitoring in Whitewater River Arm

2.1.2.1 Overview

To better understand the effectiveness of the existing submerged weir and evaluate current-day (i.e., baseline) water quality information in the Whitewater River cove of Lake Jocassee[3], Duke Energy gathered continuous temperature and periodic (bi-weekly) DO data from the three historic water quality monitoring stations in the Whitewater River cove from June through September 2023. Data collection in 2023 represents conditions under two-unit and three-unit[4]

[3] Water quality in the Whitewater River cove is reflective of water quality conditions in the upper reservoir. Water from Bad Creek Reservoir is exchanged directly with Lake Jocassee; due to the small drainage area of Bad Creek Reservoir, inflows are minimal and have limited to no effect on water quality or Project operations. Additionally, retention time in the upper reservoir is approximately three days under single pump-turbine operation. There are no existing water quality data in the upper reservoir; it is used only for Project operations and there is no public access.

[4] Unit 3 became operational in March 2023.

operations at the Project. Duke Energy will continue to monitor water quality (continuous temperature and bi-weekly DO) throughout summer 2024 to capture conditions with all four existing unit upgrades completed.

Summaries of methods and results are provided below, and the draft interim report is included in **Appendix A, Attachment 2**.

2.1.2.2 Methods Summary

Three historic water quality monitoring stations in the Whitewater River arm of Lake Jocassee were assessed as part of Water Resources Study (Stations 564.1, 564.0, 560.0). Continuous water quality data (temperature and DO) were collected at all three stations from June 1 – October 11, 2023 with in-Situ VuLink® dataloggers positioned at five staggered elevations.

Water temperature and DO data were also collected during the discrete bi-weekly sampling events; vertical profiles were collected from the water surface to the lake bottom (in approximately 6-foot [2-meter] increments) at all three monitoring locations.

Detailed methods and instrumentation descriptions are included in **Appendix A, Attachment 2**.

2.1.2.3 Results Summary

Results from water quality monitoring in the Whitewater River cove indicate water on the upstream side of the weir is well-mixed and, as expected, there is no stratification in the water column. Stratification at the two stations downstream of the submerged weir under two- and three-unit pumping and generation, even under the warmest months of the year, is noted at depth.

A more comprehensive analysis using data from 2023 and 2024 will be provided in the USR during fourth quarter of 2024. Detailed results to-date from this study are included in **Appendix A, Attachment 2.**

2.1.3 Task 3 – Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse

2.1.3.1 Overview

Duke Energy developed a three-dimensional computational fluid dynamics (CFD) model to determine the spatial extent of vertical mixing in the Whitewater River arm under three scenarios: 1) current conditions, 2) upgraded conditions, and 3) proposed conditions (additional

operation of Bad Creek II Complex). In advance of CFD modeling, a 2-D hydraulic model was developed to determine the approximate affected area (associated with the Project and Bad Creek II Complex operations) to establish the CFD boundary based on the hydraulic model results. Sixteen scenarios were evaluated to help determine the impact of Project operations on mixing in the Whitewater River arm with and without expanding the existing submerged weir (in both generating and pumping mode; and at full pond and maximum drawdown).

Summaries of methods and results are provided below, and the final report is included in **Appendix A, Attachment 3**. The study report was reviewed by relicensing stakeholders (Water Resources Resource Committee) and a meeting was held in July 2023 to discuss preliminary findings; the final report addresses Committee feedback and suggested revisions.

2.1.3.2 Methods Summary

Models developed for determining the effect of a second powerhouse include a 2-D hydraulic flow model and a 3-D computational flow model (CFD). The 2-D model was developed first to evaluate the hydraulics of the Whitewater River cove with the goal of determining the CFD model boundary. Results from the 2-D model were used as input into the CFD model to determine the downstream modeling boundary; the significantly reduced computational run time of the 2-D model was able to achieve this step in a single model run as opposed to a lengthy iterative process. Sixteen scenarios were evaluated using the CFD model to evaluate effects of Project operations on vertical mixing in the Whitewater River arm and downstream of the submerged weir to determine how far downstream Project effects extend. Scenarios modeled the existing and expanded submerged weir configuration in both generating and pumping mode; and at full pond (elevation 1,110 feet mean sea level) and maximum drawdown (elevation 1,080 feet). Results under full pond and maximum drawdown provide potential upper and lower limits of hydraulic effects of Bad Creek II Complex operations. The CFD model domain covers approximately 922 acres and generally encompasses the area upstream of the Devil's Fork arm and Whitewater River arm confluence. Scenarios were compared relatively to assess how pumping and generating affect the hydraulics downstream of the submerged weir and also to assess how the geometry of the submerged weir affects the flow patterns and vertical mixing downstream of the weir.

Flows were measured in the Whitewater River cove along five transects with an acoustic doppler current profiler to provide verification and confidence in modeled results. Results from the verification studies agreed well with modeled results and a verification report was developed as an addendum to the Task 3 report (included in **Appendix A**, **Attachment 3**).

More details on model description, limitations, and modeling approach are included in **Appendix A, Attachment 3**.

2.1.3.3 Results Summary

The CFD model domain was appropriately sized to evaluate the hydraulic effects of the Project and Bad Creek II Complex. Results indicate hydraulic effects in Lake Jocassee due to operations are limited to the model domain (i.e., the area upstream of the Devil's Fork arm and Whitewater River arm confluence) and conditions to maintain natural stratification downstream of the weir exist under all modeled scenarios.

In generation mode, the energy of the water discharged from the Project is dissipated as it is forced across the top of the existing submerged weir. Similar vertical mixing patterns result from the existing and proposed expanded weir geometries under existing and proposed generation flows. Model results indicate Bad Creek II Complex powerhouse operations will not alter existing stratification patterns observed at Station 564.0 (downstream of weir) or further downstream into Lake Jocassee.

In pumping mode, hydraulic effects due to Bad Creek II Complex operations are limited to the Whitewater River cove upstream of the submerged weir and in the upper water column across the top of the weir. No modeled configuration of pumping operations creates mixing downstream of the submerged weir. Water quality profile data (current and historic) also support CFD model results, indicating stratification is preserved downstream of the submerged weir.

Detailed results from this study are included in **Appendix A, Attachment 3**.

2.1.4 Task 4 – Water Exchange Rates and Lake Jocassee Reservoir Levels

2.1.4.1 Overview

Operation of the proposed Bad Creek II Complex, which will add pumping and generating capacity to the Project, has the potential to impact water surface elevation rate of change in Lake Jocassee compared to typical conditions (but will not change the allowable fluctuation in Lake Jocassee under the KT Project License and associated agreements). Duke Energy used the existing Computer Hydro-Electric Operations and Planning Software™ (CHEOPS) model to evaluate the difference in water exchange rate, frequency, and magnitude between Bad Creek Reservoir and Lake Jocassee due to the addition of a second powerhouse. Additionally, potential impacts to Lake Keowee as a result of operating an additional powerhouse at the Project were considered.

On July 27, 2023, a meeting was held to discuss the Water Resources Study and solicit feedback from the Water Resources Resource Committee regarding performance measures for the CHEOPS modeling study. Interested parties were requested to submit input regarding performance measures by August 15, 2023 and a follow-up meeting was scheduled with the SCDNR (per their request) on August 17, 2023. Several performance measures were revised during this meeting and comments were requested by September 15, 2023; all correspondence regarding stakeholder involvement in the CHEOPS study task is included in **Appendix A, Attachment 6**.

This evaluation is ongoing. Duke Energy expects to distribute a draft report to the Water Resources Resource Committee for review during the first quarter of 2024. The final report will include Committee feedback and will be submitted in advance of the USR with a future Quarterly ILP Study Progress report in 2024.

2.1.5 Task 5 – Future Water Quality Monitoring Plan Development

As described in the RSP, the future Water Quality Monitoring Plan will be developed to support the proposed Bad Creek II Complex. The monitoring plan will include three phases: pre construction, construction, and post construction of Bad Creek II Complex, including identification of applicable and appropriate threshold values for water quality parameters and monitoring means and methods. Key components will include the construction of a new

inlet/outlet and expanding the submerged weir, construction in upland areas, and potential upland spoil disposal. The future monitoring plan will be developed in consultation with and distributed to stakeholders and resource agencies in 2024 and provided in the USR.

2.1.6 Study Status

Duke Energy has partially completed the Water Resources Study in accordance with the RSP and the Commission's SPD. The Water Resources Study Report is included in **Appendix A** of this ISR, which includes six attachments (two of the six attachments are placeholders for the USR). Task 1 (Summary of Existing Water Quality and Standards) and Task 3 (Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse) are complete and the final technical reports associated with these study tasks have undergone stakeholder review; they are attached to **Appendix A** as **Attachment 1 and Attachment 3**. A summary of methods and results from water quality monitoring in the Whitewater River cove during the 2023 field season to support Task 2 (Water Quality Monitoring in the Whitewater River arm) is included as a draft interim technical report attached to **Appendix A, Attachment 2**. The final report detailing both study seasons (2023 and 2024) will be included in the USR. Efforts for Task 5 (Future Water Quality Monitoring Plan Development) will be carried out in 2024 in consultation with resource agencies and stakeholders.

2.1.7 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP; however, the study area has been expanded to incorporate effects of the temporary access road to water resources. This modification is relevant for Task 5 only.

2.2 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 construction and operation of the proposed Bad Creek II Complex.

The main objectives of this study are to:

- Evaluate the potential for increased fish entrainment due to the addition of Bad Creek II Complex and consult with agencies and other Project stakeholders regarding results of the recent desktop Entrainment Study.

- Assess changes to pelagic and littoral aquatic habitat in Lake Jocassee resulting from the expanded underwater weir and additional discharge, using models developed for the Water Resources Study and Keowee-Toxaway Hydroelectric Project (KT Project) relicensing.
- Evaluate 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; including presence/absence mussel surveys of streams located in upland areas where spoil deposition may occur will also be conducted.

The three main tasks of this study are described below in Section 2.2.1 through Section 2.2.3. Individual reports documenting methods and results of completed study tasks are included in **Appendix B**. All stakeholder consultation documentation for the Aquatic Resources Study since the time of RSP filing is also provided in **Appendix B**.

2.2.1 Task 1 – Consultation on Entrainment

2.2.1.1 Overview

Fish entrainment at the existing Bad Creek Project has been a subject of extensive studies throughout the Project's history. Therefore, a significant baseline of entrainment information is currently available for review. An empirical entrainment study was completed by Duke Energy in cooperation with the SCDNR and U.S. Fish and Wildlife Service at the Project during the first three years of operations (1991 to 1993) (Barwick et al. 1994). An updated desktop entrainment study was completed in 2021 and attached to the PAD as Appendix F. In response to comments made on the PAD from stakeholders, Duke Energy proposed Task 1 Consultation on Entrainment under the PSP and RSP and approved by FERC in the SPD. A meeting with the Aquatic Resources Resource Committee was held on April 6, 2023 (meeting notes are provided in Appendix B, Attachment 1); the desktop entrainment study was subsequently revised considering stakeholder comments.

The Desktop Entrainment Analyses (Kleinschmidt 2023) included in Appendix B, Attachment 1 carried out as part of the Aquatic Resources Study was developed as a desktop study in support of the relicensing and proposed project expansion (i.e., the addition of a second powerhouse, identical in size and capacity to the existing powerhouse and adjacent to the existing powerhouse). More specifically, it considers the potential for the entrainment of Lake Jocassee fishes through the Project under the proposed action (i.e., two powerhouses).

Summaries of methods and results are provided below, and the final report is included in **Appendix B, Attachment 1**. The study report was reviewed by the Aquatic Resources Resource Committee in November 2023; the final report addresses committee feedback and suggested revisions.

2.2.1.2 Methods Summary

Entrainment rates for the assessment were developed from previously observed entrainment via hydroacoustic monitoring and tailrace netting at the Project intake (Barwick et al. 1994). Entrainment rates are typically expressed in fish per million cubic feet of water; because the number of hours the Project and Bad Creek II Complex is expected to run each day and the total volume of water pumped is known, the number of fish expected to be entrained can be estimated. An entrainment risk assessment was used to identify and analyze potential future entrainment mortality events while assessing the resiliency of the population (i.e., its ability to tolerate the expected level of mortality).

Seasonal entrainment rates were described with Log Normal distributions. The Project, under the proposed action of adding an additional twin powerhouse, is intended to pump up to 6 hours per day on weekdays and 2 hours per day on weekends. Duke Energy provided operations data from 2014 to 2018 in 15-minute increments that would also be reflective of the new pumping operations. It was assumed that if a unit was pumping, it was pumping at max capacity for the entire 15-minute period. Therefore, the number of hours operated per day is the number of 15-minute intervals with pumping operations divided by 4. Entrainment mortality events were simulated with the open-source software package Stryke[5]. It was also assumed that all fish simulated are routed through the Project and Bad Creek II Complex powerhouses and that there is 100 percent mortality. Seasonal event scenarios and seasonal unit operations are included in **Appendix B, Attachment 1**.

2.2.1.3 Results Summary

Based on the exploratory analysis and simulation, risk of entrainment increases at lower Lake Jocassee surface water elevations. Fluctuation in forebay elevations could increase risk of

[5] https://github.com/knebiolo/stryke

entrainment. The estimated rates of entrainment mortality at the Project or Bad Creek II Complex are not expected to affect the long-term sustainability of Lake Jocassee fish populations based on intrinsic population growth rates. The species with the largest impact, Blueback Herring and Threadfin Shad, have relatively high fecundity, meaning that population-level compensatory mechanisms would likely offset the entrainment losses in terms of effects on these fish populations. In addition, while some level of entrainment mortality will inevitably occur, many natural populations have excess reproductive capacity that will compensate for some losses of individuals. No expected risk to Blueback Herring was indicated because the estimated entrainment rate of 0.7 percent per year is substantially below the expected recovery rate of the species. The expected entrainment rate of 12 percent for Threadfin Shad is close to the expected annual increase for the slowest recovery surrogate, American Shad, indicating that entrainment mortality may keep the population from substantial increase, but is not likely to cause the population to decrease, unless combined with other non-project impacts. Detailed results from this study are included in **Appendix B, Attachment 1.**

2.2.2 Task 2 – Effects of Bad Creek II Complex and Expanded Weir on Aquatic Habitat

2.2.2.1 Overview

This evaluation will be based on results developed under Task 3 and 4 of the Water Resources Study and is ongoing. Duke Energy expects to distribute a draft report to the Aquatic Resources Resource Committee for review during the first quarter of 2024. The final report will include Committee feedback and would be submitted in advance of the USR with a future Quarterly ILP Study Progress report in 2024.

2.2.3 Task 3 – Impacts to Surface Waters and Associated Aquatic Fauna

2.2.3.1 Overview

The construction of Bad Creek II Complex and expanded submerged weir is likely to result in impacts to surface waters and wetlands in the proposed expanded Project boundary (Figure 1), and subsequently, may result in impacts to aquatic life. Therefore, Duke Energy is evaluating the level of impacts by quantifying and characterizing surface waters, including resource quality.

This task is ongoing and objectives will be 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. During the first study year, Duke Energy proposed development of a temporary access road (see Section 1.3) to provide an alternate route to the Fisher Knob community during Bad Creek II Complex construction. The proposed 3.7-mile-long gravel road is not presently included in the proposed expanded FERC Project boundary and was not yet planned at the time of RSP filing. Therefore, this study task was modified to consider this additional scope and area in support of future anticipated CWA Section 404/401 authorizations.

Summaries of methods and results are provided below, and the draft report is included in **Appendix B, Attachment 3**. There were several points of SCDNR consultation associated with this study task. Additionally, a meeting was held on December 19, 2023 between Duke Energy, SCDNR, and HDR to discuss findings of the draft report. Formal comments were subsequently submitted by SCDNR to Duke Energy on December 21, 2023, which are included in the consultation documentation in **Appendix B, Attachment 4**. Duke Energy plans to continue to consult with SCDNR and other interested parties to address and resolve comments. The final report will include Resource Committee feedback and will be submitted in advance of the USR with a future Quarterly ILP Study Progress report in 2024.

2.2.3.2 Methods Summary

Stream habitat quality surveys were completed for streams within proposed spoil locations using U.S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocol and the North Carolina Stream Assessment Method. With the addition of the proposed temporary access road and through consultation with the SCDNR, additional methodologies for stream habitat assessments related to the SQT were adapted by Duke Energy into the study. Detailed methods are provided in **Appendix B, Attachment 3**. Additionally, a memo developed as a summary of stream survey approach methods prepared during consultation with SCDNR and filed with the Commission with the September 28, 2023, Relicensing Study Progress Report No. 3 is also provided in **Appendix B, Attachment 3**.

Mussel surveys consisted of an assessment for supportive habitat, followed by timed searches where suitable habitat was identified. Areas surveyed for suitable mussel habitat included the shoreline of Lake Jocassee in the vicinity of the submerged weir and the proposed Bad Creek II Complex inlet/outlet structure, and Howard and Limber Pole creeks. Timed searches were a minimum of four person-hours in Lake Jocassee and one person-hour in creeks. Detailed methodology information for mussel surveys is provided in **Appendix B, Attachment 3**.

2.2.3.3 Results Summary

Stream habitat quality assessments of streams within spoil locations using the USEPA Rapid Bioassessment Protocol and North Carolina Stream Assessment Method indicated the streams within potential spoil locations and those potentially crossed by the proposed temporary access road are in fully functioning condition. SQT stream ratings along the temporary access road are relatively low due because streams exhibiting moderate hydraulic disconnect from the floodplain, however the streams are generally in stable, functioning condition for the stream classification and characteristics which they exhibit (e.g., streams classified as Rosgen B-type streams at this position in the watershed typically exhibit entrenchment). Macroinvertebrate surveys of Limber Pole Creek and Howard Creek found abundant EPT taxa and suitable habitat conditions, resulting in a high bioclassification score indicating a fully supporting system. While fish community sampling resulted in limited fish species collected from Howard Creek and none from Limber Pole Creek, this is typical of streams high in the watershed elevation 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 Limber Pole Creek, Howard Creek, and areas of shoreline in Lake Jocassee, no native mussels were observed during any of the surveys. Additional study details and assessment of impacts are included in **Appendix B, Attachment 3.**

2.2.4 Study Status

Duke Energy has partially completed the Aquatic Resources Study in accordance with the RSP and the Commission's SPD. Work for Task 1 (Consultation on Entrainment) of the Aquatic Resources Study is complete and the final technical report is included in **Appendix B, Attachment 1**. The draft Task 3 study report has undergone Resource Committee review, and

comments in response to the ISR filing or the ISR meeting will be resolved through further consultation with the Resource Committee in 2024. Efforts for Task 2 are ongoing and a draft study report associated with this task will be distributed to relicensing stakeholders in 2024. All finalized study reports will be included in the USR.

2.2.5 Variances from FERC-Approved Study Plan

While there have been no variances from the FERC-approved RSP for Tasks 1 and 2 of the Aquatic Resources Study, there were minor variances for Task 3 associated with safety concerns in the field due to inclement / severe weather during field data collection. Data forms for five streams were not completed; however, consistent with SCDNR determination during the July 2023 site visit (see **Appendix B, Attachment 3**) it is likely that these streams also present fully functioning conditions.

Additionally, similar to the Water Resources study, the study area for Aquatic Resources has been expanded to incorporate effects of the temporary Fisher Knob access road to aquatic resources. This additional area was not included in the RSP.

While not considered a variance, methods for determining stream quality were expanded to include the SQT methodology, which was completed in collaboration with the SCDNR.

2.3 Visual Resources Study

The goal of the Visual Resources Study is to document existing (i.e., baseline) conditions and evaluate potential visual impacts from construction and operation of the Bad Creek II Complex. The study is ongoing and includes nine tasks which are summarized below. Study goals for the Visual Resources Study will be met through the following objectives:

- Describe the key scenic characteristics of the existing landscape within the Project area and surrounding lands expected to potentially be within visual range of Project facilities.
- Identify areas within the existing landscape from which the existing and proposed Bad Creek facilities are or would potentially be visible.
- Identify existing project operations and maintenance activities that affect visual characteristics.

- Evaluate expected impacts of construction and operation of the Bad Creek II Complex on visual resources and any proposed protection, mitigation, and enhancement measures.

The main tasks of this study are briefly described below in Section 2.3.1 through Section 2.3.9. Stakeholder consultation documentation for the Visual Resources Study since the time of RSP filing is provided in **Appendix C.**

2.3.1 Task 1 – Existing Landscape Description

2.3.1.1 Overview

The goal of Task 1 is to describe the key scenic characteristics of the existing landscape within the Project area and surrounding lands expected to potentially be within visual range of Project facilities.

2.3.1.2 Methods Summary

Duke Energy's subcontractor, Landscape Planning and Design Associates, Inc. (LPDA), reviewed regional management plans within the Visual Resources Study Area to identify management goals associated with visual resources. These include:

- Keowee-Toxaway Shoreline Management Plan (Duke Energy 2014)
- Nantahala and Pisgah National Forests Final Land Management Plan (USDA 2023)
- Resource Management Plan for Jocassee Gorges Property, Oconee and Pickens Counties, South Carolina (SCDNR 1998)
- Revised Land and Resource Management Plan Sumter National Forest (USDA 2004)

2.3.1.3 Results Summary

The Existing Landscape Description will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.2 Task 2 – Seen Area Analysis

2.3.2.1 Overview

Task 2 identified areas within the existing landscape from which the existing and proposed Bad Creek facilities are or would potentially be visible. The seen area analysis was then used to identify potential Key Views (Task 4) for additional field investigations (Task 3).

2.3.2.2 Methods Summary

The Seen Area Analysis methodology is based on the use of standard Geographic Information System tools for calculating viewsheds based on a digital elevation model (DEM) and a set of observer points. The model analysis takes the observer dataset and a DEM raster dataset and analyzes which cells can be seen by the observer and which cannot, typically because a landform feature blocks the sight line.

The Seen Area Analysis was performed using Viewshed Analysis Spatial Analyst Tool in Esri ArcGIS Pro software. The data utilized to perform the analysis are U.S. Geological Survey DEM data which are bare earth data that do not account for trees, buildings, or other surface objects. This represents line-of-sight conditions based only on topography. Because the primary Project area is predominantly forested, the bare earth seen area analysis results are a conservative representation of potential visibility. The seen area analysis also does not account for the effects of atmospheric conditions such as humidity, cloud cover, or fog. The effects of revegetation of spoils areas and the potential temporary access road are also not incorporated in the analyses.

The analysis was run from the perspective of project features looking out over the landscape. The results of the analysis can be used inversely to identify points in the landscape with direct views of Project features.

2.3.2.3 Results Summary

The seen area maps show a color gradation, with darker color indicating more observation points if the feature is visible. Areas of the landscape with a color, even pale, indicates that at least a portion of the Project feature is visible. The maps were provided to the Visual and Recreational Resources Resource Committee at its July 27, 2023, meeting and are provided in **Appendix C, Attachment 1**.

2.3.3 Task 3 – Field Investigation

2.3.3.1 Overview

The goal of Task 3 was to acquire photographs of potential Key Views for use in completing Tasks 4 through 9.

2.3.3.2 Methods Summary

Photographs were collected on December 6, 2023 at the potential Key Views selected by the Visual and Recreational Resources Resource Committee at its July 27, 2023, meeting. As specified in the FERC-approved study plan, photos were collected during leaf-off conditions.

Nighttime views were also captured from four viewpoints during the same field visit. These images will be used to simulate lighting effects in conjunction with Task 9.

2.3.3.3 Results Summary

The images collected in December 2023 will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.4 Task 4 – Key Views Selection

2.3.4.1 Overview

The objective of Task 4 was to identify a set of Key Views that adequately covers the range of visibility and potential scenic and visual impacts of the Project. Considerations in selecting specific Key Views included viewing distance to ensure adequate representation of potential foreground, middleground, and background views of the Project features; viewing direction; and the types of viewer groups (residents, recreational users, and motorists) that might experience views of the Project facilities.

2.3.4.2 Methods Summary

Based on the results of the Seen Area Analysis developed for Task 2, travel routes, and potential viewer characteristics, Duke Energy identified 11 potential Key Views. The Recreation and Visual Resources Resource Committee evaluated these sites during its July 27, 2023 meeting and selected six for additional evaluation (Task 3). The Resource Committee elected to use the existing visualization of the intake/outlet area as viewed from the Whitewater River Cove that was developed during initial project planning instead of re-creating it. While this visualization was not done during leaf-off conditions, views of the structure are unaffected given there is very little vegetation between the structures and the lake. Duke Energy agreed to include an analysis of the visual effects along with the additional four visualizations to be developed in this study.

During the first half of 2024, the Recreation and Visual Resources Resource Committee will select four daytime Key Views for use during Tasks 5 through 9 and two nighttime viewpoints for use with Task 9.

2.3.4.3 Results Summary

The potential Key Views are included in **Appendix C, Attachment 2**. The photographs will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.5 Task 5 – Existing Visual Quality Assessment

2.3.5.1 Overview

This task will involve assessing the existing scenic and visual quality at each Key View identified during Key View selection (Task 4) based on consideration of the standard visual elements (form, line, color, texture, and pattern), the apparent naturalness of the landscape as seen from the specific Key View, and the degree of human modification of the landscape.

2.3.5.2 Methods

Scenic and visual quality will be evaluated using concepts from the U.S. Forest Service Scenery Management System, which includes landscape character descriptions and scenic integrity objectives for U.S. Forest Service landscapes that can be used to help assess the compatibility of a proposed project with the surrounding landscape.

2.3.5.3 Results

The Existing Visual Quality Assessment will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.6 Task 6 – Visual Analysis

2.3.6.1 Overview

This task will involve specific assessment of the expected scenic and visual impact at each Key View, based on changes in landform, change or addition to structures, to determine the potential extent of visual contrast introduced by the proposed Bad Creek II Complex, and the expected viewer response to those changes.

2.3.6.2 Methods

Visual simulations of the expected appearance of Bad Creek II Complex from a specified set of Key Views will be used to provide the basis for the visual analysis, which includes assessing the effect the expansion of the Project to the landscape would have on the area's landscape character and the landscape's scenic integrity. These Project elements will then be assessed in terms of their level of impact based on setting and viewer characteristics.

2.3.6.3 Results

The Visual Analysis results will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.7 Task 7 – Visual Management Consistency Review

2.3.7.1 Overview

This task will involve review of the consistency of the Bad Creek II Complex visualizations (Task 6) with visual resource protection guidance in the management plans reviewed during Task 1.

2.3.7.2 Results

The Visual Management Consistency review will be included in the study report that will be distributed in 2024.

2.3.8 Task 8 – Mitigation Assessment

2.3.8.1 Overview

This task will involve identification and assessment of potential mitigation measures that would address the scenic and visual impacts of the Bad Creek II Complex identified during the visual impact assessment (Task 6).

2.3.8.2 Methods

Measures that could reduce the contrast created by the Project facilities, and thereby reduce the level of scenic and visual impact, will be identified. Potential measures will be evaluated in terms of their physical feasibility, approximate cost, and effectiveness in reducing contrast and visual impact.

2.3.8.3 Results

The mitigation assessment will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.9 Task 9 – Conceptual Design of Bad Creek II Complex

2.3.9.1 Overview

This task will assess, to the extent possible, visual resource conditions relative to site layouts, conceptual designs, proposed construction processes, and lighting.

2.3.9.2 Methods Summary

Based on Recreation and Visual Resources Resource Committee requests to evaluate the potential effects of additional lighting associated with Bad Creek II Complex, a similar process to the Key Views Selection (Task 4) was used to identify potential viewpoints for lighting visualizations. HDR identified four potential nighttime viewpoints – two with foreground views and two background views. The foreground views have a clear view of the facility while the background views will support evaluation of the effects of additional facility lighting on the surrounding landscape. Photographs were collected at the four potential viewpoints and members of the Resource Committee will select two for use with the lighting visualizations.

HDR will develop visualizations of lighting using the selected viewpoints, evaluate the management plans reviewed during Task 1, and develop three-dimensional renderings.

2.3.9.3 Results Summary

The evaluation of the conceptual design of Bad Creek II Complex will be included in the study report that will be developed and distributed during the first half of 2024.

2.3.10 Visual Resources Study Status

Duke Energy has partially completed the Visual Resources Study in accordance with the RSP and the Commission's SPD. This study is on-going; Duke Energy anticipates completing the study during the first half of 2024. The final Visual Resources Study Report will be included in the USR.

2.3.11 Variances from FERC-Approved Study Plan

The following changes to the study have been made in consultation with the Visual and Recreational Resources Resource Committee:

- **Key Views:** The study plan specified that up to four Key Views would be identified. However, the Resource Committee requested, and Duke Energy agreed to evaluate five Key Views including the visualization of the inlet/outlet structure on Lake Jocassee that was developed during Bad Creek II Complex planning.
- **Lighting Evaluation:** Task 9 does not specify how the lighting evaluation or effects would be evaluated. Duke Energy elected to develop visualizations using nighttime images for use with the evaluation. Duke Energy consulted with the Resource Committee to select the viewpoints for use with the lighting visualizations.

2.4 Recreational Resources Study

Goals and objectives of the Recreational Resources Study were met through four study tasks: (1) a Recreation Use and Needs (RUN) Study for the 43-mile-long portion of the Foothills Trail (or trail) managed by Duke Energy; (2) a Foothills Trail Corridor Conditions Assessment of the 43-mile-long portion of the Foothills Trail managed by Duke Energy; (3) an Existing Recreational Use Characterization of Whitewater River cove; and (4) a Recreational Public Safety Evaluation of Whitewater River cove.

The main tasks of this study are briefly described below in Section 2.4.1 through Section 2.4.4 Individual reports documenting methods and results of completed study tasks are included in **Appendix D**. All stakeholder consultation documentation for the Visual Resources Study since the time of RSP filing is also provided in **Appendix D**.

2.4.1 Task 1 – Foothills Trail Corridor Recreation Use and Needs Methodology

2.4.1.1 Overview

The goals of Task 1 are to assess current recreation use and identify any future recreation needs along the 43-mile-long segment of the Foothills Trail and associated access areas that are

maintained by Duke Energy and referenced in the existing Recreation Plan for the Project[6]. This evaluation is ongoing; a draft report will be submitted to relicensing stakeholders (Recreation & Visual Resources Resource Committee) for their review in 2024 and the final report will be included in the USR.

2.4.1.2 Methods Summary

A variety of data collection methods were employed to characterize current recreational use and determine future needs at the access areas on the Foothills Trail. Data collection methods include completion of a recreation site inventory, deployment of traffic and trail counters at access areas, collection of in-person user surveys at four access areas, and collection of user surveys accessed via QR code at ten access areas. Data collected will be used to conduct a parking demand analysis, trail carrying capacity analysis, future recreation use analysis, and recreation needs assessment.

2.4.1.3 Results Summary

User surveys were collected between March and November 2023. Sixty-two surveys were collected via QR code. An additional 261 surveys were collected in-person by survey clerks; 99 were collected at the Bad Creek Hydro Trail Access, 32 were collected at Horsepasture River Trail Access, 74 were collected at Laurel Valley Trail Access, and 56 were collected at Toxaway River Trail Access.

Traffic and trail counters collected data at the following access areas between March and November 2023:

- Table Rock State Park
- Sassafras Mountain Trail Access
- Chimneytop Gap Trail Access
- Laurel Valley Trail Access
- Laurel Fork Creek Falls Spur Trail Access
- Toxaway River Trail Access
- Canebrake Trail Access
- Lower Whitewater Falls Overlook
- Bad Creek Hydro Project Trail Access

[6] Duke Energy filed a copy of the 1980 document, "A Plan for Development and Management of the Foothills Trail and a supplement to the Bad Creek Pumped Storage Project #2740 Exhibit R," with the Commission on July 25, 2022, in response to additional information requested by FERC staff.

- Coon Branch Spur Trail
- Upper Whitewater Falls Trail Access

Following discussions with the Recreational Resources Resource Committee, an additional trail counter was installed on April 20, 2023 between the trail counter at Table Rock State Park and the trail counter at Sassafras Mountain Trail Access and collected data through November 2023. A traffic counter was also installed at the entrance to Musterground Road between September 15, 2022 and January 15, 2023 and again from March 20-May 10, 2023. Due to a malfunction with the traffic counter, data was not collected at Musterground Road for a portion of time between September 15, 2022 and January 15, 2023. Therefore, the counter was re-deployed at Musterground Road on September 15, 2023 and will continue to collect data through January 15, 2024.

This evaluation is ongoing. A draft report will be submitted to the Recreational Resources Resource Committee for review in 2024 and the final report will be provided in the USR.

2.4.2 Task 2 – Foothills Trail Corridor Conditions Assessment

2.4.2.1 Overview

The goal of Task 2 was to evaluate the current condition of trail surface and corridor and identify key areas of future maintenance needs or improvements for the 43-mile segment of the Foothills Trail maintained by Duke Energy. Summaries of methods and results are provided below, and the draft report is included in **Appendix D, Attachment 2**. The study report was reviewed by the Recreation and Visual Resources Resource Committee in November and December 2023. A revised study report will be provided for Resource Committee review in 2024, and a final report will be provided in the USR.

2.4.2.2 Methods Summary

Duke Energy subcontracted Long Cane Trails to perform a trail conditions assessment involving analyzing sections of trail and determining its maintenance needs[7]. Long Cane Trails divided the 43-mile segment of the Foothills Trail maintained by Duke Energy into six sections using the

[7] Inspections of engineered bridges on the Duke Energy-maintained portion of the Foothills Trail are performed every five years by a licensed Professional Engineer in accordance with the Duke Energy Foothills Trail Maintenance Program.

Foothills Trail Guidebook (Foothills Trail Conservancy 2018) as a reference for location descriptions. All 43 miles of the main trail corridor as well as spur trails were assessed for trail tread, out slope, backslope, drainage, constructed structures (not including engineered bridges) and corridor condition. Trail standards from the Trail Solutions guide (Felton 2004) on building singletrack was used as a base for trail condition analysis. Constructed structures (such as stairs, hand railings, bridges, etc.) were identified and recorded and location tracked geospatially. Structures in need of significant maintenance or replacement were recorded in detail with photo documentation. Similarly, trail condition and corridor features requiring maintenance or repair as well as areas of significant erosion, areas with significant drainage issues (i.e., standing water), or obstructed areas along the trail (i.e., downed trees), and notable occurrences of litter and vandalism were recorded and tracked geospatially.

2.4.2.3 Results Summary

Long Cane Trail identified 89 areas needing maintenance or improvements (i.e., trail issues) along the 43-mile segment of the Foothills Trail and five spur trails maintained by Duke Energy. Detailed results and photographs are included in **Appendix D, Attachment 2.**

2.4.3 Task 3 – Whitewater River Cove Existing Recreational Use Evaluation

2.4.3.1 Overview

The objectives of Task 3 included establishing baseline recreational use within the study area, specifically the level of boating use in Whitewater River cove, and quantifying recreational impacts of temporary closures of Whitewater River cove during Bad Creek II Complex construction. Summaries of methods and results are provided below, and the final report is included in **Appendix D, Attachment 3**. The study report was reviewed by the Recreation and Visual Resources Resource Committee in November and December 2023; the final report addresses committee feedback and suggested revisions.

2.4.3.2 Methods Summary

Duke Energy deployed a drone over the Whitewater River cove of Lake Jocassee to capture aerial images of recreation use to determine the number, type, and location of boats within the study area.

Drone flights occurred on 20 individual days scheduled between Memorial Day weekend and Labor Day weekend to evaluate use. Drone flights were conducted on a mix of weekdays, weekends, and holidays and imagery was collected every hour generally between 9:00 AM and 4:00 PM, as weather allowed. Data were extrapolated to draw conclusions related to the rate and patterns of recreational use in Whitewater River cove of Lake Jocassee and used to quantify the impacts of temporary closures in Whitewater River cove related to the proposed construction of Bad Creek II Complex.

2.4.3.3 Results Summary

Based on population projects in Oconee County, if construction were to begin in 2030, closure of the Whitewater cove could displace between approximately 19,895 and 27,852 boats during the construction period (five to seven years). It can be assumed that most of these boats would be motorboats and most displaced visitors would be sightseers. Detailed results are included in **Appendix D, Attachment 3**.

2.4.4 Task 4 – Whitewater River Cove Recreational Public Safety Evaluation

2.4.4.1 Overview

This evaluation is ongoing; a draft report will be submitted to relicensing stakeholders for their review in 2024 and the final report will be included in the USR.

2.4.5 Study Status

Duke Energy has partially completed the Recreational Resources Study in accordance with the RSP and the Commission's SPD. Task 3 of the Recreational Resources Study is complete and the final technical report is included in **Appendix D, Attachment 3**. The draft Task 2 report has undergone Resource Committee review and will be revised in continued consultation with the Committee in 2024. Work for Task 1 and Task 4 will be completed in 2024. Draft reports will be submitted for Resource Committee review in 2024, and the final reports will be submitted with the USR.

2.4.6 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP.

2.5 Cultural Resources Study

Effects from the potential addition of the Bad Creek II Complex could result in construction activities in previously undisturbed lands, and in areas to be used for rock and soil spoil disposal, access roads, and staging areas. The main objective of the Cultural Resources Study is to:

- Coordinate with the South Carolina State Historic Preservation Office (SHPO), Indian Tribes, and other stakeholders regarding potential issues with respect to cultural resources that may be located within the area of influence of the Bad Creek II Complex construction.

Goals and objectives of the study were met through two main study tasks which included determining the Area of Potential Effect (APE) for the Project as defined in 36 CFR § 800.16(d) and performing a cultural resources survey of the APE. The main tasks of this study are briefly described below in Section 2.5.1 through Section 2.5.2.

Summaries of methods and results are provided below, and the final report is included in **Appendix E.** The Cultural Resources Study Report is being filed separately as CUI // PRIV pursuant to 18 CFR § 388.112, as this report contains information regarding the specific location and nature of historic and archaeological resources, which is not for public disclosure. Stakeholder consultation documentation for the Cultural Resources Study since the time of RSP filing is provided in **Appendix E.**

2.5.1 Task 1 – APE Determination

2.5.1.1 Overview

Duke Energy has defined the APE in consultation with the SHPO and Indian Tribes as a component of this Cultural Resources Study. The APE is defined as follows:

> "The APE includes all lands within the Project boundary. The APE also includes any lands outside the Project boundary where cultural resources may be affected by Project-related activities that are conducted in accordance with the FERC license."

The Commission has not yet defined an APE for the Bad Creek II Complex. All Project-related operations, potential enhancement measures, and routine maintenance activities associated with the implementing a New License issued by the FERC are expected to take place within the proposed expanded Project boundary.

2.5.1.2 Methods Summary

Concurrence from the SHPO and participating Indian Tribes for the proposed expanded Project boundary to include areas that may be affected by the construction and operation of Bad Creek II was received in early 2022. Duke Energy requested concurrence to expand the APE to include the temporary Fisher Knob access road in a revised expanded APE and concurrence was received in the fall of 2023.

2.5.1.3 Results Summary

Concurrence has been received for the expanded APE (to include the Fisher Knob access road). All stakeholder consultation documentation associated with the APE since the time of RSP filing is provided in **Appendix E.**

2.5.2 Task 2 – Cultural Resources Survey of the APE

2.5.2.1 Overview

2.5.2.2 Methods Summary

Terracon Consultants, Inc., on behalf of Duke Energy, completed a Phase I Archaeological Survey of approximately 946 acres (including 9.25 miles of transmission line corridor) and Phase II Testing of a previously recorded site near the Project. In addition, approximately 4.0 miles along the proposed temporary access road and a 5.0-acre proposed administration building area located at the northwest end of the Project were surveyed. The purpose of the investigation is to support Duke Energy in their relicensing efforts for the Project, particularly regarding compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. § 300101 et seq.). Archaeological fieldwork for the Project was conducted intermittently from April to June 2023 and included the Phase I survey, Phase II testing, botanical analysis, and laboratory analysis. In addition to the archaeological investigations, an architectural survey was conducted to determine whether the proposed project would affect above-ground historic resources within the APE.

2.5.2.3 Results Summary

One isolated find was identified during the archaeological survey. This resource, consisting of a single Middle Archaic Morrow Mountain point, is recommended as being ineligible for inclusion

in the National Register of Historic Places (NRHP). Six previously recorded sites in the Project area were not relocated.

Phase II testing at a previously identified site revealed the site to be a dense, multicomponent series of rockshelters containing evidence of Early Archaic through Mississippian period occupations. A possible Paleoindian component may also be present. The site is recommended as being eligible for inclusion in the NRHP under Criterion D[8] (National Register Bulletin[9] 15:21-24). The site is currently not affected by Project operations and current plans are to avoid the site during construction of the Bad Creek II Complex by directionally drilling several hundred feet below the site. If these plans change; however, then consultation with the SHPO, Indian Tribes, and other consulting parties would be required and pursued.

In addition to the archaeological survey, an architectural survey was conducted that identified four historic resources associated with Bad Creek: SHPO Site Nos. 0156–0159. None of these resources are 50 years of age nor are they considered exceptionally significant under Criteria Consideration G (National Register Bulletin 15:41-43). Therefore, these resources are recommended as being ineligible for inclusion in the NRHP but should be reevaluated once they reach 50 years of age. Lastly, although the Jocassee Hydroelectric Station (SHPO No. 0198) is eligible for the NRHP and is within the APE, the two projects are only functionally related to one another and there will be no effect on this resource as a result of Project operations.

Details of the Cultural Resources survey are included in **Appendix E (CUI // PRIV)**.

2.5.3 Study Status

The Cultural Resources Study Report comment review period extended through December 30, 2023 according to the schedule established by the RSP, therefore, comments submitted on the Cultural Resources Study Report will be addressed in a final report in 2024. As noted above, the draft study report is included in **Appendix E (CUI // PRIV)**.

[8] Criterion D. The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that have yielded or may be likely to yield, information important in prehistory or history.

[9] National Park Service. 1995. National Register Bulletin. How to Apply the National Register Criteria for Evaluation. Accessed 11/27/2023. URL: https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdfp

2.5.4 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP.

As noted above, the Area of Potential Effect has been expanded to incorporate effects of the temporary Fisher Knob access road to cultural resources. This additional area was not included in the RSP.

2.6 Environmental Justice Study

2.6.1 Overview

The Environmental Justice (EJ) Study evaluates impacts to EJ communities as they relate to 1) relicensing the existing Project without construction of the Bad Creek II Complex, and 2) relicensing the existing Project and including construction of the additional facilities as described in the PAD alternative licensing proposal. The goal of the EJ Study is to define the potential effects of continued Project operations during the term of a New License issued by FERC, including construction and operation of a second powerhouse (i.e., Bad Creek II Complex), on disadvantaged environmental justice communities that may be present in the study area.

The final EJ Study report documenting methods and results of the completed study is included in **Appendix F**. All stakeholder consultation documentation for the EJ Study since the time of RSP filing is also provided in **Appendix F**.

2.6.2 Methods Summary

The EJ Study goal was accomplished by identifying the presence of EJ communities that may be present within the study area, presence of non-English speaking populations that may be present within the study area, and sensitive receptor locations in the study area. The geographic scope includes all areas within one mile of the proposed expanded Bad Creek Project boundary and within five miles of the proposed construction of Bad Creek II Complex. An additional objective included identifying outreach strategies to engage EJ communities and non-English speaking populations in the relicensing if present within the study area. However, as discussed below, the need for additional outreach efforts beyond those currently being employed by Duke Energy as part of the relicensing process were not identified due to the distance between identified EJ communities and the potential for project-related impacts.

Potential effects and mitigation measures to avoid or minimize Project effects on EJ communities, non-English speaking communities, and sensitive receptor locations were identified and are discussed in **Appendix F**.

2.6.3 Results Summary

Using the meaningfully greater analysis method, one EJ community based on race was identified out of the thirteen census block groups within the scope of this study. Located in Transylvania County, North Carolina, the one race-related EJ community is primarily within the 5-mile buffer zone around the Project, with the southwestern portion located within the 1-mile buffer. Two EJ communities were identified based on income below poverty level, measured by household: one in Oconee County, South Carolina, and one in Transylvania County, North Carolina, both of which are located within the 5-mile buffer zone. None of the identified EJ communities are in block groups that border Project lands. Within the thirteen block groups in the study area, one block group includes a population of non-English speaking individuals. This block group is located in Pickens County, South Carolina, with one percent of the population unable to speak English. No sensitive receptor locations are present within the 1-mile radius surrounding the proposed expanded Project boundary. Within the 5-mile radius around the proposed expanded Project boundary there are two sensitive receptor locations: two schools, located within the 5-mile radius, on the southwestern extremity of the potentially effected zone. Details and locations of each are included in **Appendix F**.

2.6.4 Study Status

The EJ Study is complete and the final technical report, which has undergone Environmental Justice Resources Resource Committee review, is included in **Appendix F**.

2.6.5 Variances from FERC-Approved Study Plan

To date, the EJ Study has been conducted in accordance with the FERC-approved RSP. Expansion of the study area to accommodate potential impacts of the temporary Fisher Knob access road was not required because this area was already encompassed within the buffer areas used for this study.

3 Upcoming ILP Milestones and Study Reporting

Table 4 presents upcoming ILP milestones.

Table 4. Upcoming Major ILP Milestones

Milestone	Date
ISR Meeting (18 CFR §5.15(c)(2))	Jan 17, 2024
File ISR Meeting Summary (18 CFR §5.15(c)(3))	Feb 1, 2024
Comments on ISR Meeting and Additional or Modified Study Requests (18 CFR §5.15(c)(4))	Mar 1, 2024
File Response to Comments on ISR and Meeting Summary (18 CFR §5.15(c)(5))	Apr 1, 2024
Resolution of Meeting Summary Disagreements and Issue Amended Study Plan Determination (if required) (18 CFR §5.15(c)(6))	May 1, 2024
Conduct Second Season of Studies (if necessary)	Spring-Fall 2024
Deadline to File Updated Study Report (USR) (18 CFR §5.15(f))	Jan 3, 2025
Deadline to Conduct USR Meeting (18 CFR §5.15(f))	Jan 18, 2025
File USR Meeting Summary (18 CFR §5.15(f))	Feb 3, 2025
Deadline to File Preliminary Licensing Proposal (PLP) or Draft License Application (DLA) (18 CFR §5.16(a))	March 3, 2025
File Comments or Disagreements on USR Meeting Summary (18 CFR §5.15(f))	Mar 4, 2025
File Response to Comments on USR Meeting Summary (18 CFR §5.15(f))	Apr 3, 2025
Resolution of USR Meeting Summary Dispute (if necessary) (18 CFR §5.15(f))	May 1, 2025
Comments on PLP or DLA (18 CFR §5.16(e))	June 2, 2025
Deadline to file FLA (18 CFR §5.17)	July 31, 2025
Publish Public Notice of FLA Filing (18 CFR §5.17(d)(2))	August 13, 2025

4 Notice of Intent to File Draft License Application

As required by 18 CFR §5.16(c), Duke Energy hereby advises the Commission of its intent to file a Draft License Application, which will include the contents of a license application, rather than a Preliminary Licensing Proposal. The draft license application will be filed no later than March 3, 2025.

5 References

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Attachment 1

Attachment 1 – Study Plan Determination

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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
January 4, 2023

OFFICE OF ENERGY PROJECTS

Project No. 2740-053–South Carolina
Bad Creek Pumped Storage Project
Duke Energy Carolinas, LLC

Via FERC Service

Alan Stuart
Duke Energy Carolinas, LLC
Mail Code EC-12Q
526 S. Church Street
Charlotte, NC 28202

Reference: Study Plan Determination for the Bad Creek Pumped Storage Project, and the Potential Bad Creek II Complex

Dear Mr. Stuart:

Pursuant to 18 C.F.R. § 5.13(c) of the Commission's regulations, this letter contains the study plan determination for the Bad Creek Pumped Storage Project No. 2740 (Bad Creek Project) located in Oconee County, South Carolina, including the potential addition of a new powerhouse and facilities (Bad Creek II Complex or Complex) to be located adjacent to the existing powerhouse. The determination is based on the study criteria set forth in section 5.9(b) of the Commission's regulations, applicable law, Commission policy and practice, and the record of information.

Background

On August 5, 2022, Duke Energy Carolinas, LLC (Duke Energy) filed a proposed study plan (PSP) for six studies in support of its intent to relicense the project. The PSP addresses studies on: (1) water resources; (2) aquatic resources; (3) visual resources; (4) recreational resources; (5) cultural resources; and (6) environmental justice.

Duke Energy held a Study Plan Meeting to discuss its PSP on September 7, 2022. Comments on the PSP were filed by the Foothills Trail Conservancy, Upstate Forever, South Carolina Department of Natural Resources (South Carolina DNR), and Commission staff.

On December 5, 2022, Duke Energy filed a Revised Study Plan (RSP). Comments on the RSP were filed by the Foothills Trail Conservancy, Friends of Lake Keowee, and Upstate Forever.

General Comments

A number of the comments on the RSP do not directly address study issues. For example, several of the comments: (1) express general concerns associated with water quality, flows, and aquatic habitat conditions; (2) recommend environmental protection, mitigation, or enhancement (PM&E) measures for the Foothills Trail; or (3) request PM&E measures to address potential impacts associated with Duke Energy's construction and operation of the Bad Creek II Complex. This determination does not address such comments, but rather addresses comments specific to the merits of the proposed studies submitted pursuant to section 5.13 of the Commission's regulations and comments received thereon.

Study Plan Determination

Duke Energy's RSP is approved, with the staff-recommended modifications discussed in Appendix B. As indicated in Appendix A, of the six studies proposed by Duke, five studies are approved as filed and one is approved with modifications.

Appendix B explains the specific modifications to the study plan and the bases for modifying the proposed studies. Although Commission staff considered all study plan criteria in section 5.9 of the Commission's regulations, staff only reference the specific study criteria that are particularly relevant to the determination. Unless otherwise indicated, all components of the approved studies not modified in this determination must be completed as described in Duke Energy's RSP.

Pursuant to section 5.15(c)(1) of the Commission's regulations, the Initial Study Report for all studies in the approved study plan must be filed by January 4, 2024. As required by the Commission's regulations, Duke Energy must hold an Initial Study Report Meeting within 15 days of the filing of their Initial Study Report.

Nothing in this study plan determination is intended, in any way, to limit any agency's proper exercise of its independent statutory authority to require additional studies. In addition, Duke Energy may choose to conduct any study not specifically required herein that it feels would add pertinent information to the record.

If you have any questions, please contact Joshua Dub at joshua.dub@ferc.gov, or (202) 502-8138.

Sincerely,

for
Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of studies subject to this determination
Appendix B – Staff's recommendations on proposed studies

APPENDIX A

SUMMARY OF DETERMINATIONS ON PROPOSED STUDIES

Study	Recommending Entity	Approved	Approved with Modifications	Not Required
Water Resources	Duke Energy	X		
Aquatic Resources	Duke Energy	X		
Visual Resources	Duke Energy	X		
Recreation Resources	Duke Energy		X	
Cultural Resources	Duke Energy	X		
Environmental Justice	Commission staff, Duke Energy	X		

APPENDIX B

STAFF'S RECOMMENDATIONS ON PROPOSED STUDIES

The following discusses staff's recommendations on studies proposed by Duke Energy Carolinas, LLC (Duke Energy). The recommendations are based on the study criteria outlined in the Commission's regulations [18 C.F.R. section 5.9(b)(1)-(7)]. Except as explained below, the Revised Study Plan (RSP), filed on December 5, 2022, adequately addresses all study needs at this time.

I. Required Studies

Water Resources Study

Applicant's Proposed Study

Duke Energy proposes to conduct a Water Resources Study to evaluate the effects of current project operation, and the construction and operation of the proposed Bad Creek II Complex (Complex), on water resources and water quality within the project area. The objectives of the Water Resources Study are to: (1) conduct a literature review of existing water quality data for Lake Jocassee and Howard Creek, and identify applicable water quality standards; (2) develop a Water Quality Monitoring Plan that encompasses pre-construction, construction, and post-construction activities, and includes identification of methods for monitoring water quality and threshold values for water quality parameters; (3) use a two-dimensional hydrologic model to evaluate the downstream extent of effects (*i.e.,* vertical/horizontal mixing in Lake Jocassee) resulting from the operation of the Complex; (4) use a three-dimensional computational fluid dynamics model to: (a) evaluate water velocities and shoreline erosion in the Whitewater River arm of Lake Jocassee resulting from the operation of the Complex; and (b) evaluate the extent of vertical mixing that would occur in the Whitewater River arm and downstream of the submerged weir resulting from the operation of the Complex; (5) use the existing Computer Hydro-Electric Operations and Planning Software (CHEOPS) model to evaluate the effects of the operation of the Complex (*i.e.,* changes to water exchange rates, magnitude, and duration of flows between Bad Creek Reservoir and Lake Jocassee) on Lake Jocassee's water surface elevation; and (6) gather information related to the effects of Duke Energy's potential spoils disposal locations (*i.e.,* associated with the construction of the Complex) on streams and/or wetlands in support of Clean Water Act permitting.

Water Resources Study Plan

Comments on the Study

In its comments on the RSP, Upstate Forever states that stakeholders cannot assess Duke Energy's proposal to use existing water quality data to evaluate the effects of the construction and operation of the Complex because the referenced water quality data has not been provided or summarized in the pre-application document (PAD) or study plan documents. Upstate Forever requests that the existing water quality data be included or summarized in the Water Resources Study Plan for stakeholders to review.

Discussion and Staff's Recommendation

Duke Energy included an overview of the existing water quality data in its PAD and proposes, as part of the Water Resources Study Plan, to include a more detailed summary of historical water quality data with the initial study report (ISR) at the end of the first year of study. In addition, Duke Energy proposes collection, and inclusion in the ISR, of new water quality data and detailed modeling results, particularly focusing on issues potentially affecting high value fish habitat in the Whitewater River arm of Lake Jocassee. The Integrated Licensing Process (ILP) regulations include procedures for stakeholder review and comment on the study results presented in the ISR and for requesting study modifications based in part on the results of the first year of studies [sections 5.15(d) and 5.15(e)]. Given that the data that will be available for stakeholder review after the first study season, and the opportunity for stakeholder review and comment on the ISR, we recommended no additional data summary or collection of data beyond what Duke Energy proposes in its RSP [sections 5.9(b)(4) and 5.9(b)(7)].

Effects Of Climate Change On Water Resources

Comments on the Study

Upstate Forever states that South Carolina has seen a dramatic increase in the frequency and intensity of extreme weather events over the past several decades, including flooding and droughts. Upstate Forever contends that these weather events could have noticeable impacts on lake levels, and operation of the Bad Creek Project and downstream facilities. Upstate Forever requests that Duke Energy assess climate-related impacts to water resources and project operations as part of the Water Resources Study Plan.

Discussion and Staff's Recommendation

Duke Energy proposes to include a discussion of recent climate data, trends, and patterns and potential related impacts to the project in the Final License Application (FLA) which should provide information for staff's analysis of project-related and cumulative effects on water resources. Further, as part of the 2016 relicensing of the Keowee-Toxaway Hydroelectric Project (FERC Project No. 2503), and in support of a 2014 New Operating Agreement (NOA) between Duke Energy, the U.S. Army Corps of Engineers, and Southeastern Power Administration, Duke Energy developed operational models (including the CHEOPS model) to evaluate the effects of future climate change scenarios (*i.e.,* temperature increases, basin inflow reduction, extended drought, and water withdrawal demands) on project operations and aquatic resources in the Savannah River Basin (Basin). Because the proposed operating range of the Bad Creek Project, including the Complex, if pursued, is consistent with the operating range evaluated during the previous climate change analysis within the Basin, it should be sufficient to meet the information need described by Upstate Forever [section 5.9(b)(4) and section 5.9(b)(7)]. Therefore, we do not recommend a new, expanded evaluation of the potential effects of climate change as part of the Water Resources Study. However, we recommend that Duke Energy include a discussion of the climate data, trends, and patterns mentioned above. We also recommend that Duke Energy include the studies[1] supporting the climate change analysis in the Keowee-Toxaway Hydroelectric Project No. 2503 relicensing and the Savannah River NOA as appendices to the Bad Creek Project FLA.

Recreation Resources Study

Applicant's Proposed Study

Duke Energy proposes a Recreation Resources Study with four main components: (1) a Recreation Use and Needs (RUN) Study; (2) a Foothills Trail Corridor Conditions Assessment (Conditions Assessment) of the 43-mile-long portion of the Foothills Trail managed by Duke Energy; (3) an Existing Recreational Use Characterization; and (4) a Recreational Public Safety Evaluation of Whitewater River Cove. Duke Energy proposes

[1] Including but not necessarily limited to: (1) Appendix E6, *Final Study Reports*, Keowee-Toxaway Hydroelectric Project No. 2503 Final License Application, 2014; and (2) Final Environmental Assessment, New Operating Agreement between U.S. Army Corps of Engineers, Southeastern Power Administration, and Duke Energy Carolinas, LLC, 2014.

to use the study to identify enhancement measures, if needed, to meet current or future demand.

The goals of the RUN Study are to assess current recreation use and identify any future recreation needs along the 43-mile segment of the Foothills Trail and associated access areas that are maintained by Duke Energy and referenced in the existing Recreation Plan for the project.[2] The data collected during the RUN Study and Conditions Assessment will be used to estimate the Foothills Trail's hiking and backpacking carrying capacity[3] and develop an updated Recreation Management Plan (RMP), as needed, for the term of any new license issued, which would support characterization of existing recreational use levels for areas that could be temporarily impacted by the Complex construction. An outline of the RMP for the project will be provided with the Preliminary Licensing Proposal (PLP) or Draft License Application (DLA) for stakeholder and Commission staff review

The goal of the Conditions Assessment is to evaluate the current condition of the trail surface and corridor included in the 43-mile segment and identify key areas of future maintenance needs or improvements. The goal of the Whitewater River Cove Existing Recreational Use Characterization is to characterize recreation use in Whitewater River Cove and assess the level of boating use disruption that could occur associated with construction of the Complex. The goal of the Recreational Public Safety Evaluation is to evaluate potential public safety risks, specifically those associated with recreation activities at or near Whitewater River Cove, which may result from, or be exacerbated by, the Complex during the construction and operation phases.

Future Recreation Use Analysis

Comments on the Study

The Foothills Trail Conservancy (FTC) filed recommendations related to the Recreation Resources Study Plan. FTC states that, in response to comments (on the PSP), Duke Energy indicated that it would expand the number of counties analyzed as part of the study. However, FTC states that in Section 6.1.6 of Appendix F of the RSP

[2] Duke Energy filed a copy of the 1980 Recreation Plan on July 25, 2022, in response to additional information requested by Commission staff on June 16, 2022.

[3] In the context of recreation use, carrying capacity generally refers to the maximum number of visits or visitors that can be accommodated in a park or related area, such as a trail.

the list of counties included remains unchanged and continues to be limited to only four rural counties.[4]

Discussion and Staff Recommendation

Although, Duke Energy agrees to expand the counties that would be surveyed in response to comments on its PSP, it appears that Duke Energy did not update the list of counties in Appendix F of the RSP. Therefore, for clarity, we recommend that Duke Energy modify Appendix F to include the additional counties that Duke Energy agreed to include in the survey.

User Surveys

Comments on the Study

FTC asserts that the proposed Recreation Study survey methodologies would not provide adequate information to comprehensively evaluate trail usage. To enhance in-person surveys, FTC requests that Duke Energy conduct in-person surveys during anticipated peak usage days and times. To address concerns that cellular phone service may not be available to access the online survey via the proposed quick response (QR) code method at remote locations of the Foothills Trail, FTC recommends that Duke Energy provide a web site in addition to a QR code to access the user survey.

Discussion and Staff Recommendation

Duke Energy has proposed to collect in-person surveys on a mix of 30 weekdays, weekend days, and holidays from March through November in 4-hour shifts occurring between 8:00 am and 8:00 pm. As proposed, this approach is more robust than many generally accepted survey methodologies and likely would include adequate peak usage periods [section 5.9(b)(6)]. Therefore, we do not recommend a change to Section 6.1.3, *User Surveys* to add more in-person surveys during anticipated peak usage periods. Regarding FTC's request for a web site address for the online survey, posting the web site address alongside the QR code on the online survey signs would provide stakeholders an option to make note of the web address and complete the user survey when they have adequate cellular coverage or at their convenience, from a computer. This low-cost modification to the methods of this study could allow for more stakeholders to participate in the user survey [section 5.9(b)(7)] should it prove difficult for stakeholders to use the QR code.

[4] Oconee and Pickens counties, SC and Jackson and Transylvania counties, NC.

Trailer Parking

Comments on the Study

In response to the RSP, FTC filed comments regarding the assessment of parking demand. Specifically, FTC states that during the hunting season, Horsepasture Road ATV (all-terrain vehicle) users who park a vehicle with a trailer at the Laurel gap parking area take up more than one parking space, limiting the number of users able to park there. Therefore, FTC recommends that Duke Energy's study consider the extra demand placed on the Laurel Fork Gap parking area during hunting season due to users parking vehicles with trailers.

Discussion and Staff Recommendation

Adding a traffic counter at the Laurel Fork Gap parking area would provide a more comprehensive analysis of parking demand, including identification of any future enhancement measures needed at this site as a result of trailer parking. Therefore, given the relative low cost and modest effort involved in collecting this information [section 5.9(b)(7)], we recommend adding a traffic counter during hunting season at the Laurel Fork Gap parking area.[5]

Recreation Site Inventory Form

Comments on the Study

In comments on the RSP, FTC reiterates the importance of incorporating each of its eight recommendations, relating to the Recreation Site Inventory Form made in comments on the PSP. Specifically, FTC recommends collecting information on the site's: (1) address; (2) road access; (3) parking spaces; (4) shoreline access conditions; (5) campsites; (6) operations; (7) non-campsite infrastructure; and (8) impacts and issues. In the RSP, Duke Energy states that it will add recommendations 1 through 3 and 6 to the form. Duke Energy notes that information on shoreline access conditions (recommendation 4) will be collected during the Conditions Assessment. Duke Energy partially adopts the addition of campsite information (recommendation 5). Duke Energy does not add the non-campsite information (recommendation 7), because it already includes non-campsite infrastructure on the form. Duke Energy does not propose to add

[5] Pneumatic traffic counters are widely used to count vehicles, and can be calibrated to count multiple axles as one vehicle. *See* Methods for visitor monitoring in recreational and protected areas: An overview, Muhar, Amberger, and Brandenburg, 2002.

questions on impacts and issues (recommendation 8) because it already includes a space on the form to indicate if major repairs are needed.

In answer to Duke Energy's response to stakeholder comments on the PSP, FTC states that, while the Conditions Assessment may provide information related to shoreline access condition, obtaining additional information from trail users would provide a more comprehensive understanding of how well the trail infrastructure is serving the needs of trail users. FTC adds that including such information in the Recreation Site Inventory Form could help identify significant changes in routing needs or infrastructure conditions that may result from fire, storms, *etc.*, in a timely manner.

Discussion and Staff Recommendation

Duke Energy revised the Recreation Site Inventory Form in its RSP to incorporate some of FTC's recommendations which should adequately capture important data from respondents regarding the condition of recreation facilities [section 5.9(b)(4)]. Therefore, we do not recommend including FTC's additions to the Recreation Site Inventory Form. In the specific case of the campsite information, (recommendation 5), although Duke Energy proposes to add the number and height of bear cables and the number of latrines to the Recreation Site Inventory Form in response to stakeholder comments on the PSP, this information was not included on the Recreation Site Inventory Form submitted with the RSP. Therefore, we recommend that Duke Energy add an entry to collect this information on the form. Including this item on the form would help Duke Energy to collect valuable information about how the adequacy of trail amenities [sections 5.9(b)(6) and 5.9(b)(7)].

Foothills Corridor Conditions Assessment

Comments on the Study

FTC requests that it be present when Duke Energy's proposed, independent, third-party consultant conducts the Conditions Assessment. FTC states that it has in-depth knowledge and unique insight about the Foothills Trail that will enhance the evaluations. FTC also asserts that allowing FTC representation during the Conditions Assessment would ensure FTC members fully understand the results of the evaluation and are more informed and better prepared should trail maintenance responsibilities be transferred to FTC in the future. FTC also requests that detailed information be recorded in the Conditions Assessment, including photo documentation, for all human-made features. Finally, FTC states that the Foothills Trail includes both single track trail segments and logging and access roads, and that Duke Energy's proposal to focus only on the single track trail segments could exclude 14.8 miles of the Foothills Trail from being assessed

during the Conditions Assessment. Duke Energy did not respond to this comment on the RSP.

Discussion and Staff Recommendation

While having FTC representatives present during the evaluation could have collaborative value, there would be logistical issues that could increase the cost and effort involved in conducting the study with an unclear known benefit. The complete study results, including photo documentation of structures in need of significant maintenance or replacement, will be presented in the ISR, which stakeholders will have the opportunity to review and comment upon. Therefore, we do not recommend requiring that FTC members be present during all Conditions Assessment tasks as a requirement of the Recreation Resources Study. The request for more detailed information regarding the Conditions Assessment is already addressed by Duke Energy's proposal to identify and record information about structures in the trail corridor, including collecting geospatial coordinates for each site [section 5.9(b)(4)]. Regarding the portions of the trail following logging and access roads, Duke Energy has committed in its overall Recreation Study Plan to assess the entire 43 miles of the Foothills Trail that it is required to maintain under its current license. Making it clear that these trail segments are included in the Conditions Assessment would ensure that the study is comprehensive, because it would be certain to include the entire 43 miles of trail, rather than just the 28.2 miles of single track trail segments. Therefore, we recommend that Duke Energy include the 14.8 miles of trail that follow logging and access roads in the Conditions Assessment [section 5.9(b)(6)].

Study Area

Comments on the Study

FTC recommends minor changes to improve clarity in the Study Area section of the proposed RUN Study. FTC states that, as worded, the study area could exclude the Bad Creek Parking Access area and Bad Creek Road. FTC recommends that Figure 3-2 include detail boxes and labels for all spur trails (including Hilliard Falls and Laurel Fork Falls) within the 43-mile portion of trail to be studied by Duke Energy. FTC also states that that the location of access areas and at least one map label were removed in revisions to Figure 3-3 between the PSP and RSP and should be restored.

Discussion and Staff Recommendation

Adding all spur trails within the 43-mile portion of trail to be studied by Duke Energy to the RUN Study and Figure 3-2, as well as restoring the infrastructure items previously included in labels in the PSP RUN Study Figure 3-3, would ensure that

information on the Bad Creek Parking Access area, Bad Creek Road, and other access points is included in the ISR [section 5.9(b)(4)]. Therefore, we recommend that the RUN study, as represented in Figure 3-2 and Figure 3-3 of Appendix F3, *Study Area,* of the proposed RUN Study include detail boxes and labels for all spur trails within the 43-mile portion of trail to be studied by Duke Energy.

Trail Carrying Capacity

Comments on the Study

FTC recommends that the carrying capacity of the Foothills Trail be evaluated, including identifying major issues or concerns that could limit carrying capacity. FTC states that it is important to estimate how much recreational use can be accommodated while sustaining the natural resources and high-quality experiences.

Discussion and Staff Recommendation

Duke Energy's methodology for the overall Recreation Study is consistent with generally accepted practice in the scientific community but adding detail on the carrying capacity analysis would produce more interpretable study results. The discussion should describe a standard carrying capacity methodology that typically involves a desired condition (*e.g.,* what level of crowding should be allowed), indicator variables (*e.g.*, number of people on trails, number of large parties of people, number of fire rings, *etc.*) to be used to support the desired condition. Duke Energy should describe the standards used to define the minimum acceptable values of the indicator variables used to estimate the trail's carrying capacity. The carrying capacity analysis could integrate the results of the RUN Study and inform development of PM&Es for the project [sections 5.9(b)(3), 5.9(b)(6), and 5.9(b)(7)].

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Attachment 2

Attachment 2 – ILP Study Progress Reports

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WATER STRATEGY AND HYDRO LICENSING

Duke Energy Corporation
Regulated and Renewable Energy
526 South Church Street / EC12Q
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March 30, 2023

Electronically Filed

The Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street N.E.
Washington, DC 20426

Subject: **Bad Creek Pumped Storage Project (P-2740-053)**
Relicensing Study Progress Report No. 1

Dear Secretary Bose:

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

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 (i.e., 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 Commission approved the RSP with modifications on January 4, 2023.

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.

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. 1
March 30, 2023

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 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 provides the following clarifications regarding the Discussion and Staff Recommendations included in the Study Plan Determination (SPD):

- 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. As stated in the RSP, Duke Energy will include Oconee and Pickens counties, SC and Jackson and Transylvania counties, NC and any counties in SC, NC, and GA that are reported on the recreation user surveys. Since recreation user surveys have not been completed yet, Duke Energy is unable to list what counties will be reported at this time.
- FERC recommended that Duke Energy include the 14.8 miles of trail that follow logging and access roads in the Conditions Assessment. As stated in the RSP, Duke Energy will include the entire 43 miles of trail, including 28.2 miles of singletrack trail segments and

[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.

14.8 miles of trail that follow logging and access roads, in the Conditions Assessment. Although the Trail Solutions guide on building singletrack will be used as a base for trail condition analysis, this will not exclude non-singletrack trail segments from analysis.

- FERC recommended that the 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. In addition, as stated in the RSP, two traffic counters will be installed at the Bad Creek Hydro Project Trail Access (i.e., Bad Creek Parking Access Area and Bad Creek Road) and user surveys will be 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 Recreation Resource Committee Meeting on March 28, 2023 to discuss the carrying capacity methodology with Jeremy Wimpey of Applied Trails Research in attendance.

The following sections summarize progress implementing the relicensing studies as of March 15, 2023.

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**: Historical Lake Jocassee and Howard Creek water quality data collected by Duke Energy and Clemson University are being compiled and summarized.
- **Water Quality Monitoring in the Whitewater River Arm**: Data collection for the first field season will begin in June 2023 and extend through September 2023.
- **Computational Fluid Dynamics (CFD) Modeling of Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse:** Velocity effects and vertical mixing will be evaluated by first developing a 2-dimensional hydraulic model to determine the boundaries of the velocity effects. The effort to develop the 2D model has been initiated by Duke Energy. Once the boundaries of the velocity effects have been determined, a CFD model will be developed for that portion of Lake Jocassee potentially affected by a second discharge. The CFD output will be used to evaluate the potential effects of Bad Creek II

operation on stratification in Lake Jocassee. Initial model output is projected to be available in third quarter 2023.

- **CHEOPS Modeling of Water Exchange Rates and Lake Jocassee Reservoir Levels:** The CHEOPS model will be used to evaluate potential effects of Bad Creek II on the frequency, timing, and range of Lake Jocassee reservoir level fluctuations. Initial model results are anticipated to be available in the third quarter of 2023.
- **Future Water Quality Management Plan (WQMP) Development:** Work to develop the WQMP will begin in 2024 after the other Water Resources Study components are complete and additional information is available regarding the construction of a second powerhouse. The WQMP, which will be developed in consultation with the Water Resources, Aquatic Resources, and Wildlife and Botanical Resources Resource Committees (RCs), will likely not be included in the final Water Resources Study. Duke Energy anticipates the WQMP will be developed as a separate standalone management plan and included in the Draft and/or Final License Application.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

4.0 AQUATIC RESOURCES STUDY

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

- **Entrainment:** The previously completed desktop entrainment study has been updated based on stakeholder comments received since the filing of the Pre-Application Document. It will be provided directly to Aquatic Resources RC members and discussed during the spring 2023. A meeting has been scheduled with the Aquatics Resource Committee on April 6, 2023 to discuss the study results. The final report will be provided to the RC members during the fourth quarter of 2023.
- **Desktop Studies on Pelagic and Littoral Habitat Effects:** 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.

- **Mussel Surveys and Stream Habitat Quality Surveys:** Fieldwork for the surveys will begin in July 2023 to evaluate construction of the Bad Creek II Complex.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

5.0 VISUAL RESOURCES STUDY

Preliminary work has begun to develop the existing landscape description and to build the viewshed model that will be used for the Seen Area Analysis. As communicated during the Joint RC meeting in February 2023, Duke Energy plans to work with Recreation & Visual Resources RC members during the summer of 2023 to identify Key Views. Photographs will be taken from the Key Views in November 2023 during leaf-off conditions.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

6.0 RECREATIONAL RESOURCES STUDY

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

- **Foothills Trail Recreation Use and Needs (RUN) Study**: Data collection began in September 2022 with a break in February 2023. Data collection is on-going and scheduled to continue through November 2023.
- **Foothills Trail Condition Assessment**: Duke Energy has retained a consultant to complete the evaluation. Fieldwork will begin in spring 2023. Duke Energy anticipates distributing a draft study report for Recreation RC review in the fourth quarter of 2023.
- **Whitewater River Cove Existing Recreational Use Evaluation**: Drone flights to capture recreational boating in the Whitewater River Cove will begin in May 2023. Duke Energy anticipates distributing a draft study report to Recreation Resources RC members in the fourth quarter of 2023.
- **Whitewater River Cove Recreation Public Safety Evaluation:** This effort will integrate the CFD modeling velocity data developed in the Water Resources Study with the Whitewater River Cove recreational use data captured during the 2023 boating season. The draft report will be distributed to Recreational Resources RC members in the spring 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 archaeological survey began in March and is scheduled to be complete by August 2023. Duke Energy anticipates the draft survey report will be distributed to the South Carolina State Historic Preservation Office, federally-recognized Indian Tribes, and other consulting parties in the fourth quarter of 2023.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

8.0 ENVIRONMENTAL JUSTICE STUDY

Data compilation and analysis of EJ communities has begun. Duke Energy anticipates distributing a draft study report to the Operations RC during the second quarter of 2023. Preliminary results indicate there may be no adverse effects to EJ communities, so the public outreach meeting included in the study plan may not be warranted. The need for such a meeting will be discussed with the Operations RC during the summer of 2023 in conjunction with its review of the draft study report.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

WATER STRATEGY AND HYDRO LICENSING

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June 28, 2023

Electronically Filed

The Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street N.E.
Washington, DC 20426

Subject: **Bad Creek Pumped Storage Project (P-2740-053)**
Relicensing Study Progress Report No. 2

Dear Secretary Bose:

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

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 (i.e., 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 Commission approved the RSP with modifications on January 4, 2023.

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.

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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Senior Project Manager
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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. 2

June 28, 2023

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 have not been completed yet, Duke Energy is unable to list what counties will be reported at this 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 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.

[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.

- FERC recommended that the 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.

The following sections summarize progress implementing the relicensing studies since Study Progress No. 1 was filed.

3.0 POTENTIAL TEMPORARY ACCESS ROAD

Duke Energy is evaluating the development of a temporary access road to the Fisher Knob community for use during Bad Creek II construction. The gravel service road would be approximately 3.7 miles long, primarily follow an existing unmaintained logging road on property owned by Duke Energy, and would only be maintained during construction of Bad Creek II. The current routes under consideration are shown on Figure 1.

The study areas for the Water Resources, Aquatic Resources, Visual Resources, and Cultural Resources studies have been modified to assess the potential effects of the temporary access road as further discussed below. In addition, Duke Energy will be conducting a natural resources assessment of the proposed route to identify potential terrestrial and aquatic resources requiring additional evaluation. The results of this assessment will be shared directly with the Wildlife and Botanical Resources RC.

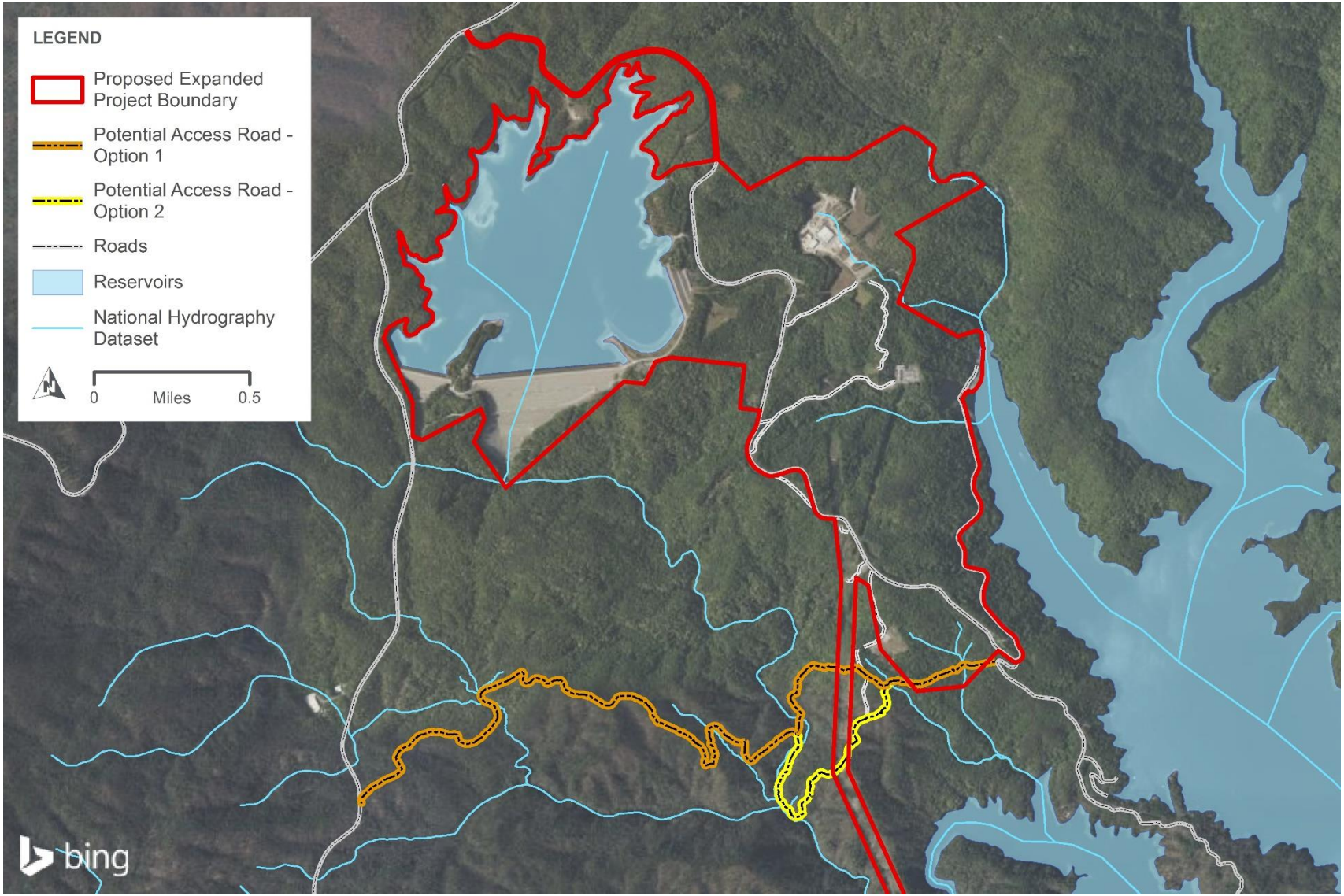

Figure 1. Potential Temporary Access Road

4.0 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**: Historical Lake Jocassee and Howard Creek water quality data collected by Duke Energy and Clemson University have been compiled and summarized. A virtual meeting was held on May 16 with the Water Resources Study RC to discuss findings of the existing water quality study effort; the draft report will be distributed to the Committee by June 30.
- **Water Quality Monitoring in the Whitewater River Arm**: Water quality instrumentation was deployed at three locations in the Whitewater River arm of Lake Jocassee, May 22-23, 2023. Data collection began in June 2023 and will extend through September 2023.
- **Computational Fluid Dynamics (CFD) Modeling of Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse:** Development of the 2D model to estimate the downstream boundary of velocity effects from the Project is complete, and Duke Energy is currently performing CFD model runs under various water level elevations and Project operational scenarios. Additional flow and temperature data will be collected in the Whitewater River cove to support model validation. Model output is projected to be available in third quarter 2023. A hybrid in-person/virtual meeting with the Water and Aquatic Resources RCs is scheduled for July 27, and the agenda for this meeting includes an update by Duke Energy on the CFD model development and results.
- **CHEOPS Modeling of Water Exchange Rates and Lake Jocassee Reservoir Levels:** The CHEOPS model will be used to evaluate potential effects of Bad Creek II on the frequency, timing, and range of Lake Jocassee reservoir level fluctuations. Generation and pumping dispatch curves are being updated for the model and work has begun to develop performance measures. Initial model results are anticipated to be available in the third quarter of 2023. As noted above, Duke Energy will provide an update on CHEOPS modeling activities to the relevant RCs at the upcoming July 27 meeting.
- **Future Water Quality Management Plan (WQMP) Development:** Work to develop the WQMP will begin in 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 (Figure 1). Potential water quality effects associated with the temporary access road would be addressed in the WQMP.

5.0 AQUATIC RESOURCES STUDY

The Aquatic Resources RC met on April 6, 2023. During that meeting, Duke Energy was asked to modify the methodology for the desktop entrainment study and mussel and stream habitat quality surveys.

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

- **Entrainment:** The updated desktop entrainment study report was provided to Aquatic Resources RC members and discussed at an Entrainment Consultation Meeting held with the Aquatic Resources RC on April 6, 2023. The outcome of this meeting was to update the entrainment analysis to include additional factors such as historical operations data, influence of operations with the addition of solar usage, pumping periods (2, 4, 6, 8, 10, and 12 hours), time period (day versus night), lake levels, and water temperature. The final report will be provided to the RC members during the fourth quarter of 2023.
- **Desktop Studies on Pelagic and Littoral Habitat Effects:** 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 4.0 for an update on the CFD and CHEOPS modeling.
- **Mussel Surveys and Stream Habitat Quality Surveys:** Fieldwork for the surveys will begin in July 2023 to evaluate construction of the Bad Creek II Complex. In accordance with the approved study plan, stream habitat assessments for streams in potential upland spoil locations will be completed with the U.S. Environmental Protection Agency Rapid Bioassessment Protocol (USEPA RBP) Stream Habitat Assessment data form. The North Carolina Stream Assessment Method (NCSAM) will also be completed to provide additional information regarding stream quality and function. Duke Energy is currently consulting with the South Carolina Department of Natural Resources (SCDNR; calls held

on May 24 and June 21, 2023) regarding stream surveys for waters crossed by the potential temporary access road described in Section 3.0 and the spoil disposal areas.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan. The methodology for stream habitat and biological assessments for streams crossed by the temporary access road and spoil areas is currently under development in consultation with the SCDNR.

6.0 VISUAL RESOURCES STUDY

The viewshed model has been developed. Duke Energy has scheduled a July meeting with the Recreational Resources RC to identify potential Key Views. Photographs will be taken from the Key Views in November 2023 during leaf-off conditions.

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.

7.0 RECREATIONAL RESOURCES STUDY

The Recreational Resources RC met on March 28, 2023, to discuss the Recreational Resources Study methodology and schedule. The components of the Recreational Resources Study and status of each are provided below:

- **Foothills Trail Recreation Use and Needs (RUN) Study**: Data were collected at Musterground Road between September 2022 and mid-January 2023, and again between March 20 and May 10, 2023. Data collection at the other access areas began in March 2023 and is scheduled to continue through November 2023.
- **Foothills Trail Condition Assessment**: Fieldwork began in May 2023. Duke Energy anticipates distributing a draft study report for Recreation RC review in the fourth quarter of 2023.
- **Whitewater River Cove Existing Recreational Use Evaluation**: Drone flights to capture recreational boating in the Whitewater River cove began Memorial Day weekend. Duke Energy anticipates distributing a draft study report to Recreational Resources RC members in the fourth quarter of 2023.
- **Whitewater River Cove Recreation Public Safety Evaluation:** This effort will integrate the CFD modeling velocity data developed in the Water Resources Study with the

Whitewater River cove recreational use data captured during the 2023 boating season. The draft report will be distributed to Recreational Resources RC members in the spring 2024.

Variance from Approved Study Plan

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

8.0 CULTURAL RESOURCES STUDY

The archaeological survey began in March and is scheduled to be complete by August 2023. Duke Energy anticipates the draft survey report will be distributed to the South Carolina State Historic Preservation Office, federally-recognized Indian Tribes, and other consulting parties in the fourth quarter of 2023.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan except the geographic scope of the study area has been expanded to encompass the proposed temporary access road (Figure 1). Duke Energy will be consulting with the South Carolina State Historic Preservation Office (SCSHPO) and Tribes to formally document the change to the Area of Potential Effect, as originally conveyed via letter dated December 9, 2022.

9.0 ENVIRONMENTAL JUSTICE STUDY

Duke Energy distributed the draft study report to the Operations RC on June 6, 2023. The report identified Environmental Justice (EJ) communities within the 5-mile buffer area. However, results indicate there may be no adverse effects to EJ communities, so the public outreach meeting included in the study plan may not be warranted. The need for such a meeting will be discussed with the Operations RC during the summer of 2023 in conjunction with its review of the draft study report.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan.

WATER STRATEGY AND HYDRO LICENSING

Duke Energy Corporation
Regulated and Renewable Energy
526 South Church Street / EC12Q
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September 27, 2023

Electronically Filed

The Honorable Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street N.E.
Washington, DC 20426

Subject: **Bad Creek Pumped Storage Project (P-2740-053)**
Relicensing Study Progress Report No. 3

Dear Secretary Bose:

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

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 (i.e., 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 Commission approved the RSP with modifications on January 4, 2023.

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.

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,

Alan Stuart
Senior Project Manager
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Duke Energy Carolinas, LLC

Enclosure

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

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Bad Creek Pumped Storage Project
Relicensing Study Progress Report No. 3
September 27, 2023

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 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.

[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.

- 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.

In its Study Progress Report No. 2, 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 were expanded to incorporate the areas potentially affected by the temporary road.

The following sections summarize progress implementing the relicensing studies since Study Progress Report No. 2 was filed.

3.0 WATER RESOURCES STUDY

The Water Resources RC and Aquatics Resources RC met jointly on July 27, 2023.

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

- **Summary of Existing Water Quality Data and Standards**: Historical Lake Jocassee and Howard Creek water quality data collected by Duke Energy and Clemson University have been compiled and summarized. The draft report was distributed to Water Resources RC members for their review on June 28, 2023, with comments due by August 28, 2023. Organizations that provided comments on the draft report include Friends of Lake Keowee Society (FOLKS) and Upstate Forever; U.S. Fish and Wildlife Service (USFWS). Advocates for Quality Development (AQD) reviewed the report but had no comments. Duke Energy addressed stakeholder comments in the final study report, which is provided in Attachment A.

- **Water Quality Monitoring in the Whitewater River Arm**: Water quality instrumentation was deployed at three locations in the Whitewater River arm of Lake Jocassee, May 22-23, 2023. Data collection began in June 2023 and will extend through September 2023. Duke Energy has made nine field visits to download dataloggers and collect water quality profile data (DO and temperature) since initial deployment. During three of these trips, water velocity at depth was measured with an acoustic Doppler current profiler (ADCP) across several transects in the Whitewater River arm to collect verification data for CFD model results.
- **Computational Fluid Dynamics (CFD) Modeling of Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse:** Development of the CFD model and model runs under various Lake Jocassee water level elevations and Project operational scenarios is complete. Model results were presented and discussed at the July 27, 2023, joint RC meeting; the draft report was provided to the Water Resources RC for review on September 11, 2023. Comments are due by October 11, 2023.
- **CHEOPS Modeling of Water Exchange Rates and Lake Jocassee Reservoir Levels:** The CHEOPS model will be used to evaluate potential effects of Bad Creek II on the frequency, timing, and range of Lake Jocassee reservoir level fluctuations. The Water Resources and Aquatics Resources RCs reviewed performance measures that will be used to evaluate model output at the joint RC meeting on July 27; a follow-up meeting (virtual) with the South Carolina Department of Natural Resources (SCDNR) was held on August 17 to further discuss performance measures. Duke Energy expects to schedule a follow-up meeting in October 2023 with the Joint RC to review model results. Following the meeting, Duke Energy will provide the report to the Water Resources and Operations RCs for a 30-day comment period.
- **Future Water Quality Management Plan (WQMP) Development:** Work to develop the WQMP will begin in 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 the temporary access road would be addressed in the WQMP.

4.0 AQUATIC RESOURCES STUDY

The Water Resources RC and Aquatics Resources RC met jointly on July 27, 2023.

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

- **Entrainment:** The desktop entrainment study report has been 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 will be provided to the RC members during the fourth quarter of 2023.
- **Desktop Studies on Pelagic and Littoral Habitat Effects:** 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.
- **Mussel Surveys and Stream Habitat Quality Surveys:** Mussel surveys were completed the week of July 24, 2023. In consultation with the SCDNR per their request, Duke Energy has refined the methodology for evaluating stream habitat and potential effects to stream function resulting from construction of a temporary access road by implementing the SCDNR Stream Quantification Tool (SQT). This tool includes assessments of stream hydrology, hydraulics, geomorphology, and biology. A summary of the approach to field studies related to the temporary access road and upland spoil locations is described in Attachment B. Stream habitat surveys at uplands spoil locations were completed September 11-13, 2023. Fish surveys in support of the SQT were completed in July and September 2023. A third and final fish survey will occur in October 2023. Habitat surveys for streams crossed by the temporary access road using the SCDNR SQT methodology will be completed in October 2023. Results of the mussel, fish, and stream habitat surveys will be summarized in a report to be shared with the Aquatic Resources RC in Q4 2023.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan except the study area has been expanded to include the temporary access road.

5.0 VISUAL RESOURCES STUDY

The Recreational Resources RC met on July 27, 2023, to discuss the Visual Resources Study and hear an update on the Recreational Resources Study.

The viewshed model has been developed. The Recreational Resources RC identified six potential Key Views during the July 27, 2023, meeting. Photographs will be taken from the Key Views in November 2023 during leaf-off conditions. The Recreational Resources RC will review the resulting photos and select four for use with the remaining visual resources study tasks.

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 Resources RC met on July 27, 2023, to discuss the Visual Resources Study and hear an update on the Recreational Resources Study.

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

- **Foothills Trail Recreation Use and Needs (RUN) Study**: Data were collected at Musterground Road between September 2022 and mid-January 2023, and again between March 20 and May 10, 2023. A traffic counter was reinstalled at Musterground Road in early September 2023 and will continue to collect data through mid-January 2024. Data collection at the other access areas began in March 2023 and is scheduled to continue through November 2023.
- **Foothills Trail Condition Assessment**: Fieldwork began in May 2023. Duke Energy anticipates distributing a draft study report for Recreation RC review in the fourth quarter of 2023.
- **Whitewater River Cove Existing Recreational Use Evaluation**: Drone flights to capture recreational boating in the Whitewater River cove began Memorial Day weekend and ended Labor Day. Duke Energy anticipates distributing a draft study report to Recreational Resources RC members in the fourth quarter of 2023.
- **Whitewater River Cove Recreation Public Safety Evaluation:** This effort will integrate the CFD modeling velocity data developed in the Water Resources Study with the

Whitewater River cove recreational use data captured during the 2023 boating season. The draft report will be distributed to Recreational Resources RC members in the spring 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 archaeological survey began in March and was completed in August 2023. Duke Energy consulted with the South Carolina State Historic Preservation Office (SCSHPO) and Tribes to modify the Area of Potential Effect (APE) to incorporate the temporary access road on September 25, 2023; concurrence from SCSHPO was received September 26, 2023.

Duke Energy anticipates the draft survey report will be distributed to the South Carolina State Historic Preservation Office, federally recognized Indian Tribes, and other consulting parties in the fourth quarter of 2023.

Variance from Approved Study Plan

The study is proceeding in accordance with the approved study plan except the geographic scope of the study area has been expanded to encompass the proposed temporary access road.

8.0 ENVIRONMENTAL JUSTICE STUDY

Duke Energy distributed the draft study report to the Operations RC on June 6, 2023, with comments due by July 6, 2023. The report identified Environmental Justice (EJ) communities within the 5-mile buffer area. Results indicate there would be no adverse effects to EJ communities associated with the relicensing of Bad Creek or construction of Bad Creek II, so the public outreach meeting included in the study plan is not warranted. No substantive comments were provided on the draft EJ report, so the report has been finalized and is included in Attachment C. No additional work is anticipated in association with the study.

Variance from Approved Study Plan

The study has been completed in accordance with the approved study plan.

9.0 WILDLIFE AND BOTANICAL UPDATE

The Wildlife and Botanical RC met (virtually) on July 31, 2023, to discuss updates regarding endangered species, the potential temporary access road, avian protection along the transmission

line corridor, and Clean Water Act permitting. A meeting summary was provided to the Wildlife and Botanical RC on August 14, 2023.

In consultation with the SCDNR, and in anticipation of information needed to support Clean Water Act permitting for Bad Creek II construction, Duke Energy also conducted herpetological surveys at potential spoil areas from September 11 to 13, 2023. Results will be summarized and shared with the Wildlife and Botanical RC.

Attachment A: Summary of Existing Water Quality Data and Standards

*The final **Summary of Existing Water Quality Data and Standards** report filed with this Progress Report on September 27, 2023 is available at Docket P-2740, Sub-Docket 053, Accession Number 0230927-5095 [https://elibrary.ferc.gov/eLibrary/docinfo?accession_number=20230927-5095].*

This report is also being filed with the ISR as Appendix A, Attachment 1

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Attachment B: Stream Assessment Methodology

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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.

[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.

North Carolina Stream Functional Assessment Team. 2013. N.C. Stream Assessment Method (NC SAM) Draft User Manual. Accessed June 2023. [URL]: https://www.saw.usace.army.mil/Portals/59/docs/regulatory/publicnotices/2013/NCSAM_Draft_User_Manual_130318.pdf

South Carolina Department of Health and Environmental Control. 2017. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling. Technical Report No. 0914-17. Bureau of Water. Columbia, South Carolina.

South Carolina Department of Natural Resources. 2022. Fish Sampling Guidance: Fish Collection Protocols for Streams. Accessed July 2023. [URL]: https://www.dnr.sc.gov/environmental/SCDNRSamplingProcedureFishes.pdf.

South Carolina Steering Committee. 2022. South Carolina Stream Quantification Tool: Data Collection and Analysis Manual, SC SQT v1.1. South Carolina Department of Natural Resources, Columbia, SC.

U.S. Environmental Protection Agency (USEPA). 2013. Technical Support Document for Conducting and Reviewing Freshwater Mussel Occurrence Surveys for the Development of Site-specific Water Quality Criteria for Ammonia. EPA 800-R-13-003. Office of Water. Washington, DC. Accessed June 2023. [URL]: https://www.epa.gov/sites/default/files/2015-08/documents/tsd_for_conducting_and_reviewing_freshwater_mussel_occurrence_surveys_for_the_development_of_site-specific_wqc_for_ammonia.pdf.

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Attachment 1

Attachment 1 – Streams and Wetlands within Potential Spoil Locations

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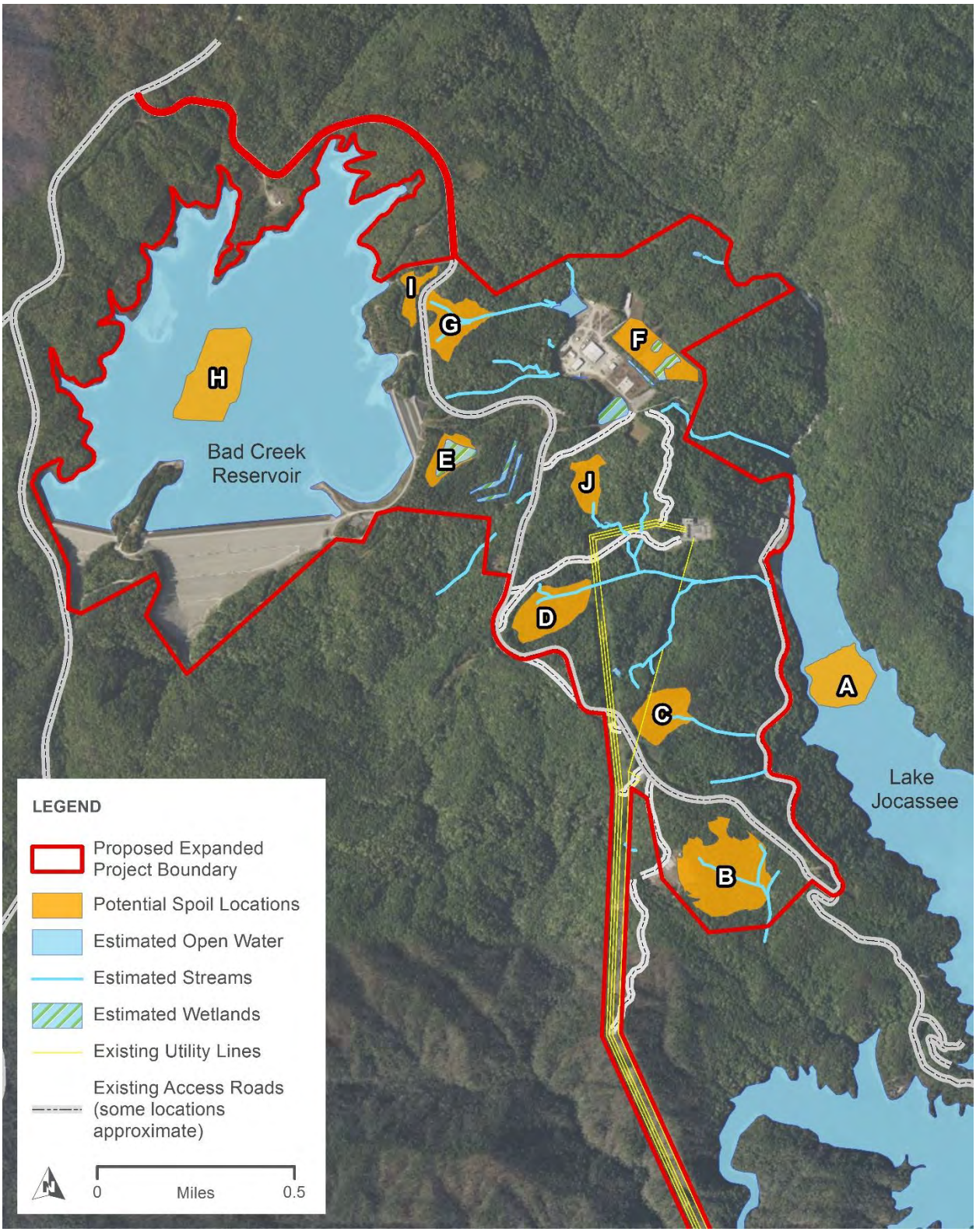
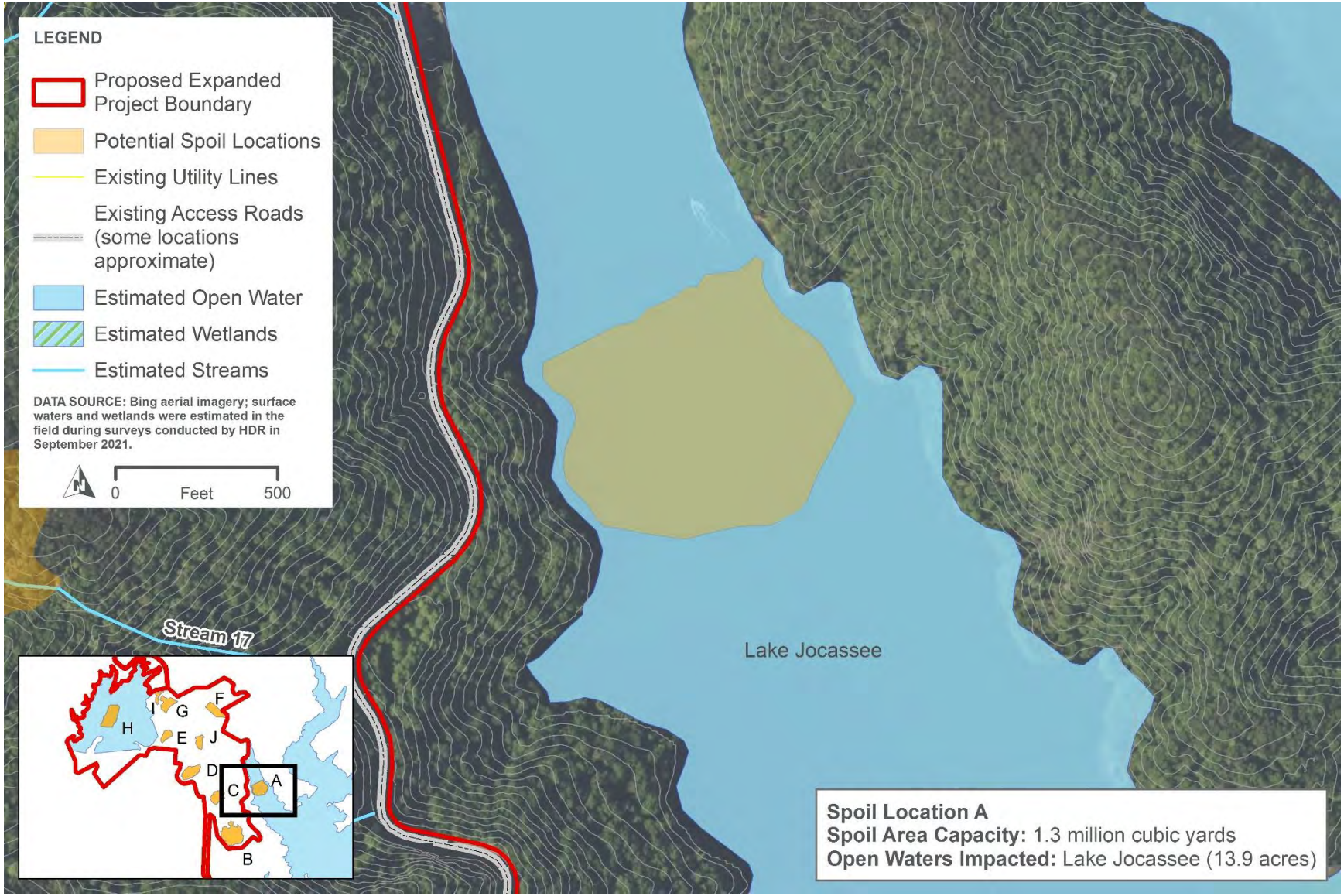
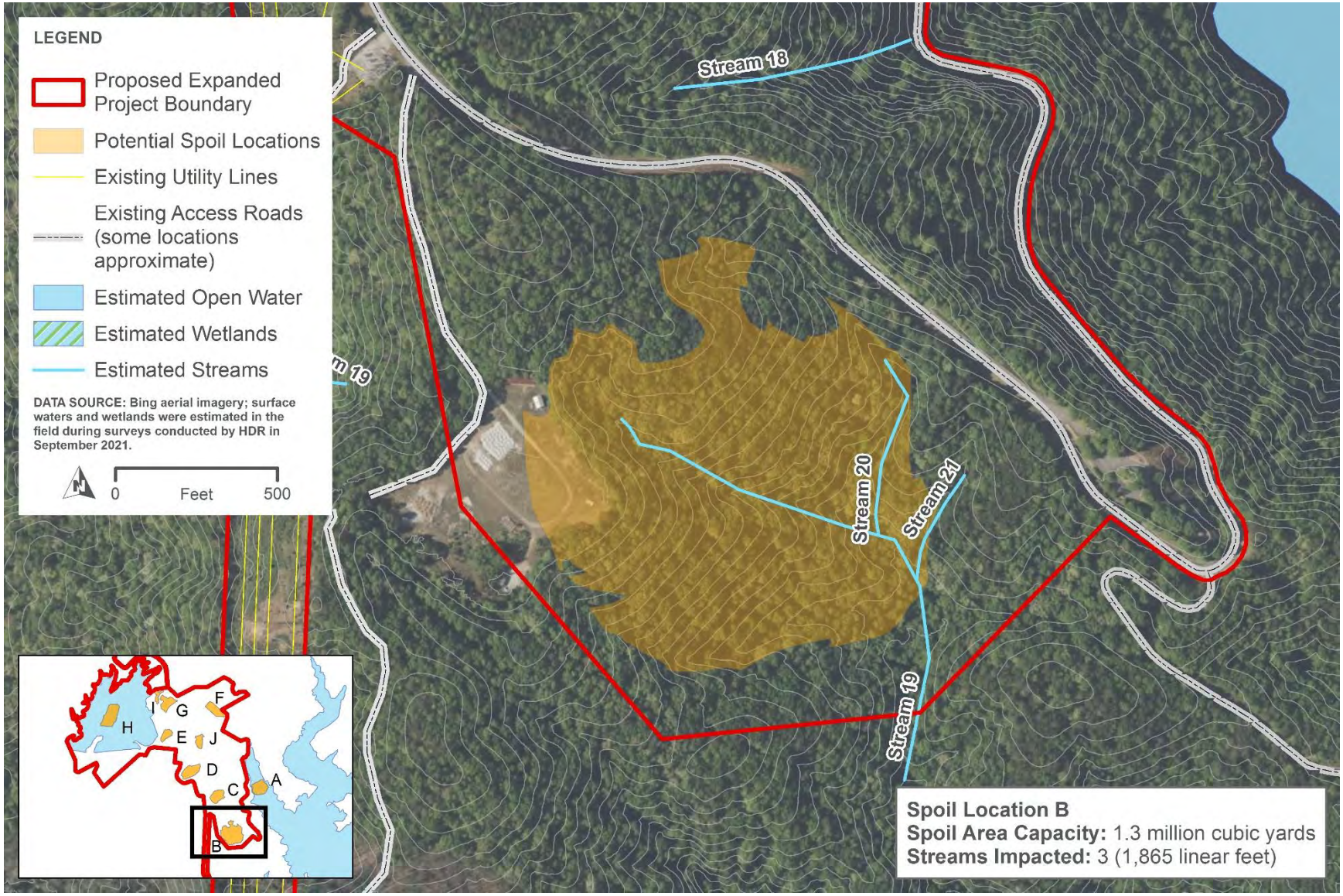
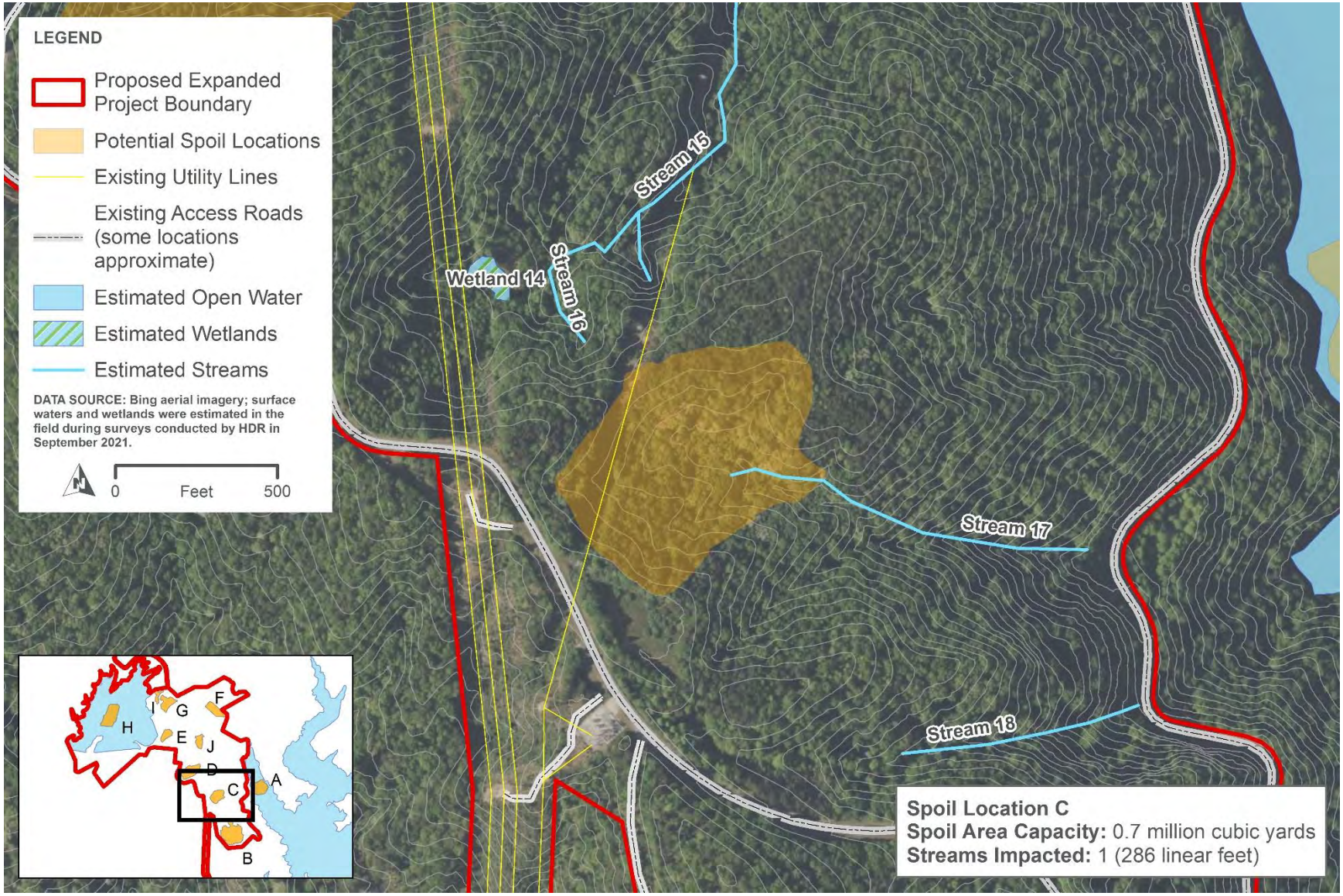
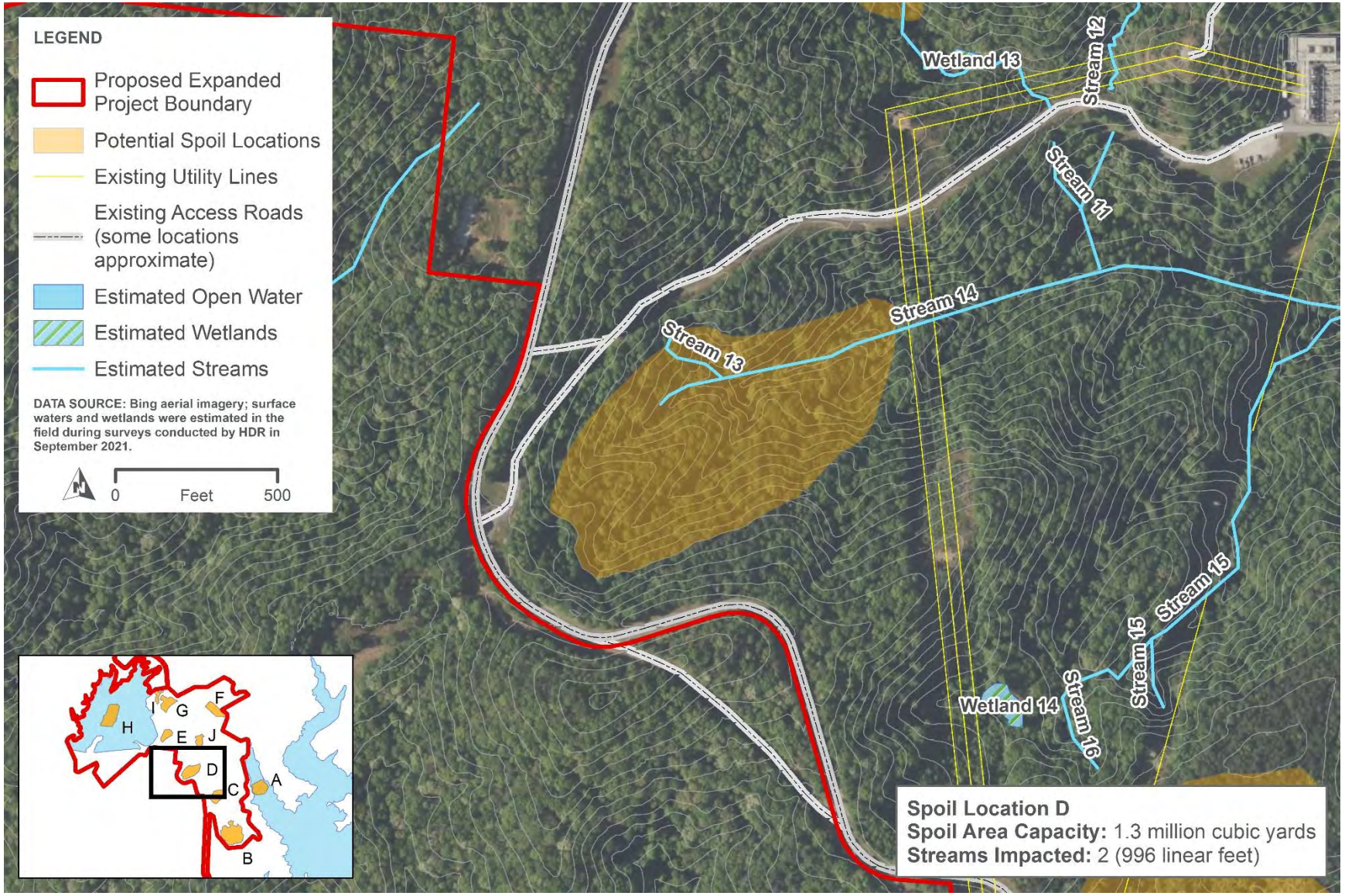
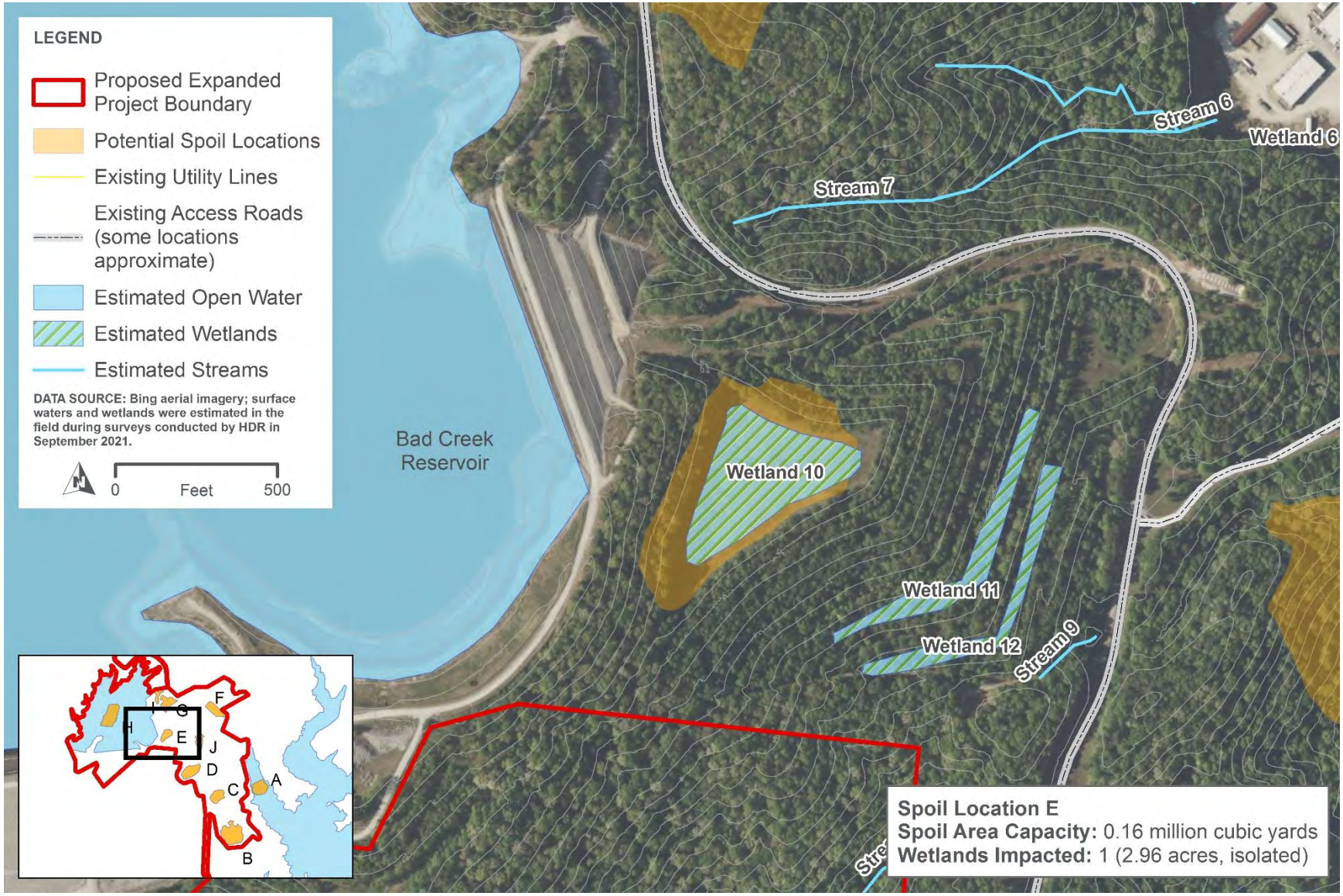

I
G
F
H
Bad Creek
Reservoir
E
J
D
A
C
Lake
Jocassee
B
LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Estimated Open Water
Estimated Streams
Estimated Wetlands
Existing Utility Lines
Existing Access Roads (some locations approximate)
N
0
Miles
0.5

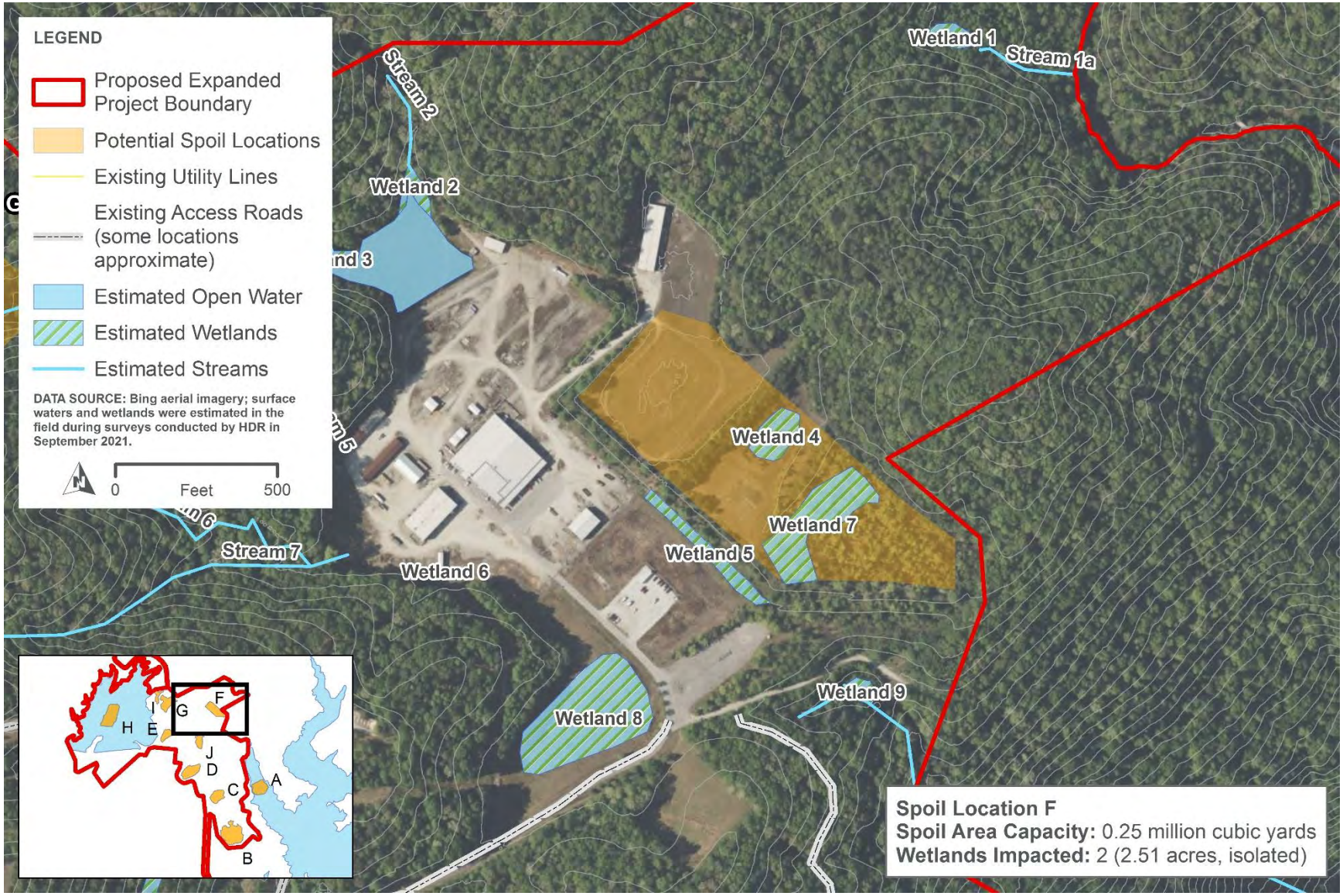

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys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

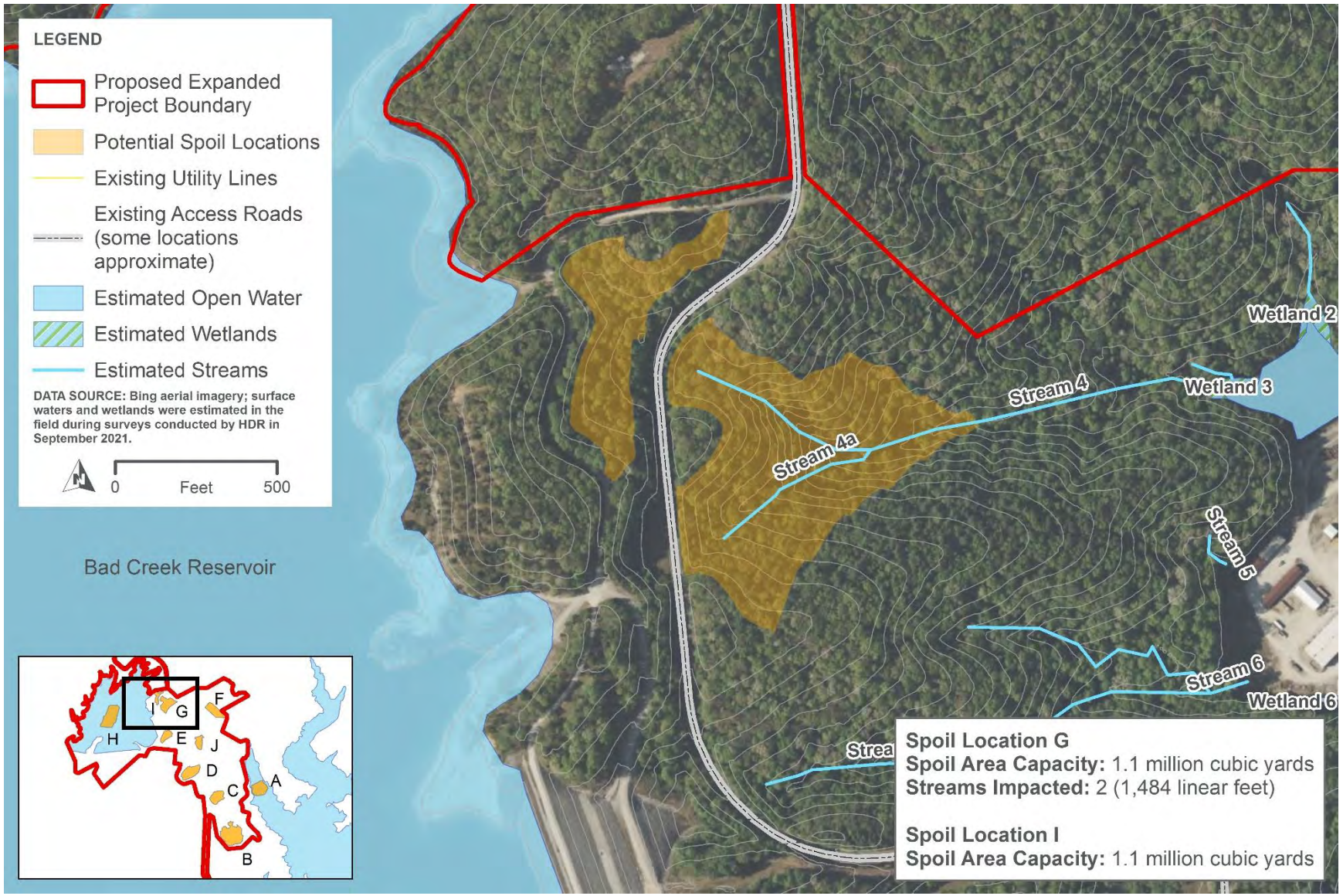

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys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

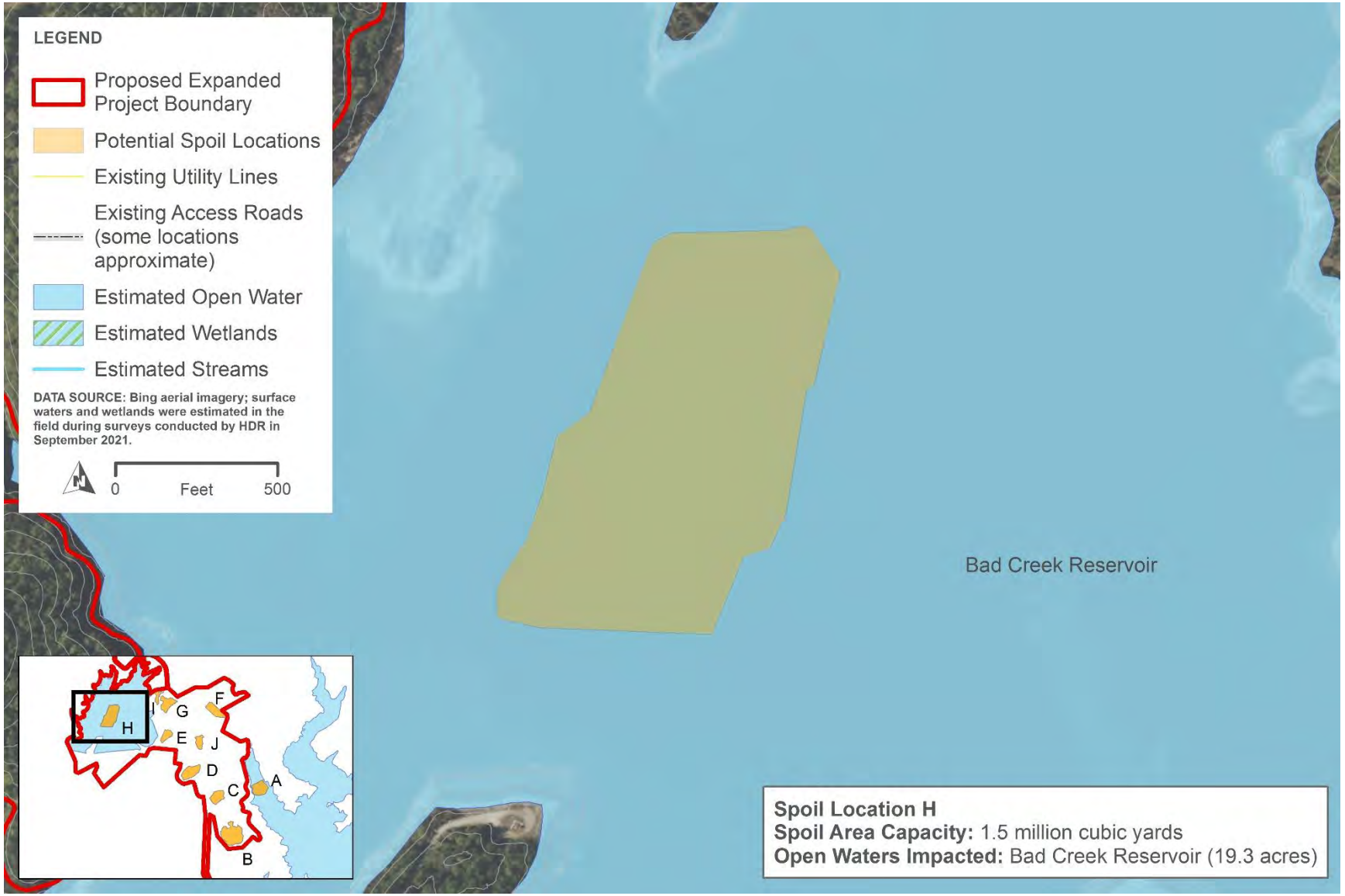

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys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

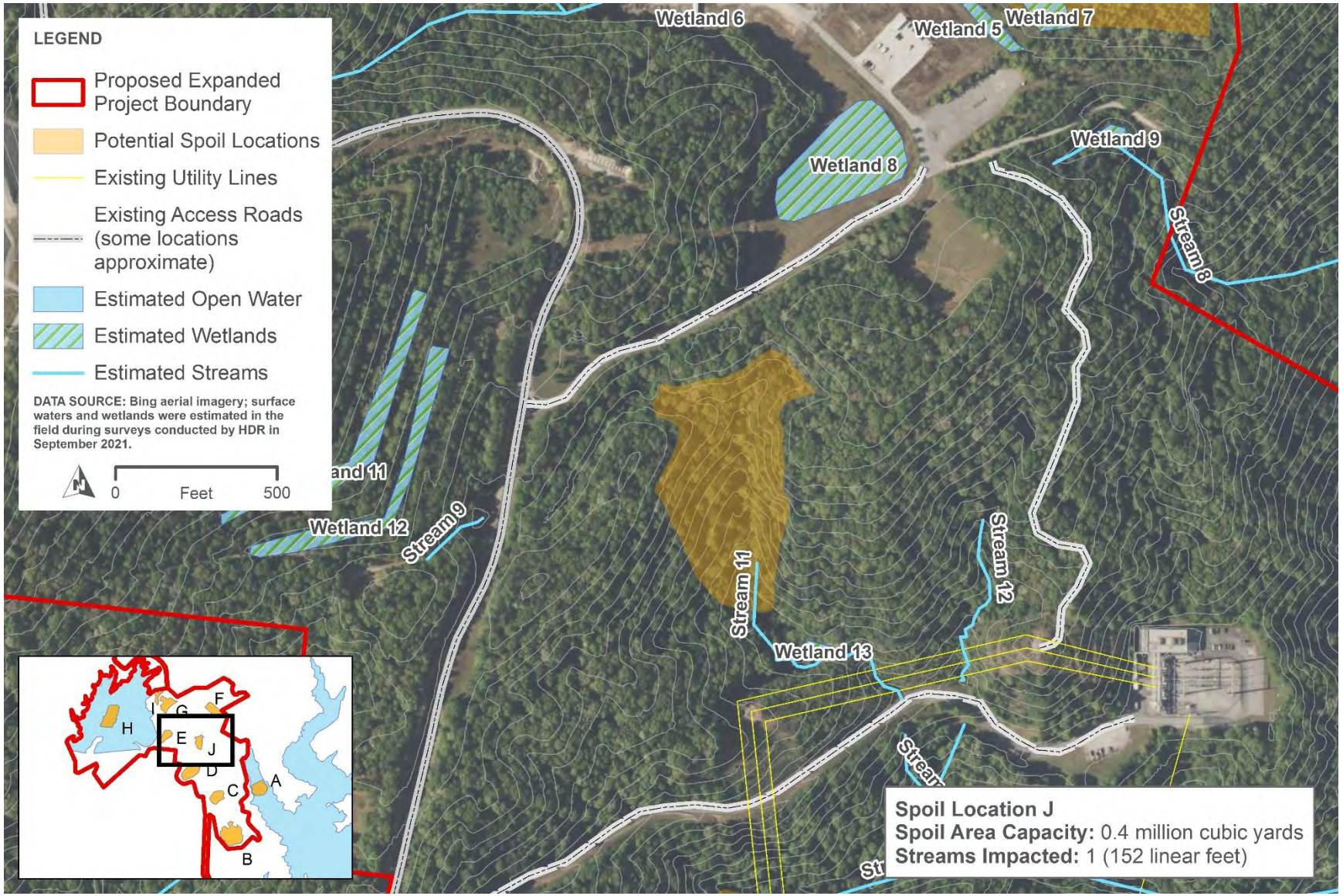

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Utility Lines
Existing Access Roads (some locations approximate)
Estimated Open Water
Estimated Wetlands
Estimated Streams
DATA SOURCE: Bing aerial imagery; surface waters and wetlands were estimated in the field during surveys conducted by HDR in September 2021.
0
Feet
500
Wetland 13
Stream 12
Stream 11
Stream 14
Stream 13
Stream 15
Stream 15
Wetland 14
Stream 16
I
G
F
H
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
F
I
G
H
E
J
D
C
A
B
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 7
Wetland 5
Wetland 6
Stream 7
Wetland 8
Wetland 9
F
G
I
H
E
J
D
C
A
B
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
Stream 4
Wetland 3
Stream 4a
Stream 5
Stream 6
Wetland 6
Strea
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
I
G
F
H
E
J
D
C
A
B


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
H
I
G
F
E
J
D
C
A
B
Spoil Location H
Spoil Area Capacity: 1.5 million cubic yards
Open Waters Impacted: Bad Creek Reservoir (19.3 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
Wetland 6
Wetland 5
Wetland 7
Wetland 8
Wetland 9
Stream 8
Wetland 12
Stream 9
Stream 11
Stream 12
Wetland 13
A
B
C
D
E
F
G
H
I
J
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

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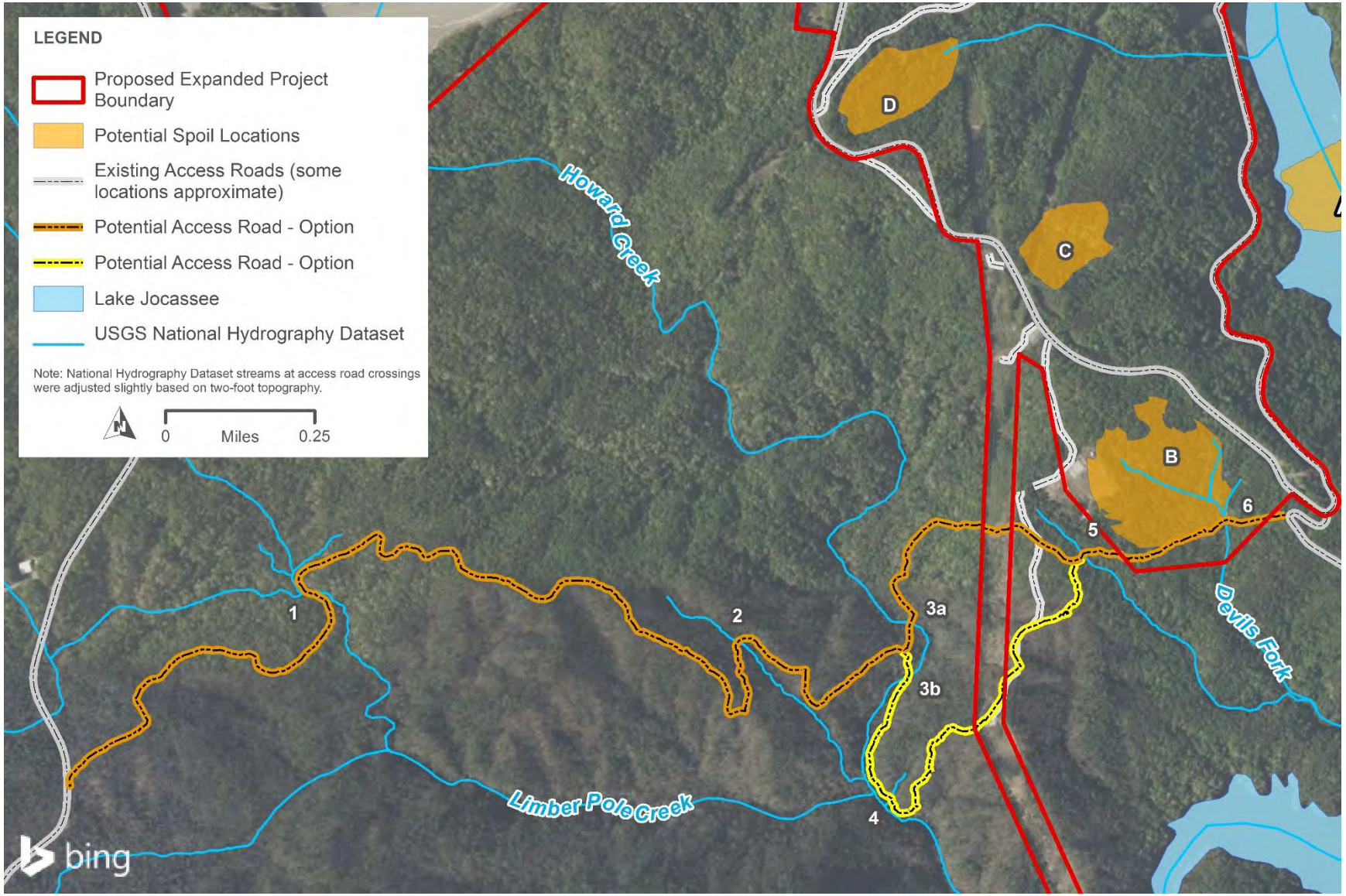
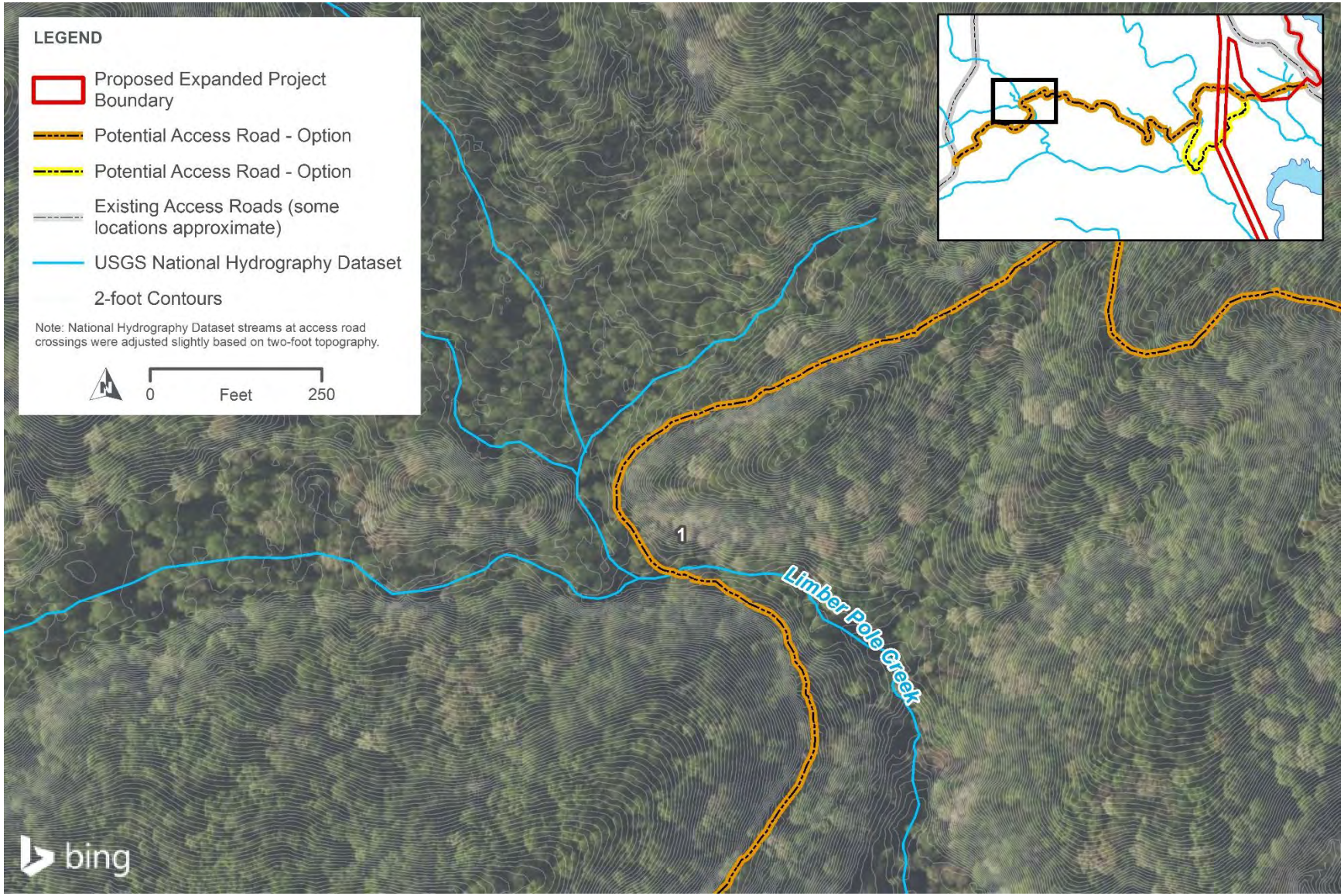
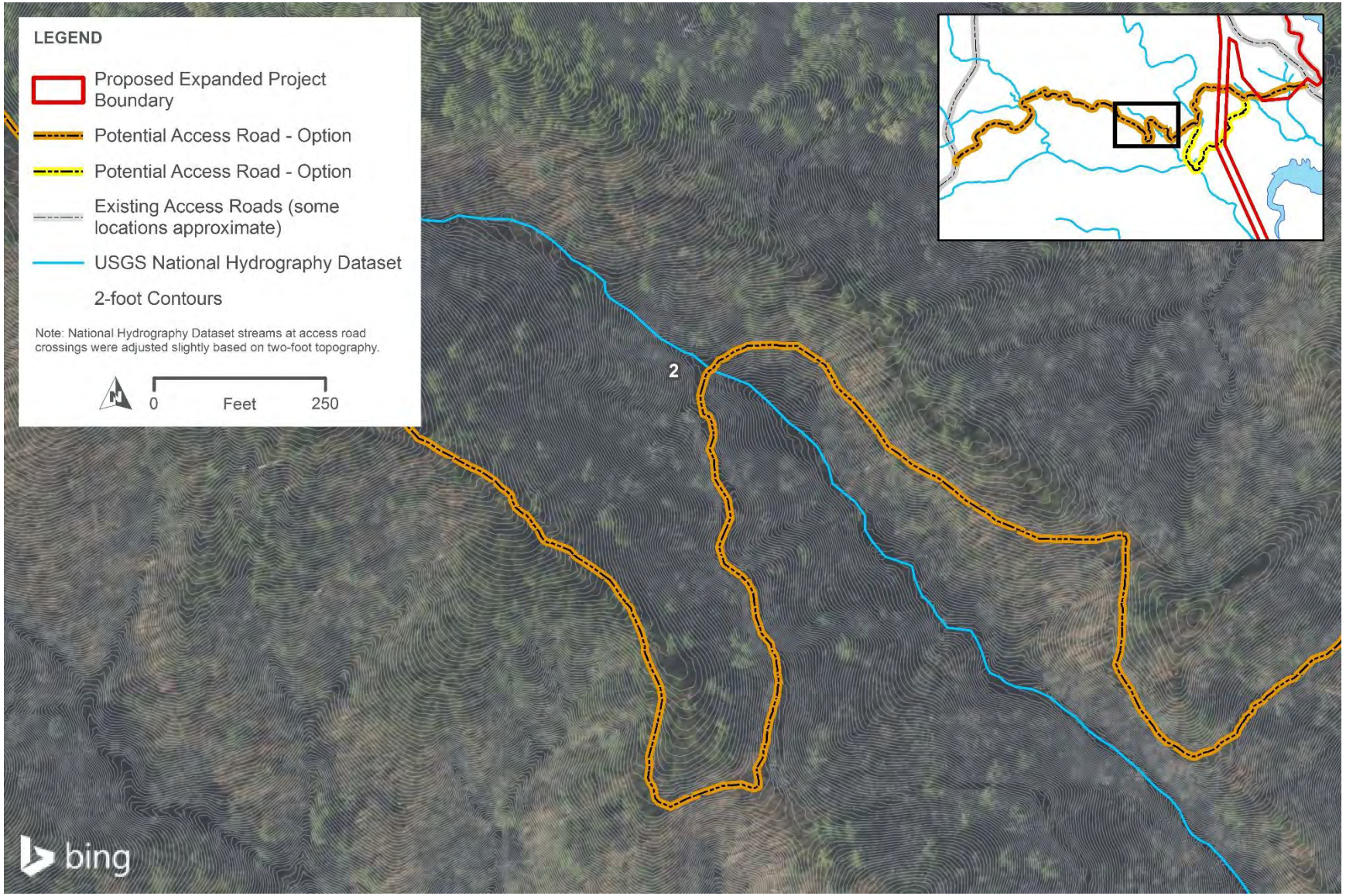
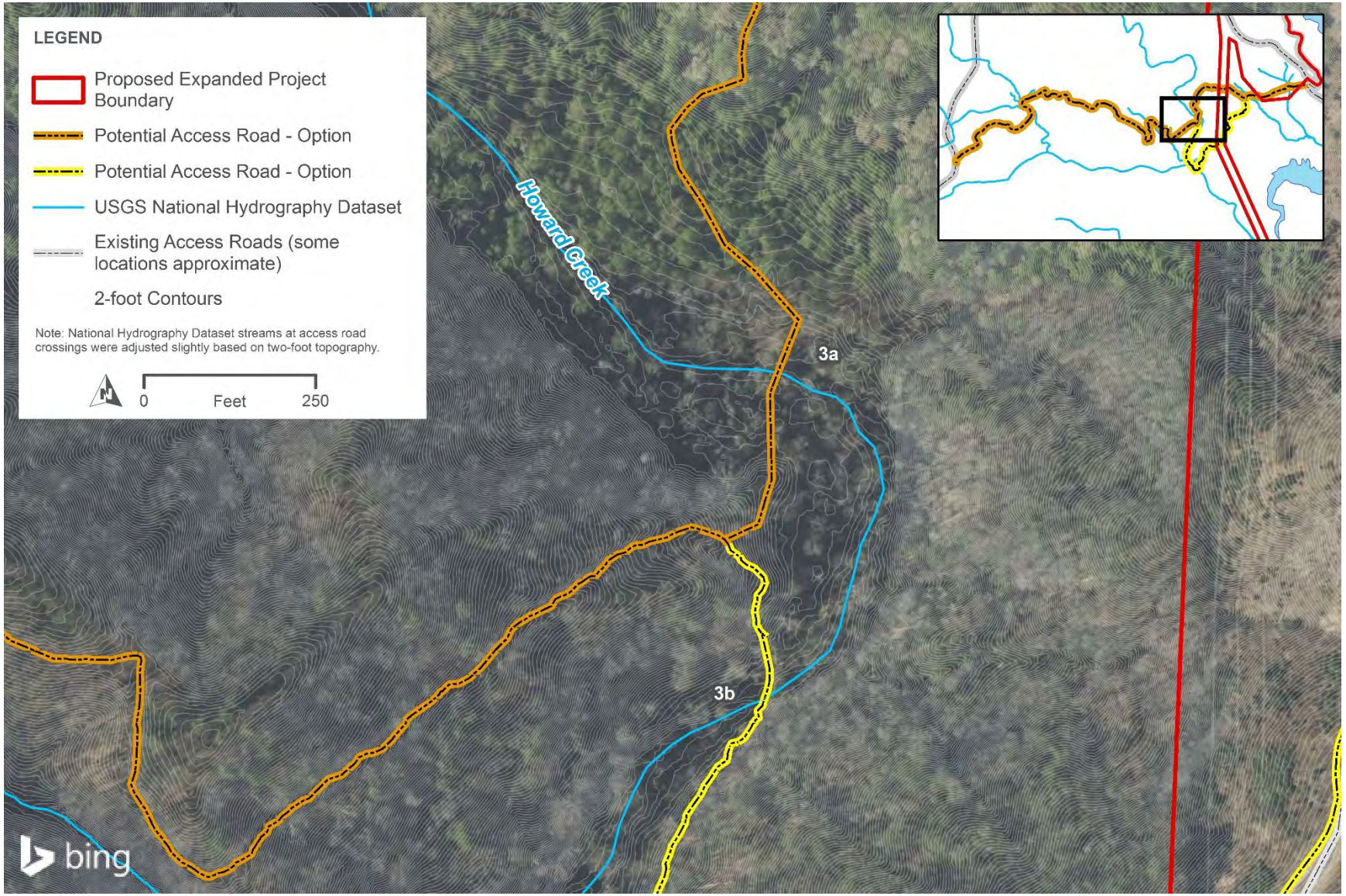
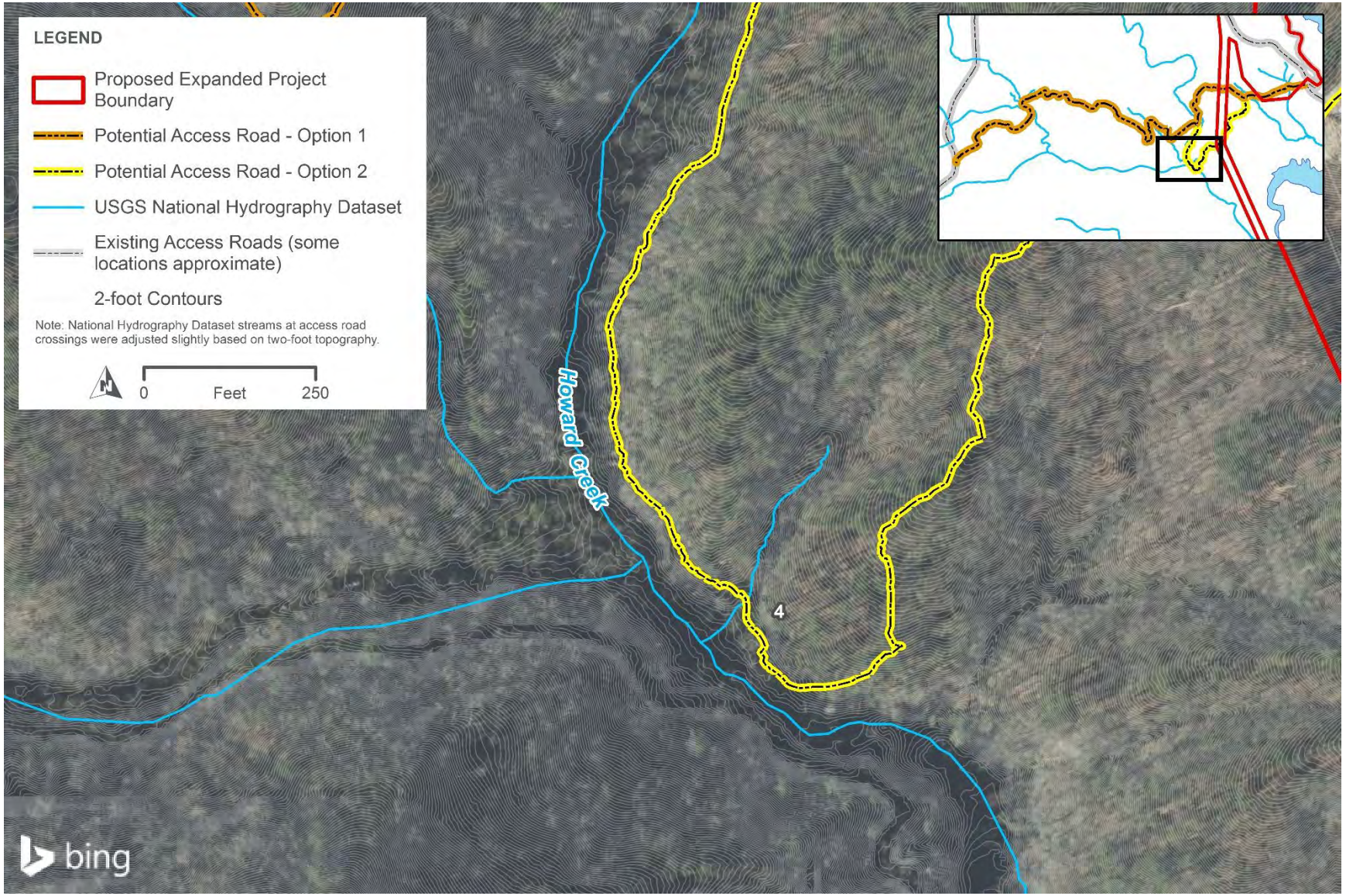
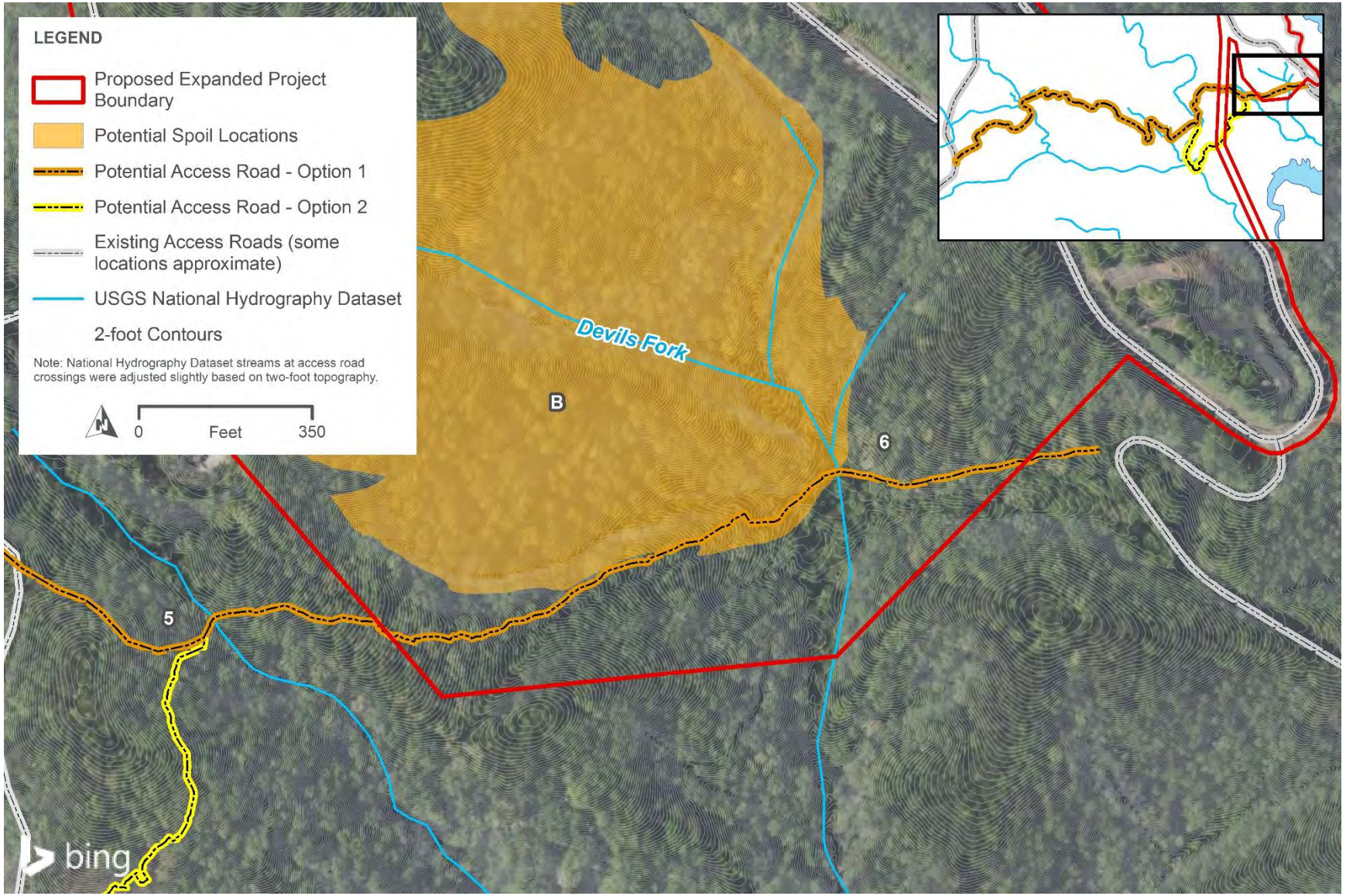

LEGEND
Proposed Expanded Project Boundary
Potential Spoil Locations
Existing Access Roads (some locations approximate)
Potential Access Road - Option
Potential Access Road - Option
Lake Jocassee
USGS National Hydrography Dataset
Note: National Hydrography Dataset streams at access road crossings were 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.
N
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.
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 C: Environmental Justice Study Report

The final Environmental Justic Study report filed with this Progress Report on September 27, 2023 is available at Docket P-2740, Sub-Docket 053, Accession Number 0230927-5095 [https://elibrary.ferc.gov/eLibrary/docinfo?accession_number=20230927-5095].

This report is also being filed with the ISR as Appendix F, Attachment 1

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Attachment 3

Attachment 3 – ISR Meeting Agenda

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Meeting Agenda

Bad Creek Pumped Storage Project Relicensing
Initial Study Report Meeting

January 17, 2024
9:00 am – 5:00 pm

Wenwood Operations Center
425 Fairforest Way, Greenville, SC 29607

Introduction • Welcome and Agenda Review • Safety Moment • Introductions and FERC ILP Schedule Review	Alan Stuart
Water Resources	
• Task 1: Summary of Existing Water Quality Data and Standards	Maverick Raber
• Task 2: Water Quality Monitoring in Whitewater River Arm	
• Task 3: Velocity Effects and Vertical Mixing in Lake Jocassee Due to a Second Powerhouse (CFD Modeling)	Joe Dvorak
• Task 4: Water Exchange Rates and Lake Jocassee Reservoir Levels (CHEOPS Modeling)	Jen Huff
• Task 5: Water Quality Management Plan	Maverick Raber
Break	
Recreational Resources • Task 1: Foothills Trail Recreation Use & Needs • Task 2: Foothills Trail Conditions Assessment • Task 3: Whitewater River Cove Existing Recreational Use • Task 4: Whitewater River Cove Recreational Public Safety Evaluation	Kelly Kirven
Lunch	
Aquatic Resources	
• Task 1: Entrainment	Kevin Nebiolo
• Task 2: Desktop Studies on Pelagic & Littoral Habitat	Erin Settevendemio
• Task 3: Mussel Surveys & Stream Habitat Quality Surveys	Erin Settevendemio
Break	
Environmental Justice	Alison Jakupca
Cultural Resources	Christy Churchill
Visual Resources	Jen Huff
Proposed Spoil Area Herptile Survey	Scott Fletcher
Closing	Alan Stuart

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Attachment 4

Attachment 4 – Proposed Spoil Area Herptile Surveys

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Date: December 18, 2023
Project: Bad Creek Pumped Storage Project
To: Alan Stuart, Duke Energy Carolinas, LLC
From: Duke Energy EHS, Corporate Environmental & Governance, Natural Resources
Subject: Proposed Spoil Area Herptile Surveys-Bad Creek Pumped Storage Project Relicensing

Project Understanding

Duke Energy Carolinas, LLC (DEC) is the owner and operator of the 1,400-megawatt Bad Creek Pumped Storage Project (Federal Energy Regulatory Commission [FERC] Project No. 2740) located in Oconee County, South Carolina. DEC is pursuing a new license for the Project and based on a request from the South Carolina Department of Natural Resources (SCDNR), and to support Clean Water Act Section 404 U.S. Army Corps of Engineers permitting, DEC proposed to evaluate the terrestrial reptile and amphibian (i.e., herptile) resources that may experience direct impacts from the proposed construction of an additional power plant complex adjacent to the existing facility (i.e., Bad Creek II Power Complex). These impacts would be associated with spoil placement of excavated material from construction of the Bad Creek II Complex. The objective of the herptile survey is to document any South Carolina Wildlife Action Plan (SWAP) Herptile Species of Concern (Table 1) and other reptile and amphibian species that occur within the proposed spoil areas and in the project vicinity, as requested by SCDNR.

Field Surveys

Terrestrial herptile field surveys of the eight proposed terrestrial spoil areas (Proposed Spoil Areas B, C, D, E, F, G, I, and J [Figure 1]) were conducted from September 11-13, 2023. The survey methodology consisted of traversing transects through the specified areas to ensure that sufficient visual coverage was obtained. The herptile surveys were conducted through visual encounter or patch sampling at specific microhabitats (e.g., rock ledges, rock piles, logs, wet depressions). These transects were generally spaced 75-feet apart depending on habitat type and/or visibility. Observed species and their locations were recorded using a handheld Global Positioning System (GPS). Vegetation cover type and specific habitats/substrates were noted for individual spoil areas, as well as incident observations of other wildlife species. Observed specimens that could be captured were taxonomically identified with photographic documentation. No voucher specimens were collected as part of this survey.

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Table 1: List of SC Wildlife Action Plan Priority Herptile Species that May Occur in the Project Area.

Common Name	Scientific Name	Status	Preferred Habitat and Notes
Seepage Salamander	*Desmognathus aeneus*	N/A	Seepages and small headwater streams.
Shovel-nosed Salamander	*Desmognathus marmoratus*	N/A	Fast moving, cold, second and third order streams. Similar to Black-bellied Salamander in appearance.
Dwarf Black-bellied Salamander	*Desmognathus folkertsi*	N/A	High gradient cold water streams. Similar to Black-bellied Salamander in appearance.
Green Salamander	*Aneides aeneus*	N/A	Crevices in rock outcroppings and ledges in moist hardwood forests. Documented in Project Area during Keowee-Toxaway Hydro Relicensing.
Four-toed Salamander	*Hemidactylium scutatum*	N/A	Hardwood forests with swamps, bogs, marshes, and vernal pools but mostly underground. Combination of four toes on each rear foot
Patch-nosed Salamander	*Urspelerpes brucei*	N/A	In many cases, associated with sphagnum moss. Also, leaf litter and under rocks near first-order streams. Smallest salamander in North America and similar to Two-lined Salamander.
Wood Frog	*Lithobates sylvaticus*	N/A	Cryptic. Spring is the best time to observe. Found in leaf packs along stream edge especially for larvae. Also, woodlands, wetlands, and vernal pools.
Pickerel Frog	*Lithobates palustris*	N/A	Slow moving streams, ponds, and wetlands with low, dense vegetation. Documented in Project Area during Keowee-Toxaway Relicensing.
Coal Skink	*Plestiodon anthracinus*	SC State Threatened	Humid hillsides and rocky bluffs in forested habitat, near springs and seeps.
Eastern Box Turtle	*Terrapene carolina*	N/A	Highly terrestrial in scrubby and wooded areas although found in shallow aquatic areas in hot and dry conditions. Documented in Project Area during Keowee-Toxaway Relicensing.
Bog Turtle	*Glyptemys muhlenbergii*	SC State Threatened	Shallow moving, mud bottomed streams in meadows, emergent marshes and sphagnum bogs.
Eastern Milk Snake	*Lampropeltis triangulum*	N/A	Open areas, ecotones such as along rights-of-way, hardwood forests.
Timber Rattlesnake	*Crotalus horridus*	N/A	Wide variety of terrestrial habitat including rock outcrops, lowland cane thickets, high areas around swamps and river floodplains, hardwood and pine forests, mountainous areas, and rural habitats in farming areas. Documented in Project Area during Keowee-Toxaway Hydro Relicensing.

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Common Name	Scientific Name	Status	Preferred Habitat and Notes
Northern Pine Snake	*Pituophis melanoleucus*	N/A	Open areas within pine-oak forests with well-drained and sandy soils. Also, rock outcrops and habitat edges.

N/A – Not Applicable

Findings

Over the three-day survey period, all eight terrestrial potential spoil sites were surveyed by Duke Energy (Ethan Smith and Mark Auten) and HDR (Jenessa Kay and Michael Inman) personnel. The only herptile species observed on the SWAP Priority Herptile Species List was the Eastern Box Turtle. Two Eastern Box Turtle carapace shells (deceased) were observed within Area B and Area I (Figure 2). Photos are included in the attached photolog, and photo locations are included on Figure 2. An incidental observation of a live Eastern Box Turtle was documented crossing a county road (off site) in the vicinity of the spoil area surveys. Table 2 lists all 14 amphibian and reptile species observed and the proposed spoil area in which they were observed (Figure 3).

Table 2: List of Herptile Species Observed in the Project Spoil Areas.

Common Name	Scientific Name	Spoil Areas*
Green Anole	*Anolis carolinensis*	B and G
Eastern Fence Lizard	*Sceloporus undulatus*	B
Red-spotted Newt	*Notophthalmus viriascens*	D
Red Salamander	*Pseudotriton ruber*	G
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	C, D, G, and I
Southern Appalachian Salamander	*Plethodon teyahalee*	E
Chattooga Dusky Salamander	*Desmognathus perlapsus*	C and G
Seal Salamander	*Desmognathus monticola*	B and I
Black-bellied Salamander	*Desmognathus quadramaculatus*	G and I
Eastern Copperhead	*Agkistrodon contortrix*	B
Black Racer	*Coluber constrictor*	E
Eastern Box Turtle	*Terrapene carolina*	B and I
Fowler's Toad	*Anaxyrus fowleri*	I
Green Frog	*Rana [Lithobates] clamitans*	G

* - See Figure 1 for location of Proposed Spoil Areas

Spoil Area A

Spoil Area A is an aquatic site (Figure 1) with no terrestrial habitat; therefore, reptile and amphibian species were not assessed.

Spoil Area B

Spoil Area B is the largest proposed spoil site with an area of 26.3 acres (Figure 1). This proposed spoil area has an elevation of approximately 1,497 to 1,827 feet above mean sea level (msl) and an estimated

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average slope of 8.1 percent. The proposed spoil area was surveyed on both September 12 and 13, 2023, due to inclement weather. The survey resulted in six individual herptile specimens comprised of five species (Table 3).

Table 3: Spoil Area B Herptile Species

Common Name	Scientific Name	Lat/Long and Notes	Location*
Green Anole	*Anolis carolinensis*	34.994702, -82.996888	1
Eastern Fence Lizard	*Sceloporus undulatus*	34.994556, -82.996756 34.995499, -82.997478	2 and 3
Seal Salamander	*Desmognathus monticola*	34.993853, -82.993489.	4
Eastern Copperhead	*Agkistrodon contortrix*	34.995452, -82.995640	5
Eastern Box Turtle	*Terrapene carolina*	34.993333, -82.994167 (Carapace Only)	6

* - See Figure 3 for locations of species

The vegetative community at Spoil Area B is a mixed hardwood-pine forest comprised of mature woody, herbaceous and vine species including chestnut oak (*Quercus prinus*), scarlet oak (*Quercus coccinea*), northern red oak (*Quercus rubra*), tulip poplar (*Liriodendron tulipifera*), white pine (*Pinus strobus*), black gum (*Nyssa sylvatica*), flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), Fraser magnolia (*Magnolia fraseri*), pawpaw (*Asimina triloba*), mountain laurel (*Kalmia latifolia*), rosebay rhododendron (*Rhododendron maximum*), dog hobble (*Leucothoe fontanesiana*), Christmas fern (*Polystichum acrostichoides*), New York fern (*Amauropelta noveboracensis*), large-flowered heartleaf (*Hexastylis shuttleworthii*), and downy rattlesnake plantain (*Goodyera pubescens*). In addition to the vascular plants, two species of fungus were found including fragile dapperling (*Leucocoprinus fragillissimus*) and frosts bolete (*Exsudoporus frostii*). Other fauna observed in the survey area included a set of Black Bear (*Ursus americanus*) prints in the soil.

Spoil Area C

Spoil Area C was surveyed on September 13, 2023 and has an area of 9.6 acres (Figure 1) with an elevation of approximately 1,729 to 1,805 feet msl and an estimated average slope of 4.6 percent. The survey resulted in three individual herptile specimens comprised of two species (Table 4).

Table 4: Spoil Area C Herptile Species

Common Name	Scientific Name	Lat/Long	Location*
Chattooga Dusky Salamander	*Desmognathus perlapsus*	35.000289, -82.997458	7
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	35.000278, -82.998056 and 35.000556, -82.997778	8 and 9

* - See Figure 3 for locations of species

The vegetative community at Spoil Area C is a mixed hardwood-pine forest comprised of mature woody, herbaceous, and vine species including white pine, Virginia pine (*Pinus virginiana*), loblolly pine (*Pinus taeda*), red maple, black locust (*Robinia pseudoacacia*), chestnut oak, white oak (*Quercus alba*), southern red oak (*Quercus falcata*), black oak (*Quercus velutina*), flowering dogwood, Fraser magnolia, American beech (*Fagus grandifolia*), mountain laurel, rosebay rhododendron, muscadine grape (*Vitis rotundifolia*),

running cedar (*Diphasiastrum digitatum*), New York fern, common polypody fern (*Polypodium vulgare*), pinesap (*Monotropa hypopitys*), poison ivy (*Toxicodendron radicans*).

Spoil Area D

Spoil Area D was surveyed on September 13, 2023 and has an area of 12.5 acres (Figure 1) with an elevation of approximately 1,613 to 1,872 feet msl and an estimated average slope of 11.9 percent. The survey resulted in three individual herptile specimens comprised of two species (Table 5).

Table 5: Spoil Area D Herptile Species

Common Name	Scientific Name	Lat/Long	Location*
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	35.003056, -83.004167 35.004722, -83.001944	10 and 11
Red-spotted Newt	*Notophthalmus viriascens*	35.003030, -83.004446	12

* - See Figure 3 for locations of species

The vegetative community at Spoil Area D is a mixed hardwood-pine forest comprised of mature woody, herbaceous and vine species including white pine, northern red oak, chestnut oak, white oak, Fraser magnolia, red maple, mockernut hickory (*Carya tomentosa*), yellow birch (*Betula alleghaniensis*), mountain laurel, rosebay rhododendron, Christmas fern, and large-flowered heartleaf.

Spoil Area E

Spoil Area E was surveyed on September 11, 2023 and has an area of 6.2 acres (Figure 1) with an elevation of approximately 2,227 to 2,280 feet msl and an estimated average slope of 9.6 percent. This area appears to have already been utilized as a spoil area from the existing Bad Creek Pumped Storage Project. The survey resulted in two individual herptile specimens comprised of two different species (Table 6).

Table 6: Spoil Area E Herptile Species

Common Name	Scientific Name	Lat/Long and Notes	Location*
Black Racer	*Coluber constrictor*	35.010278, -83.007778	13
Southern Appalachian Slimy Salamander	*Plethodon teyahalee*	35.010856, -83.008786 (found just outside study area)	14

* - See Figure 3 for locations of species

The vegetative community at Spoil Area E is a mixed hardwood-pine forest comprised of mature woody and herbaceous, species and most of the area is covered in a herbaceous mix of grasses and wild flowers including loblolly pine, white pine, white oak, chestnut oak, sawtooth oak (*Quercus acutissima*), flowering dogwood, red maple, tulip poplar, black locust, sourwood persimmon (*Diospyros virginiana*), sassafras (*Sassafras albidum*), bulrush (*Scirpus cyperinus*), tickseed (*Bidens* sp.), partridge pea (*Chamaecrista nictitans*), goldenrod (*Solidago* spp.), yellow crownbeard (*Verbesina occidentalis*), great blue lobelia (*Lobelia siphilitica*), cardinal flower (*Lobelia cardinalis*) and boneset (*Eupatorium perfoliatum*).

Other fauna observed during the study of the spoil area included Snowberry Clearwing Moth (*Hemaris diffinis*), Ambush Bug (*Phymata* sp.), bumblebees (*Bombus* spp.), Eastern Tiger Swallowtail (*Paplio*

glaucus), Long-tailed Skipper (*Urbanus proteus*), other skippers (*Hesperiidae* spp.) and Gulf Fritillary (*Agraulis va*nillae).

Spoil Area F

Spoil Area F was surveyed on September 12, 2023 and has an area of 10.7 acres (Figure 1) with an elevation of approximately 1,971 to 1,986 feet msl and no significant slope. This site consists of mixed hardwood-pine forest and large flat open fields (one field included a helicopter landing pad). Area F also appears to have been utilized as a spoil area from the original project. No herps or other fauna were observed.

The vegetative community at Spoil Area F is a mixed hardwood-pine forest comprised of mature woody and herbaceous species. The vegetation included white pine, Virginia pine, tulip poplar, shortleaf pine (*Pinus echinate*), red maple, persimmon (*Diospyros virginiana*), eastern red cedar (*Juniperus virginiana*), sawtooth oak, American holly (*Ilex opaca*), black locust, silk tree (*Albizia julibrissin*), devils walkingstick (*Aralia spinosa*), dog fennel (*Eupatorium capillifolium*). The open field vegetative community is covered in a herbaceous mix of unidentified pasture grasses, sericea lespedeza (*Lespedeza cuneata*), great blue lobelia, mullein (*Verbascum thapsus*), boneset, partridge pea, evening primrose (*Oenothera biennis*), goldenrod species, ebony spleenwort (*Asplenium platyneuron*), Virginia creeper (*Parthenocissus quinquefolia*) and muscadine grape.

Spoil Area G

Spoil Area G was surveyed on September 12, 2023 and has an area of 10.5 acres (Figure 1) with an elevation of approximately 2,065 to 2,266 feet msl and an estimated average slope of 10.2 percent. This area is extremely steep with numerous rock outcroppings. The survey resulted in 11 individual herptile specimens comprised of six different species (Table 7).

Table 7: Spoil Area G Herptile Species

Common Name	Scientific Name	Lat/Long	Location*
Chattooga Dusky Salamander	*Desmognathus perlapsus*	35.015000, -83.006667 35.015278, - 83.008889	15 and 23
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	35.014444, -83.008056 35.014444, -83.008056 35.015278, - 83.008889 35.015342, -83.007503 35.015263, -83.007718	16, 17, 18, 20 and 21
Black Bellied Salamander	*Desmognathus quadramaculatus*	35.014722, -83.007222	22
Red Salamander	*Pseudotriton ruber*	35.015556, -83.008889	19
Green Anole	*Anolis carolinensis*	35.015114, -83.006388	24
Green Frog	*Rana [Lithobates] clamitans*	35.015278, -83.008889	25

* - See Figure 3 for locations of species

The vegetative community at Spoil Area G is a mixed hardwood-pine forest comprised of mature woody and herbaceous, species including chestnut oak, northern red, southern red oak, black oak, Fraser magnolia, mockernut hickory, red maple, tulip poplar, flowering dogwood, white pine, eastern hemlock

(*Tsuga canadensis*) mountain laurel, rosebay rhododendron, hydrangea (*Hydrangea* sp.), galax (*Galax urceolata*), partridgeberry (*Mitchella repens*), Christmas fern, maidenhair fern (*Adiantum pedatum*), grape fern (*Sceptridium biternatum*), American cancer-root (*Conopholis americana*), roundleaf greenbrier (*Smilax rotundifolia*) and muscadine grape. Other fauna observed in the survey area included White-tailed Deer (*Odocoileus virginianus*).

Spoil Area H

Spoil Area H is an aquatic site (Figure 1) with no terrestrial habitat; therefore, reptile and amphibian species were not assessed.

Spoil Area I

Spoil Area I was surveyed on September 11, 2023, and has an area of 3.6 acres (Figure 1) with an elevation of approximately 2,282 to 2,324 feet msl and an estimated average slope of 1.4 percent. The survey resulted in eight individual herptile specimens comprised of five different species (Table 8).

Table 8: Spoil Area I Herptile Species

Common Name	Scientific Name	Lat/Long and Notes	Location*
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	35.015833, -83.009444 35.016111, - 83.009444 35.014722, - 83.009444 35.015157, -83.009764	31, 33, 29, and 28
Blackbelly Salamander	*Desmognathus quadramaculatus*	35.015833, -83.009444	26
Seal Salamander	*Desmognathus monticola*	35.015833, -83.009444	27
Fowlers Toad	*Anaxyrus fowleri*	35.016660, -83.010255	32
Eastern Box Turtle	*Terrapene carolina*	35.015833, -83.009444 (Carapace Only)	30

* - See Figure 3 for locations of species

The vegetative community at Spoil Area I is a mixed hardwood-pine forest comprised of mature woody and herbaceous, species including chestnut oak, white oak, Fraser Magnolia, mockernut hickory, red maple, tulip poplar, black locust, flowering dogwood, sourwood, sassafras, white pine, loblolly pine, eastern hemlock, mountain laurel, Christmas Fern, roundleaf greenbrier, muscadine grape, poison ivy (*Toxicodendron radicans*) and American ginseng (*Panax quinquefolium*).

Spoil Area J

Spoil Area J was surveyed on September 13, 2023 and has an area of 5.8 acres (Figure 1) with an elevation of approximately 1,732 to 1,935 feet msl with an estimated average slope of 0.8 percent. The survey resulted in one observed herptile specimen/species (Table 9), possibly due to significant rainfall that increased the water depth and turbidity in the small drainage.

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Table 9: Spoil Area J Herptile Species

Common Name	Scientific Name	Lat/Long	Location*
Southern Gray-cheeked Salamander	*Plethodon metcalfi*	35.009137, -83.002272	34

* - See Figure 3 for locations of species

The vegetative community at Spoil Area J is a mixed hardwood-pine forest comprised of mature woody and herbaceous, species including chestnut oak, white oak, Fraser magnolia, mockernut hickory, red maple, tulip poplar, flowering dogwood, white pine, loblolly pine, mountain laurel, Christmas fern, roundleaf greenbrier, muscadine grape and poison ivy.

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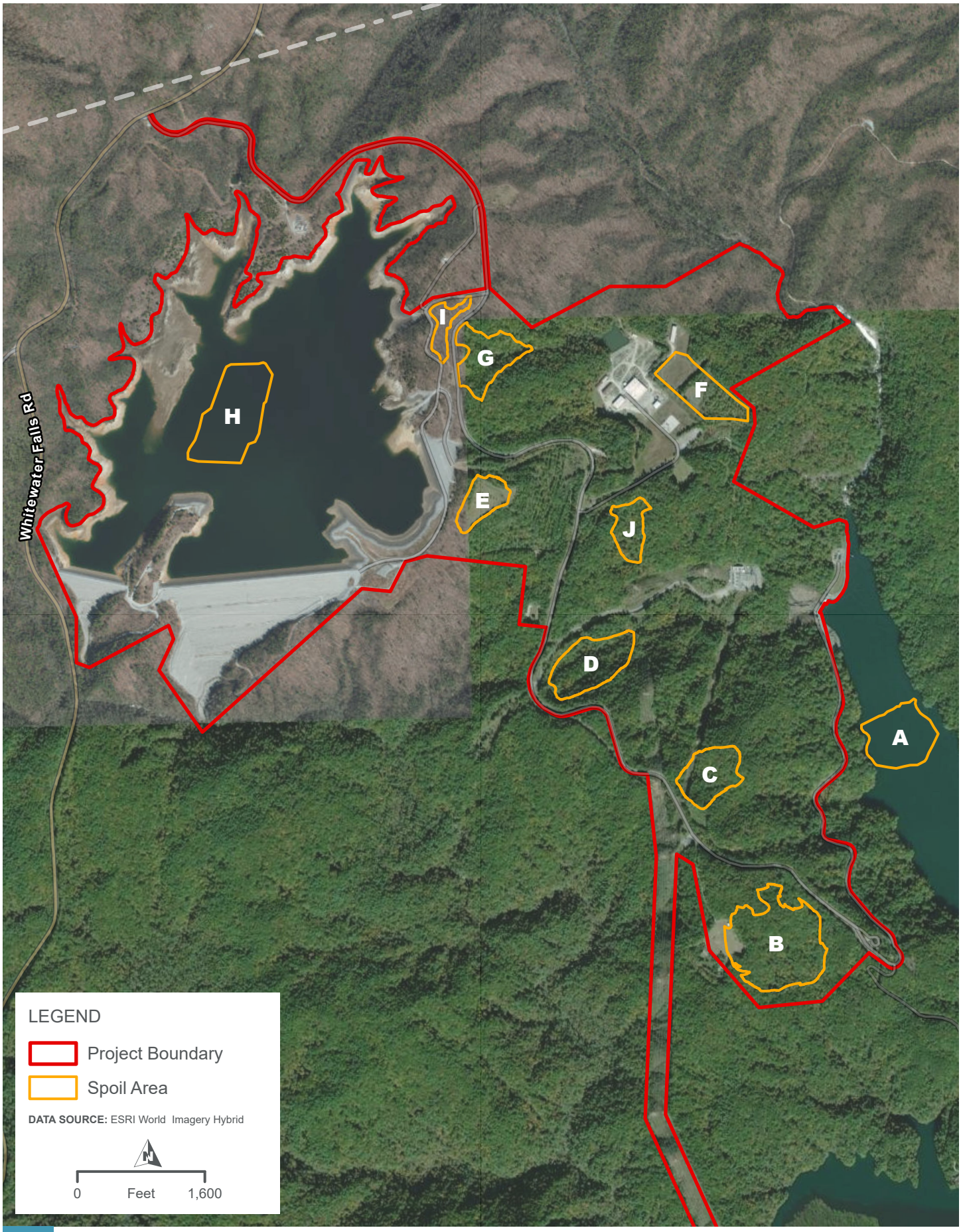
FIGURES



BAD CREEK PUMPED STORAGE PROJECT

SURVEY AREA LOCATION

FIGURE 1

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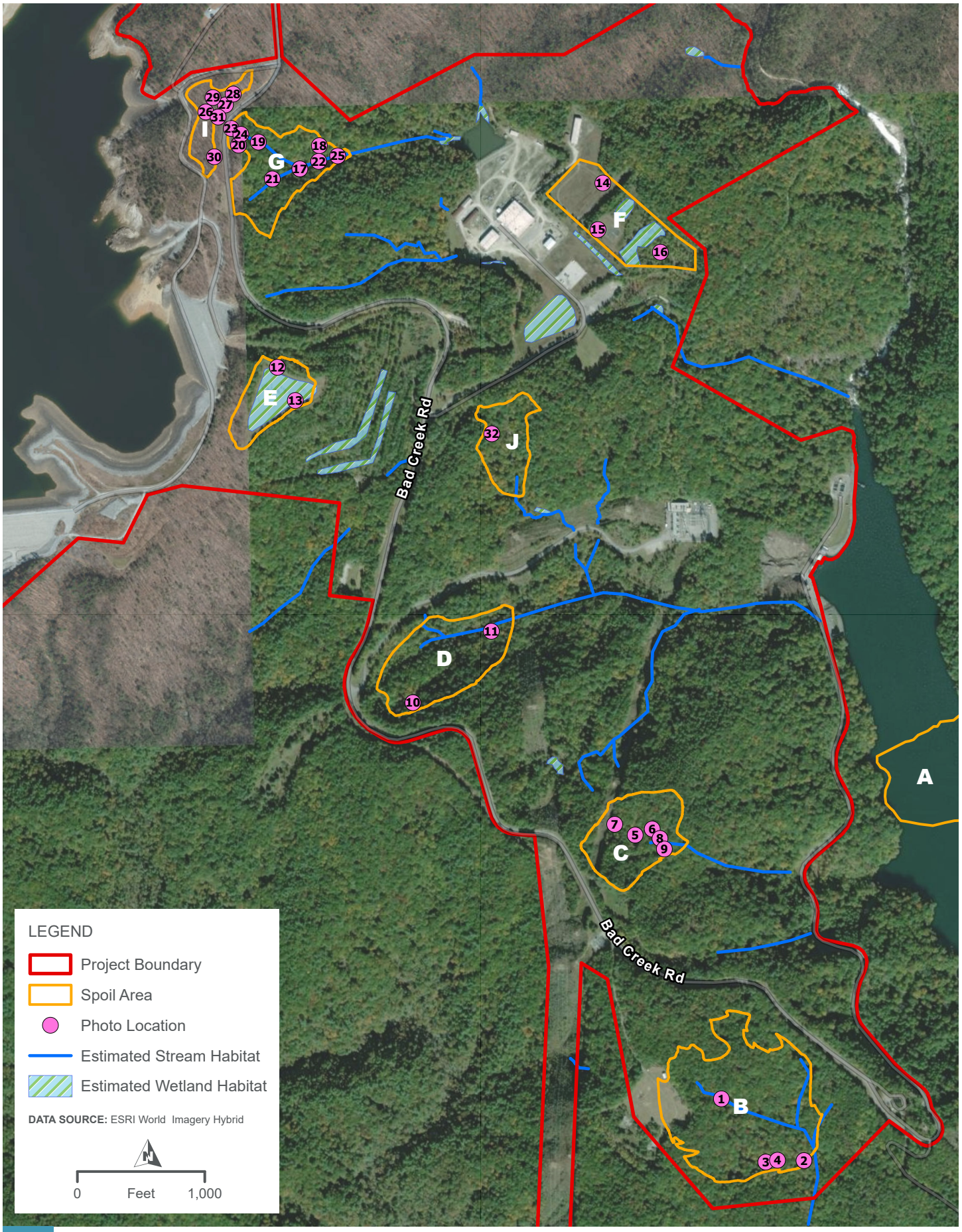

BAD CREEK PUMPED STORAGE PROJECT

HERPETOLOGY PHOTOGRAPH LOCATIONS

FIGURE 2

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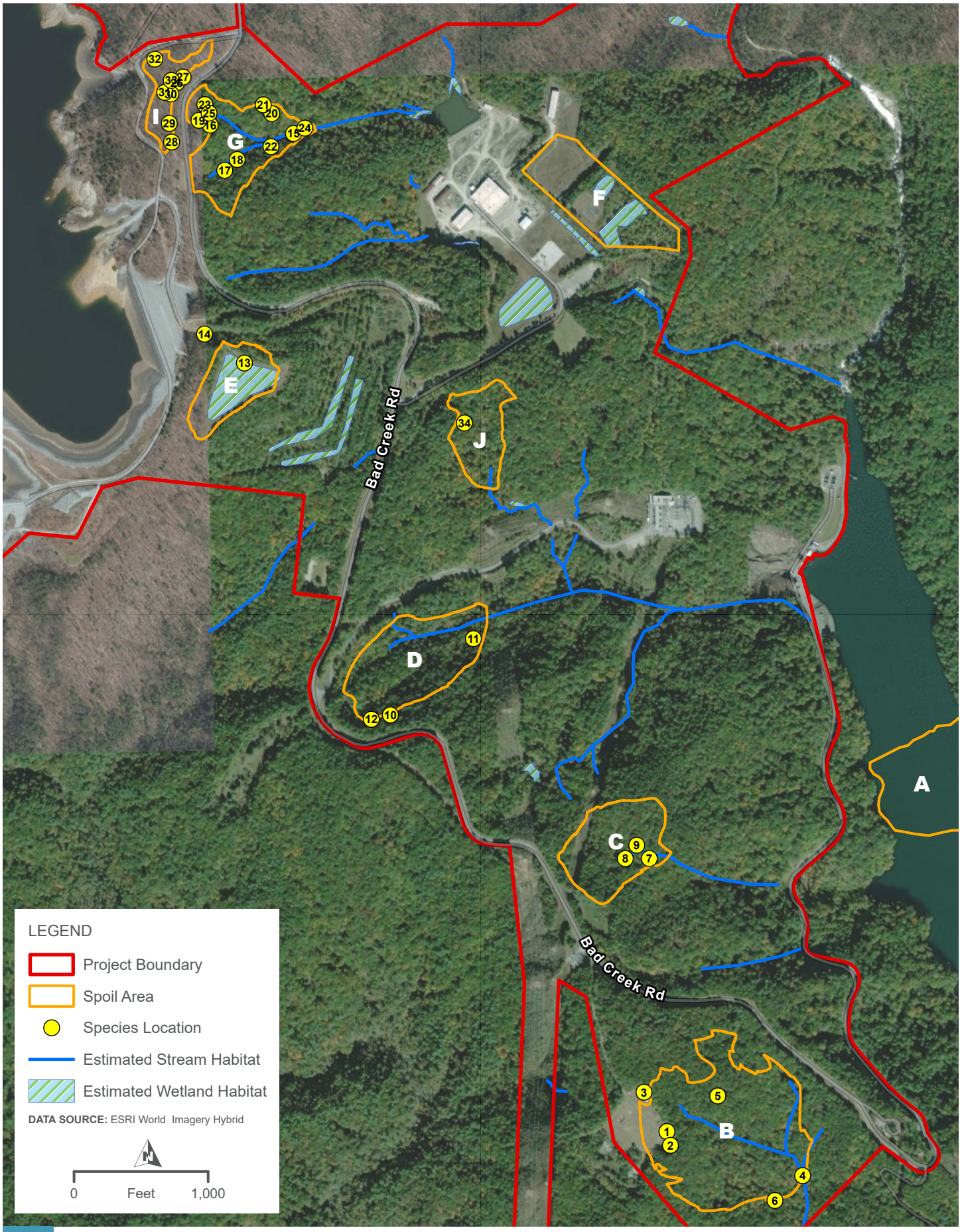

BAD CREEK PUMPED STORAGE PROJECT

HERPETOLOGY SPECIES LOCATIONS

FIGURE 3

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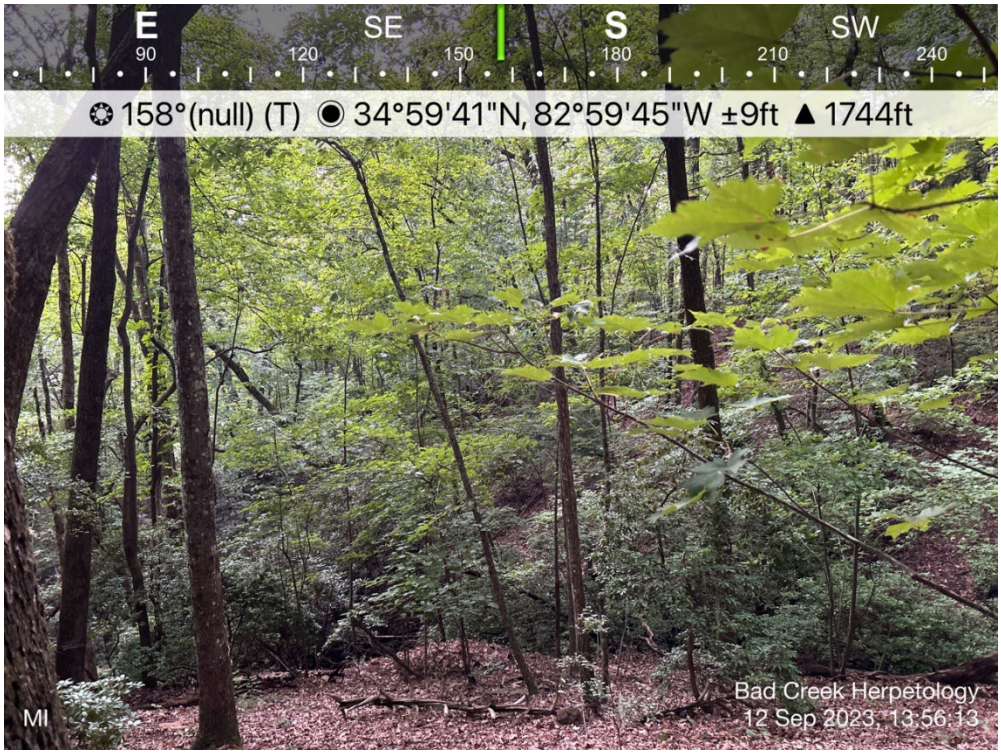
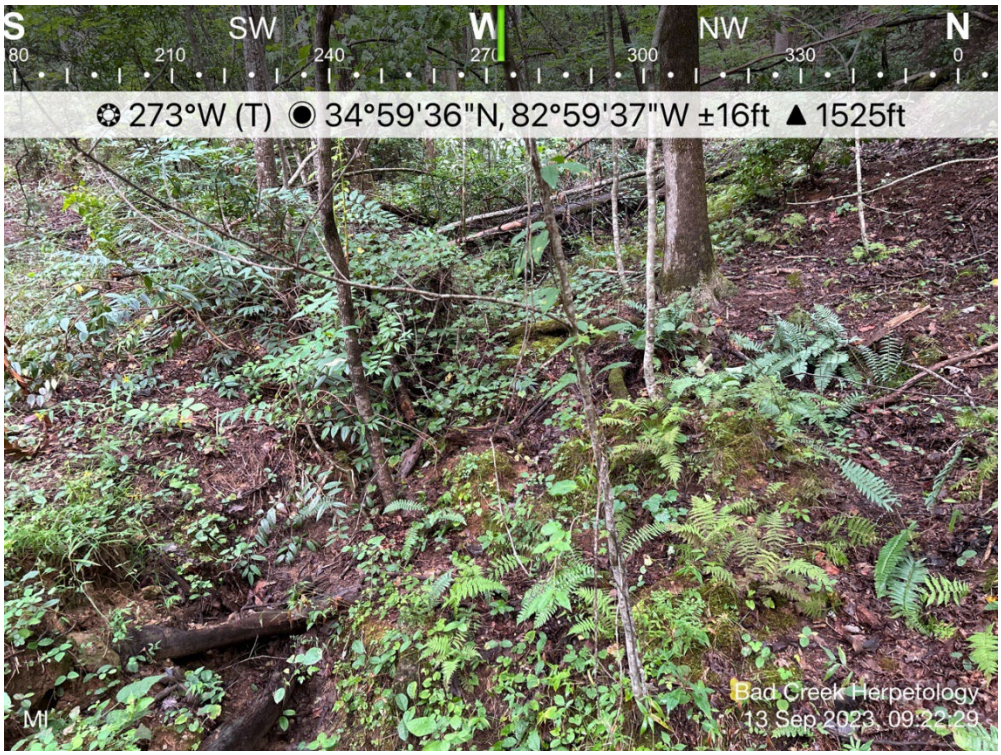
PHOTOLOG



Photograph 1 – Area B, forested area



Photograph 2 – Area B, forested area

Photograph 3 – Area B, stream

Photograph 4 – Area B, box turtle shell

Photograph 5 – Area C, Southern gray-cheeked salamander

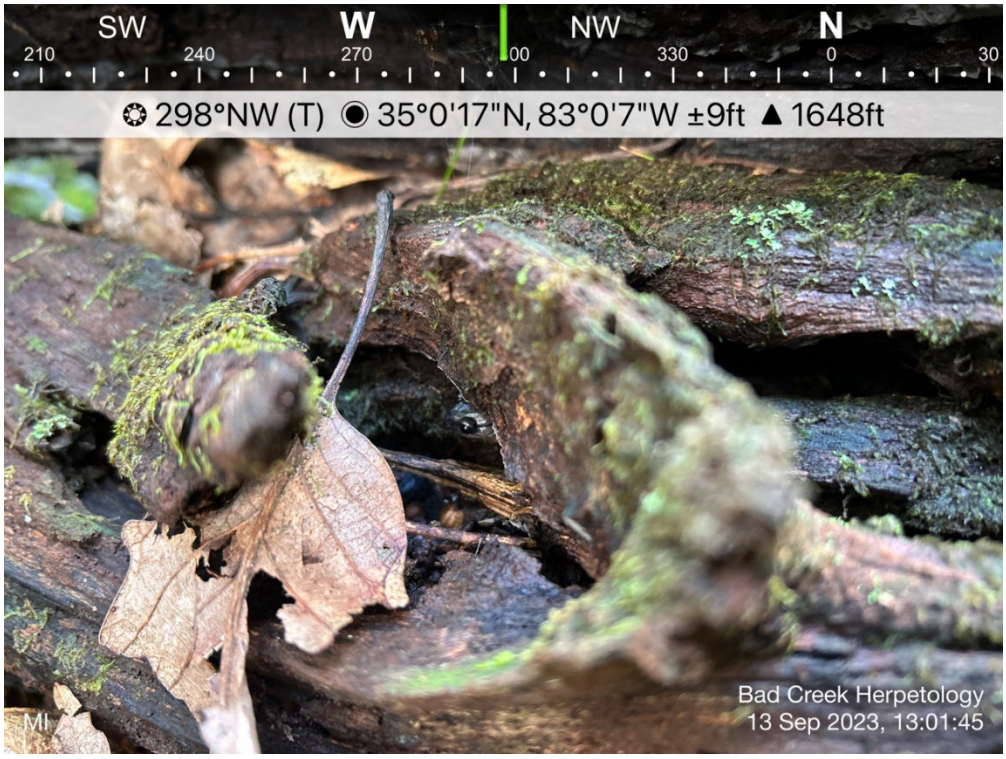
Photograph 6 – Area C, Southern gray-cheeked salamander

Photograph 7 – Area C, forested area

Photograph 8 – Area C, stream

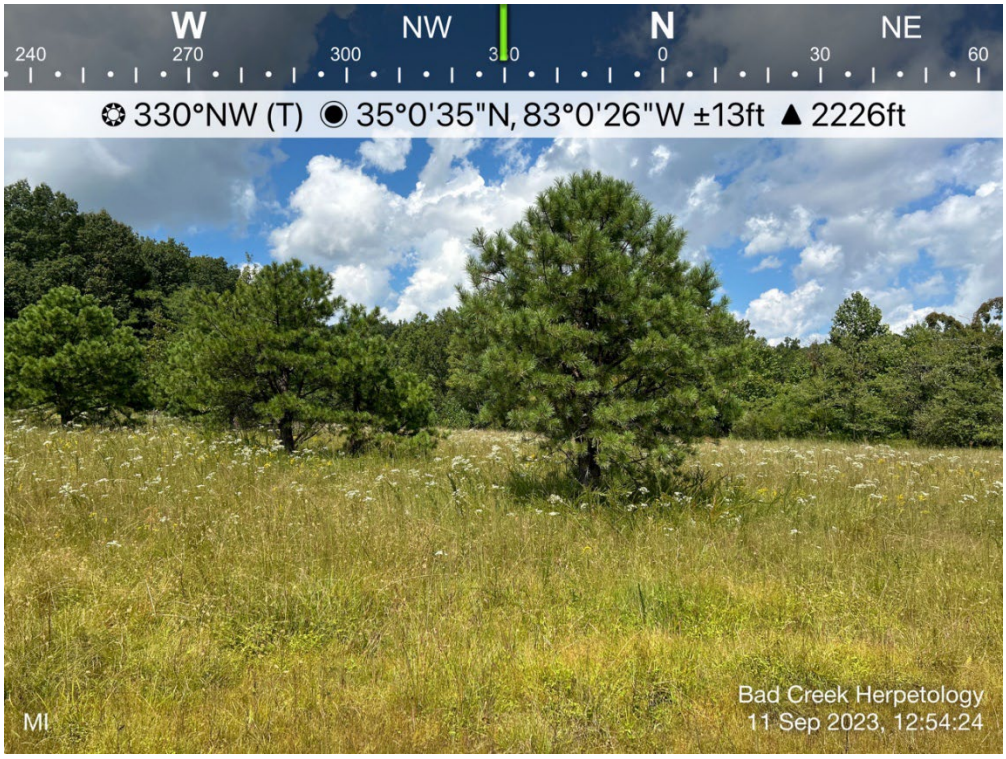
Photograph 9 – Area C, stream

Photograph 10 – Area D, Southern gray-cheeked salamander in crack

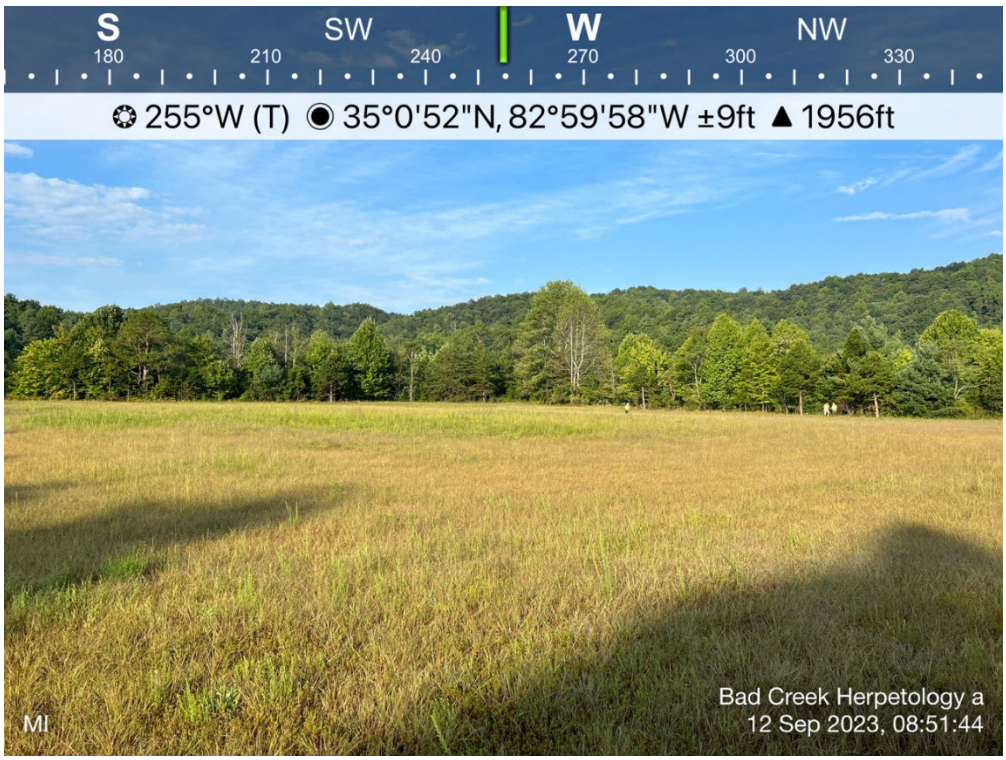


Photograph 11 – Area D, Southern gray-cheeked salamander in log

Photograph 12 – Area E, black racer snake



Photograph 13 – Area E, open field



Photograph 14 – Area F, open field

Photograph 15 – Area F, helicopter pad

Photograph 16 – Area F, structure

Photograph 17 – Area G, Blackbelly salamander in stream

Photograph 18 – Area G, Chatooga dusky salamander

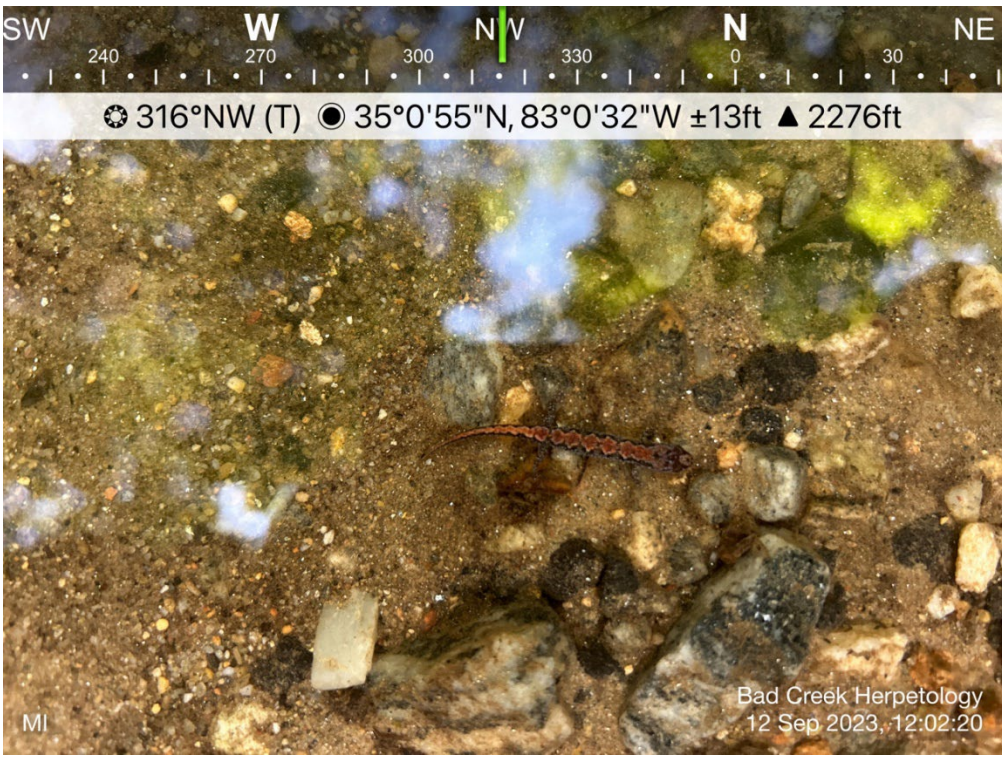
Photograph 19 – Area G, frog (unknown sp.)

Photograph 20 – Area G, Southern gray-cheeked salamander

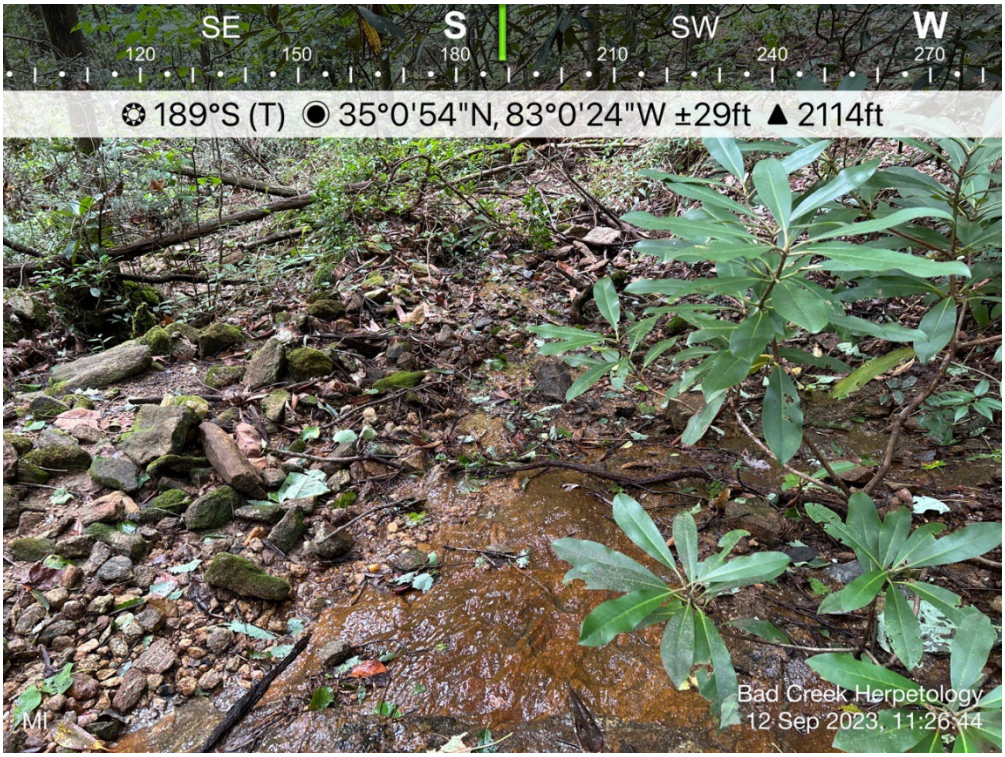
Photograph 21 – Area G, Southern gray-cheeked salamander

Photograph 22 – Area G, Southern gray-cheeked salamander

Photograph 23 – Area G, red salamander

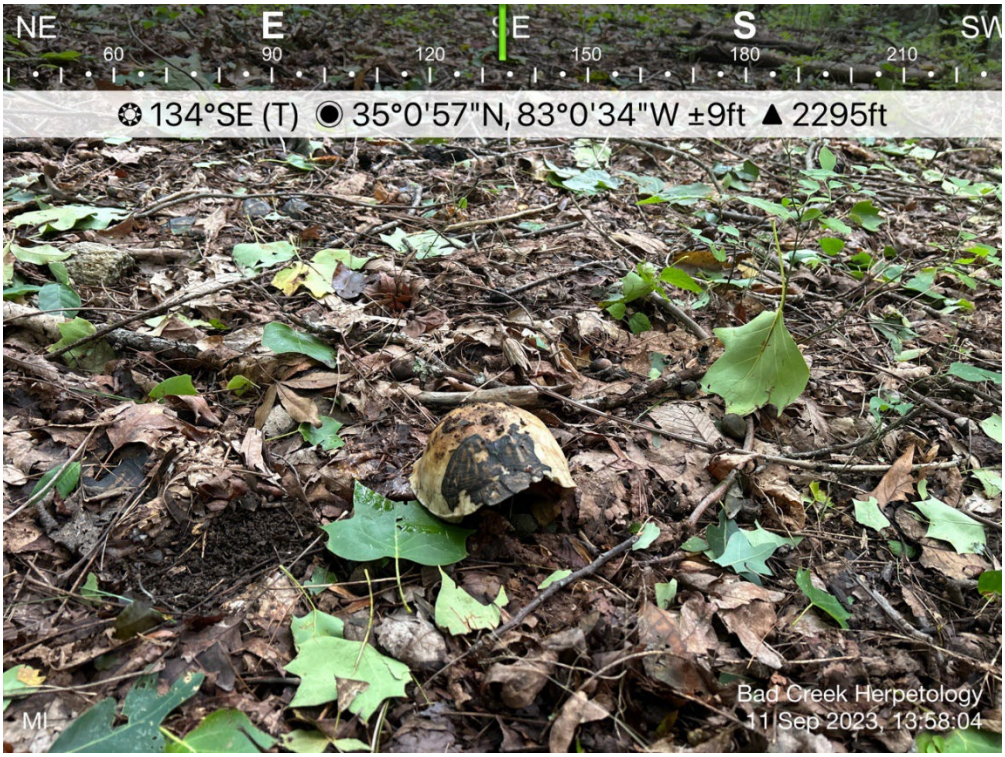


Photograph 24 – Area G, salamander in stream



Photograph 25 – Area G, stream

Photograph 26 – Area I, blackbelly salamander



Photograph 27 – Area I, box turtle shell

Photograph 28 – Area I, Southern gray-cheeked salamander

Photograph 29 – Area I, Southern gray-cheeked salamander

Photograph 30 – Area I, Southern gray-cheeked salamander

Photograph 31 – Area I, salamander