Schoolfield Hydroelectric Project
(FERC No. 2411)

FINAL

Application for New License Major Water Power Project 5 Megawatts or Less

Attachment 1

Draft Study Plan

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DRAFT STUDY PLAN

SCHOOLFIELD HYDROELECTRIC PROJECT (FERC No. 2411)

April 2020

Prepared for:

STS Hydropower, LLC
a subsidiary of

EAGLE CREEK RENEWABLE ENERGY
— EXCELLENCE IN HYDRO —

&

City of Danville, Virginia

Danville VIRGINIA

Prepared by:

WSP

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1.0 INTRODUCTION

STS Hydropower, LLC (STS), a subsidiary of Eagle Creek Renewable Energy, and the City of Danville, VA are co-Licensees (Licensees) and are licensed by the Federal Energy Regulatory Commission (FERC or Commission) to operate the 4.5-Megawatt (MW) Schoolfield Hydroelectric Project (Project, FERC No. 2411) located on the Dan River in Pittsylvania County, Virginia. The current license to operate the Project was issued on August 26, 1994 for a 30-year term. Therefore, the current license expires on July 31, 2024.

On May 31, 2019, the Licensees initiated Project relicensing by filing, with the Commission, a Notice of Intent (NOI) to File Application for New License, a request to relicense the Project using the Commission's Traditional Licensing Process (TLP), accompanied by a Pre-Application Document (PAD). On July 24, 2019 FERC approved the Licensees' request to use the TLP; therefore, the Licensees are pursuing a New License for the Project following the TLP, as specified in 18 CFR §16.8.

In accordance with the TLP, the Licensees held a Joint Agency Meeting and Site Visit on September 18, 2019. Subsequent to the Joint Agency Meeting and Site Visit, resource agencies submitted study requests.[1] In total, ten study requests were collectively received from the U.S. Fish and Wildlife Service (FWS), the Virginia Department of Game and Inland Fish (VDGIF), and the North Carolina Wildlife Resource Commission (NCWRC). The requested studies include:

- Water Quality Study (FWS);
- Flow Assessment Study (NCWRC, VDGIF);
- Aquatic Fauna Survey (NCWRC);
- Fish Survey (FWS, VDGIF);
- Mussel Survey (FWS, VDGIF);
- Fish Passage and Protection Assessment (FWS, VDGIF);
- Entrainment and Impingement Study (FWS);
- Roanoke Logperch (RLP) Assessment (VDGIF);
- Recreation Use and Enhancement Assessment (VDGIF); and,
- Bald Eagle Nest Survey (FWS).

There is no requirement to prepare a formal study plan as is required by the Integrated Licensing Process (ILP), and therefore, there is no subsequent study plan determination by FERC. Nonetheless, the Licensees prepared this Draft Study Plan to facilitate consultation with the resource agencies so that a set of specific individual study plans is agreed upon among the

[1] Letters providing the study requests from the FWS,VDIGF, and NCWRC are filed with the Commission. See Accession Nos. 20191115-5067 (FWS), Accession No. 20191115-5234 (VDGIF), and Accession No. 20191115-5099 (NCWRC).

agencies and Licensees. The intent of these specific individual study plans is to form the Final Study Plan document, guiding the collection of additional information to support the relicensing process. To support this goal, in Section 2, the Licensees present the rationale for adopting, adopting with modification, or not adopting the study requests received. In Section 3, the Licensees provide specific individual study plans for the adopted studies to support the relicensing process.

2.0 RESPONSE TO STUDY REQUESTS

The purpose of relicensing studies is to supplement existing, relevant, and reasonably available information so that the Commission and other licensing participants have an adequate factual record to assess Project effects and to inform proposed requirements in the new license. In developing this Draft Study Plan, the Licensees evaluated the merits of each study request submitted by the stakeholders based on the seven study criteria set forth in §5.9(b) of the Commission's ILP regulations. These criteria are designed to ensure that requested studies are needed to help focus the evaluation of Project effects (FERC, 2012).

The Licensees propose to adopt, but with modification, the requested Water Quality Study, Flow Assessment Study, Mussel Survey, Entrainment and Impingement Study, RLP Assessment, and Bald Eagle Nest Survey. The Licensees justification for adopting these studies, but with modification are provided in Section 2.1. Individual study plans for proposed studies are presented in Section 3. The Licensees do not propose to perform, as requested, the recommended: Aquatic Fauna Survey, Fish Survey, Fish Passage and Protection Assessment, and the Recreation Use and Enhancement Assessment. The Licensees' justification for not performing these studies is provided in Section 2.2.

2.1 Studies Adopted with Modification by the Licensees

2.1.1 *Water Quality Study*

The water quality study requested by the FWS aims to assess Project effects on water quality, with an emphasis during non-spill low flow conditions. The FWS states that because there is sparse continuous water temperature and dissolved oxygen data available for Project-affected reaches of the Dan River the existing water quality information is not sufficient to evaluate Project effects on water resources (§5.9(b)(4)). The FWS recommends the Licensees collect water quality data using scientific water quality sampling techniques used in most hydropower licensing proceedings. The FWS also recommends the study be performed during the spring, summer, and fall with monitoring stations upstream of the Project reservoir, in the reservoir, and downstream of the Project powerhouse. The FWS also recommends the study include a provision for an additional year of study, if the FWS determines the data collected is inadequate or if river flows are atypical for the initial study year.

According to the USGS Gage 02075045 Dan River at STP near Danville, VA, river flows are generally variable with some spates during the spring, progressively decreasing through the summer, and are near their lowest during the early-fall. The Licensees propose to collect continuous water quality data during the period June 1 through September 30, 2020, which will capture flow variability, including non-spill and spill conditions. This time period will also capture the period when water temperature and dissolved oxygen conditions are most limiting for aquatic resources, due to higher water temperatures and low oxygen solubility of water. Therefore, rather than collect continuous data during the entire spring, summer, and fall season, as recommended by the FWS, the Licensees propose June 1 through September 30 as the monitoring period.

The FWS requested water temperature and dissolved oxygen data be collected at a location upstream of the Project reservoir, and outside of the Project boundary, which would serve as a

reference site. The Licensees are proposing to monitor water quality at a location near the upper extent of the reservoir. Section 3 describes the proposed monitoring stations for the water quality study.

In regard to repeating the study over a second study season if the FWS determines the data that is collected is inadequate or if river flows are atypical, Commission regulations allow for resource agencies to request additional scientific studies (§4.32(b)(7)). In addition, the FWS does not specify how they would judge the data to be adequate or inadequate, nor does the FWS specify what would be considered atypical river flows. Therefore, the Licensees respectfully declines to commit to a second study season in the water quality study plan because a provision for additional scientific study is already in Commission regulations, and the ambiguous nature of the FWS's decision criteria. in determining the inadequacy of the data and what river flows would be considered atypical. Nonetheless, the Licensee's aim to distribute to the resources agencies the draft study reports during the first quarter of 2021 for review and comment. As part of the review and comment portion of the draft report review, the Licensees would consult with the agencies regarding the results of the study and the conditions under which they were recorded and would consider a request for additional study at that time should a request be necessary..

2.1.2 *Flow Assessment Study*

NCWRC and VDGIF state that rapid and frequent fluctuations in Project discharge can impact fish and mussel populations, particularly in riffles and other shallow habitats. Data from the downstream USGS Gage 02075045 Dan River at STP near Danville, VA indicate that the Project potentially causes flows in the Dan River to fluctuate downstream of the Project. In addition, both NCWRC and VDGIF suggest that the fluctuation flows observed at the downstream gage may be the result of hydropower projects upstream of the Project, such as the U.S. Army Corp of Engineers Philpott Hydroelectric Project on the Smith River. NCWRC's goal for the study is to understand Project operations under a range of inflow conditions and the resulting effects on downstream flows. VDGIF's goal for the study is to fully assess the effect of Project operations on downstream flows and evaluate options for utilizing the Project to attenuate highly altered inflows to mimic a more natural flow regime. NCWRC recommends the Licensees collect fine-scale reservoir and tailwater elevation data over a 12-month period. VDGIF does not recommend a study methodology, but rather defers to additional consultation.

The Licensees agree that the downstream USGS gage does suggest that the Project may regulate to some extent flows of the Dan River. However, the Project is licensed to operate as a run-of-river facility. The Project operator assures run-of-river operations by monitoring set-points and alarms of reservoir water level readings from a headwater level transducer and inflow to manually operate each of the six fixed-output turbines. Therefore, as inflows fluctuate, the operator maintains a relatively constant reservoir water level by adjusting turbine discharge. To elucidate this operation regime, the Licensee propose a flow assessment study, with the following modifications. Section 3 describes the proposed water level monitoring locations for the flow assessment study.

In their study request letter VDGIF states, "inflows to the [P]roject are highly altered by upstream projects." Because the waters of the Dan River upstream of the Project are influenced by other developmental activities that are not Project related there is no reasonable Project nexus to flow of the Dan River upstream of the Project reservoir (§5.9(b)(5)). In addition, there can be

no license requirement that requires the Licensees to mitigate a non-Project related effect, such as flow alterations caused by an upstream Project or activity, and outside of the influence of the Schoolfield Project (§5.9(b)(5)). The Licensees, therefore, respectfully decline to study the feasibility to use the Project to attenuate inflow into the Project to match a more natural flow regime.

NCWRC recommends the Licensees collect fine-scale reservoir and tailwater elevation data over a 12-month period. However, Project impacts on downstream river flow would only occur when the river flows are less than the Project's hydraulic capacity of 2,160 cfs. This typically occurs in the late spring, summer, and fall. During this time period spates also occur. Therefore, the Licensees proposed to collect the requested data over a shorter time period, June 1 through September 30 concurrent with other field studies, which would reduce the level of effort and cost of the study (§5.9(b)(4) and §5.9(b)(7)).

2.1.3 *Mussel Survey*

VDGIF and FWS requested a freshwater mussel assessment to include the identification of suitable mussel habitat, the species present, and an evaluation of mussel population trends, including upstream of the Project reservoir. VDGIF and FWS state the study is needed because there is no freshwater mussel data of the Project reservoir and downstream of the Project dam, and existing mussel data from the Dan River are insufficient to assess Project effects on freshwater mussels and their habitat in the Project area. To collect this data, VDGIF and FWS recommend an approved surveyor perform surveys for mussels in and upstream of the Project reservoir.

The Project reservoir extends approximately 6 river miles upstream of the Project dam, which represents the maximum upstream extent of Project impacts. Because the Dan River upstream of the Project reservoir is not influenced by Project operations, but rather by other non-Project related activities, there can be no license requirement to require mitigation of a non-Project effect (§5.9(b)(5)). For the reasons discussed above, the Licensees propose to conduct a Freshwater Mussel Survey within the Project reservoir and tailwater, as described in Section 3.

The FWS also recommends, as a study objective, the Licensees use the study to establish a baseline to measure changes in mussel occurrence over time. According to FERC (2012), the Commission uses the current condition, the environment as it exists at the time of licensing, as its baseline for evaluating Project effects. Nonetheless, Licensees are proposing to perform a Freshwater Mussel Survey to characterize baseline conditions; the scope of which is described in Section 3.

2.1.4 *Entrainment and Impingement Study*

The entrainment and impingement study requested by the FWS seeks to determine the effect the Project has on the existing fish community. Specifically, the FWS requests the Licensees provide information on survival rates of all species and life stages that may become impinged on the Project's trashracks, entrained into the Project turbines, and provide estimates of annual mortality rates. The FWS also requests that the Licensees provide estimates of indirect, latent mortality of those fish become pass through the Project turbines, and consider cumulative effects of multiple, stacked hydroelectric projects on the Dan and Roanoke Rivers. The FWS states the

study is needed because there is no recent, existing levels of entrainment and turbine mortality at the Project, and such data are needed to assess Project effects. The FWS recommends the Licensees perform the study following methods used in other hydropower relicensing entrainment and impingement studies.

In general, the Licensees propose to adopt the entrainment and impingement study, as recommended by the FWS, with the following modifications: not including an analysis of indirect, latent mortality and a cumulative effects analysis. FERC uses the Council of Environmental Quality (CEQ) definition of direct, indirect, and cumulative effects in determining effects of existing Projects.[2] CEQ defines an indirect effect as, "effects, which are caused by the action and are later in time or farther removed in distance, but are reasonably foreseeable." Mortality at a later date from predation, disease, or physiological stress may not be reasonably foreseeable or certain to occur. For a study that investigates an indirect effect, the study proponent should show that such indirect effects are reasonably certain to occur, the effects would be attributable to the licensing action, the Project's contribution to the indirect effects are measurable and would be significant enough to warrant the cost of the study, and the results would contribute to a meaningful license condition (FERC, 2012). Often, indirect effects are speculative, and analysis of such is not likely to be meaningful (FERC, 2012). Nonetheless, studying direct effects first may reveal that indirect effects may be possible and necessary. Therefore, the Licensees do not adopt the study goal of analyzing effects of indirect effects and latent mortality at this time, but rather a Desktop Entrainment and Mortality Study that would provide additional information on potential direct project effects.

With regard to cumulative effects, FERC staff considers such effects in their environmental document (e.g., Environmental Assessment) when appropriate. If the Project contributes to cumulative effects, FERC staff may require the Licensees to provide additional information to support their environment analysis. In a TLP proceeding, this would likely be in the form of an Additional Information Request (AIR) after the final license application is filed. FERC, however, would not require an applicant to study effects related to other, non-Project activities. In summary, "a potential applicant would not be responsible for conducting studies to gather data on other projects that may be necessary to assess cumulative environmental impacts of those projects and the potential applicant's project."[3] For these reasons, the Licensee does not propose to study cumulative effects.

2.1.5 *Roanoke Logperch Assessment*

The goal of the Roanoke logperch (RLP) assessment requested by VDGIF is to determine the status of the RLP in areas affected by the Project. VDGIF indicates the study is needed because there has been no targeted RLP survey in the Virginia segment of the Dan River, and such information is needed to determine the effect Project operations may have on the species. VDGIF recommends an approved RLP expert perform a survey for the RLP upstream of the

[2] On January 10, 2020 CEQ published in the Federal Register (85 Fed. Reg. 1684) a proposal to update regulations implementing the procedural provision of the National Environmental Policy Act (NEPA), a provision of which is to eliminate an analysis of cumulative effect in the NEPA process.

[3] See FERC Statutes and Regulations, Hydroelectric Relicensing Regulations Under the Federal Power Act; Order on Rehearing, Order No. 513-A, December 26, 1989, (RM87-33-001) 55 F.R. 4,[¶30,869] at p. 31,615.

Project reservoir, within the Project reservoir, and downstream of the Project dam using backpack electrofishing, SCUBA and/or snorkeling areas of suitable habitat. The Licensees propose to perform the RLP assessment within the Project tailwater. As discussed above, the Dan River upstream of the Project is influenced by other developmental activities that are not Project related; therefore, there is no Project nexus to RLP in the Dan River upstream of the Project reservoir (§5.9(b)(5)). Additionally, Duke (2019) sampled suitable RLP habitat in the Dan River upstream of the Project that is similar in habitat of the upper Project reservoir using appropriate methods over three years, and no RLP were collected. This postulate is also supported by Roberts (2012). Roberts (2012) reported that the only known extant RLP population in Virginia reside in the Smith River, which is far upstream of the Project. To determine if RLP reside in other tributaries of the Dan River in Virginia, Roberts (2012) sampled the Dan River mainstem in Patrick County and numerous tributaries of the Dan River from Patrick County to the Kerr Reservoir, including the Sandy River, which is located one-mile downstream of the Project dam. In summary, Roberts (2012) collected no RLP. Because recent sampling efforts that targeted suitable RLP habitat in the Dan River basin, the RLP is very likely not present in the Project reservoir, primarily due to the lack of suitable habitat.[4]

2.1.6 *Bald Eagle Nest Survey*

The FWS recommended the Licensees survey for bald eagle nests within the Project area to determine if bald eagles are affected by Project operations or activities. However, the FWS does not provide a bald eagle nest survey study request. Nonetheless, the Licensees propose to survey for bald eagle nests to support the FWS Project review process. The Licensees propose a bald eagle survey in Section 3.

2.2 Studies Not Adopted by the Licensees

2.2.1 *Aquatic Fauna Survey and Fish Survey*

The Aquatic Fauna Survey, as requested by NCWRC, includes four study components: a baseline fish survey, a freshwater mussel survey, a RLP assessment, and a benthic species survey. The FWS and VDGIF also requested a fish survey. The Licensees are proposing to perform a freshwater mussel survey and a RLP Assessment (see Sections 2.1, 3.4, and 3.6). The Licensees do not propose to conduct fish or benthic species surveys for the reasons described below.

The purpose of the fish survey would be to collect baseline data to characterize the occurrence, distribution, and relative abundance of fish species upstream of the Project reservoir, the Project reservoir, and downstream of the Project using multiple gear types. NCWRC, FWS, and VDGIF indicate that such a fish survey is needed because an assessment of Project aquatic fauna is lacking, the existing data presented in the PAD is outdated, and the species that comprise the existing fish community needs to be known so impacts on the fish community can be analyzed.

[4] Suitable RLP consists of medium-to-large, warm, usually clear streams and small rivers of moderate to low gradient with exposed, silt free gravel substrate (FWS, 2010).

The fish community information presented in the PAD is based on various sources, but not recent site-specific data. Since the filing and distribution of the PAD, Duke Energy made publicly available their *Dan River Long-Term Environmental Monitoring Report* (Duke, 2019).[5] The report summarizes three years of intensive fisheries sampling (2015 through 2017) using multiple gear types, including upstream of the Project reservoir and within the Project reservoir. Within the Project reservoir, boat electrofishing was performed four times per year for three years along two transects parallel to each shore with three 200-300 m long stations per transect. In addition, in riffle or shoal areas of the Dan River upstream and downstream of the Project, other gear types were used, including fyke nets, hoop nets, backpack electrofishers, and seines. The data provided consists of species, lengths, weight, and presence of parasites, disease, abnormalities. Overall, Duke (2019) provides recent information regarding the fish community of the Dan River in the Project area that adequately characterizes the Project's fish community; therefore, there is no need to collect additional information(§5.9(b)(4)). The Licensees present the results of Duke (2019) fish sampling of the Project's reservoir in Appendix A.

Benthic macroinvertebrate samples were also collected as part of the Dan River long-term monitoring effort (Duke, 2019). This effort included sampling six locations once per year for three years (2015 through 2017) throughout the Dan River, including upstream of and within the Project reservoir, following the methods for wadeable and non-wadeable areas as described in North Carolina Division of Water Resources (NCDWR) (2016). Overall, the data collected were used to characterize the existing benthic macroinvertebrate community of the Dan River, including the vicinity of the Project (§5.9(b)(4)), which is summarized in Appendix B. Duke (2019) adequately characterizes the benthic macroinvertebrate community within the Project area; therefore, there is no need to collect additional information.

NCWRC, FWS, and VDGIF also asked that the surveys include the area upstream of the Project reservoir. The Dan River upstream of the Project reservoir is not influenced by Project operations, but rather by other non-Project related activities; therefore, there is no Project nexus(§5.9(b)(5)). For this reason, areas upstream of the Project's operational influence will not be studied.

2.2.2 *Fish Passage and Protection Assessment*

The fish passage assessment, as requested by VDGIF and FWS, seeks to enhance upstream and downstream fish passage at the Project for all species. VDGIF indicates their resource management goal is to restore river connectivity in the segment of the Dan River occupied by the Project, while FWS states their resource management goal is to provide safe, timely, and effective passage to migratory species affected by the Project. The requested study would include a literature search of available passage designs, and an evaluation of those designs that would include an engineering component to inform what fish passage facility design and Project operations would to facilitate passage.

[5] A copy of Duke (2019) is available at: https://www.duke-energy.com/_/media/pdfs/our-company/ash-management/dan-river-ltmp-report.pdf.

VDGIF and FWS indicates the dam significantly limits upstream fish passage and potentially results in mortality through turbine passage. VDGIF states there are no diadromous fish present in the Project area. This statement is support by the fish assemblage data collected by Duke (2019). Furthermore, the two downstream low-head dams on the Dan River, also within the City of Danville, are known barriers to upstream fish passage. Therefore, there is no nexus to Project effects germane to upstream fish passage for obligate migratory species (§5.9(b)(5)).

Furthermore, the study requests appear to be based on assumptions that the dam is a significant barrier to fish passage and that turbine mortality needs to be mitigated. However, these assumptions are provided without supporting, site-specific information (§5.9(b)(4)). In summary, the study requests seek to mitigate a Project effect without knowing the extent of the effect, if any, and is pre-mature because no protective, mitigation, or enhancement measures could be developed without first understanding the effect the Project has on the resource. To develop this understanding, the Licensees propose a Desktop Entrainment and Turbine Mortality Study in Section 3.3.

2.2.3 *Recreation Use and Enhancement Assessment Study*

The recreation use and enhancement assessment, as requested by VDGIF seeks the enhancement of recreation access at the Project, or at a location outside the Project boundary, if enhancements within the Project boundary are not feasible. VDGIF suggests the study is needed because there is a demand for water-based recreation in the Danville, Virginia area. Specifically, VDGIF states there is a need for access to the Dan River upstream of the Project reservoir, downstream of the Project dam, and a canoe portage. The study request does not propose a methodology, but rather defers to consultation regarding potential enhancements.

Within the FERC-licensed Project area, there are opportunities for the public to access Project lands and waters. In addition, the City of Danville maintains a trail system that parallels the Dan River downstream of the Project. This trail system follows the Dan River from the Piedmont Driver Bridge immediately downstream of the Project, approximately 6 river miles downstream to near the VA-NC border. The City of Danville is also planning to provide water-based recreation downstream of the Riverside and Long Mill Dams, which would enhance downstream water-based recreation (City, 2020). With this addition, there is no need to enhance downstream water-based recreation at the Project.

Article 407 of the current FERC Project license required the Licensees to file a plan to provide a canoe portage at the Schoolfield Project. After consultation with agencies and other interested parties, however, it was decided in the mid-1990s that there is no appropriate portage location or path at the Project due to topography of the area, and layout project facilities and infrastructure. In lieu of constructing the canoe portage required by Article 407, VDGIF and VDCR recommended the Licensee fund improvements to a City-owned park (currently named the Abreu-Grogan Park) upstream of the Project that would include improvements to the existing access road, parking area, and the construction of a new boat ramp. The Licensee and the resource agencies then discussed entering into a Memorandum of Understanding to provide those improvements in lieu of constructing a canoe portage at the Project. As such, Article 407 requiring construction of the canoe portage was deleted by the Commission in an order issued on

November 9, 1995.[6] That order instead required the Licensees to contribute money in lieu of construction of a canoe portage for improvements at a Abreu-Grogan Park, where there is currently a boat launch, picnic area, boat dock, and canoe rental operation. This recreation site is not part of the Project license; however, it does contribute to some of the boating activity in and around the project. Because public access to Project lands and waters currently exists, the Commission previously determined that a canoe portage around Schoolfield Dam is not feasible, and circumstances regarding the reasons why a portage at the Project is not feasible have not changed. As such, there is no need to study recreation use and access at the Project.

[6] See Accession No. 19951117-0018.

3.0 DRAFT STUDY PLANS

3.1 Baseline Water Quality Monitoring Study

3.1.1 *Goals and Objectives*

The goals of the study are to 1) collect baseline water temperature and dissolved oxygen data to document the existing water quality conditions of the Dan River in the Project area; and, 2) determine whether the water quality of Project-effected reaches of the Dan River are consistent with Virginia water quality standards and designated uses. To accomplish these goals the study would have the following objectives:

1) Collect continuous baseline water temperature and dissolved oxygen data at representative locations within a riverine area of upper reservoir, forebay area, and tailrace from June 1 through September 30;

2) Characterize the baseline water temperature and dissolved oxygen data collected in Project area;

3) Analyze the continuous water temperature and dissolved oxygen data in comparison to Virginia surface water quality standards, inflow, and Project operations (headwater and tailwater elevation (ft), and generation (cfs and kW)).

3.1.2 *Existing Information and Need for Additional Information*

Existing water quality information in the Project area consists of various grab sample data and some continuous water temperature and specific conductivity data. The existing grab sample data is not collected at a frequency sufficient to assess effects of Project operations. Furthermore, the continuous data was collected downstream of the Project reservoir; thus those data do not lend themselves to an assessment of Project operations. Therefore, a need exits to collect water quality data at a frequency sufficient to assess effects of Project operations, and determine consistency with state surface water quality standards.

3.1.3 *Project Nexus*

Operation of the Project results in the discharge of waters impounded by the Project dam for the purpose of electrical generation, which may affect water quality within Project-affected reaches.

3.1.4 *Methodology*

Study Area

The proposed study area includes Project reservoir downstream to the Project tailwater. Figure 3.1.4-1 depicts the proposed monitoring station locations within the proposed study area.

Continuous Water Temperature and Dissolved Oxygen Monitoring

Continuous water quality data will be collected *in situ* at 15-minute intervals by deploying at each station U26-001 HOBO® Dissolved Oxygen Loggers (Onset Computer Corporation). Parameters to be measured include: water temperature (°C) and dissolved oxygen (mg/L and percent saturation). Calculation of dissolved oxygen percent saturation requires barometric pressure; therefore, a data logger that records barometric pressure, such as the U20L HOBO® Water Level Recorder (Onset Computer Corporation), will be installed out of water at the Project powerhouse. Each logger will be calibrated following the manufacturer's instructions and deployed at a representative location in the vicinity of the proposed sampling stations: one station in the upper reservoir, forebay, and tailrace (Figure 3.1.4-1). The upper reservoir and tailrace loggers will be tethered to shore and anchored by cinderblocks, whereas the forebay logger will be deployed at approximately 25% depth from the water surface when set, and suspended from a buoy that is anchored to the riverbed also by cinderblocks. The instruments will be deployed during a four month period from June 1 through September 30 to document baseline water quality conditions during the summer period. Each station will be visited every two weeks to off-load data; perform replicate fouling and calibration measurements per the manufacturer's instructions to assist in data correction; and clean, inspect, calibrate, and redeploy the instruments. It may be necessary to visit the stations to service the instruments weekly depending on the degree of fouling; however, we assume biweekly sampling would be sufficient. Fouling and calibration measurements will be collected using a recently calibrated water quality meter (e.g., YSI ProSolo or similar). Prior to redeployment, the data series will be visually examined in the field for any aberrant measurements that would indicate an instrument is malfunctioning, warranting further troubleshooting and/or replacement. All data will be recorded on field datasheets or recorded within the instruments' internal memory

Weather, River Flow, and Operations Data

Weather, river flow, and operations data will also be collected to add context to the water quality data. Weather data will be obtained from NOAA Station US1VALYC007, located 2.1 miles WSW of the Project. River flow data would be obtained from USGS Gage 02075045 Dan River at STP near Danville, VA, located approximate 5.2 river miles upstream of the Project dam. Operations data, such as turbine discharge (cfs) and generations (kW), will be provided by the Licensees.

Data Analysis

All field-collected data will undergo a thorough QA/QC review process to ensure the accuracy and completeness of the dataset prior to analysis. Data quality targets for this study include actual measurements obtained pre- and post-deployment in comparison to the field replicate data collected with a recently calibrated water quality meter should a relative percent difference (RPD) of ≤ 10%; and 80 % of all measurements collected must pass the QA/QC process. For dissolved oxygen (mg/L), RPD would be calculated as:

$$RPD = [\,|\,(a_i - b_i)\,|\,/\,((a_i + b_i)\,/\,2)] * 100$$

where;

a_i = actual measurement from the data logger at site visit i
b_i = side-by-side replicate reading from the handheld water quality meter at site visit i

The continuous temperature and dissolved oxygen datasets will be initially reviewed and analyzed for outliers, aberrant measurements, and missing data to ensure the collected data are valid. Corresponding field calibration measurements will then be used to determine if data correction is required for a specific deployment period. Correction of the data will occur *post-hoc* and will be performed using the Dissolved Oxygen Assistant within the manufacturer's HOBOware software. Any data point that does not pass QA/QC review and cannot be corrected will be flagged and removed from the final dataset prior to analysis.

The final water temperature and dissolved oxygen dataset will be summarized (e.g., mean, median, maximum, and minimum) and compared to applicable Virginia surface water quality standards. The final dataset will also be compared with Project operation data by plotting the water temperature and dissolved oxygen time series with operations.

Reporting

Results of the Baseline Water Quality monitoring Study will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment. The report would provide the methods and results of the study.

3.1.5 *Consistency with Generally Accepted Scientific Practice*

Data collection will be in accordance with methodology and instrumentation generally accepted by the scientific community. The data will be evaluated to determine Project effects on water quality.

3.1.6 *Study Schedule*

The Licensees anticipate this study would be implemented during the 2020 study season, between June 1 and September 30, during conducive and safe flow conditions. Further, the Licensees also anticipates to provide the draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

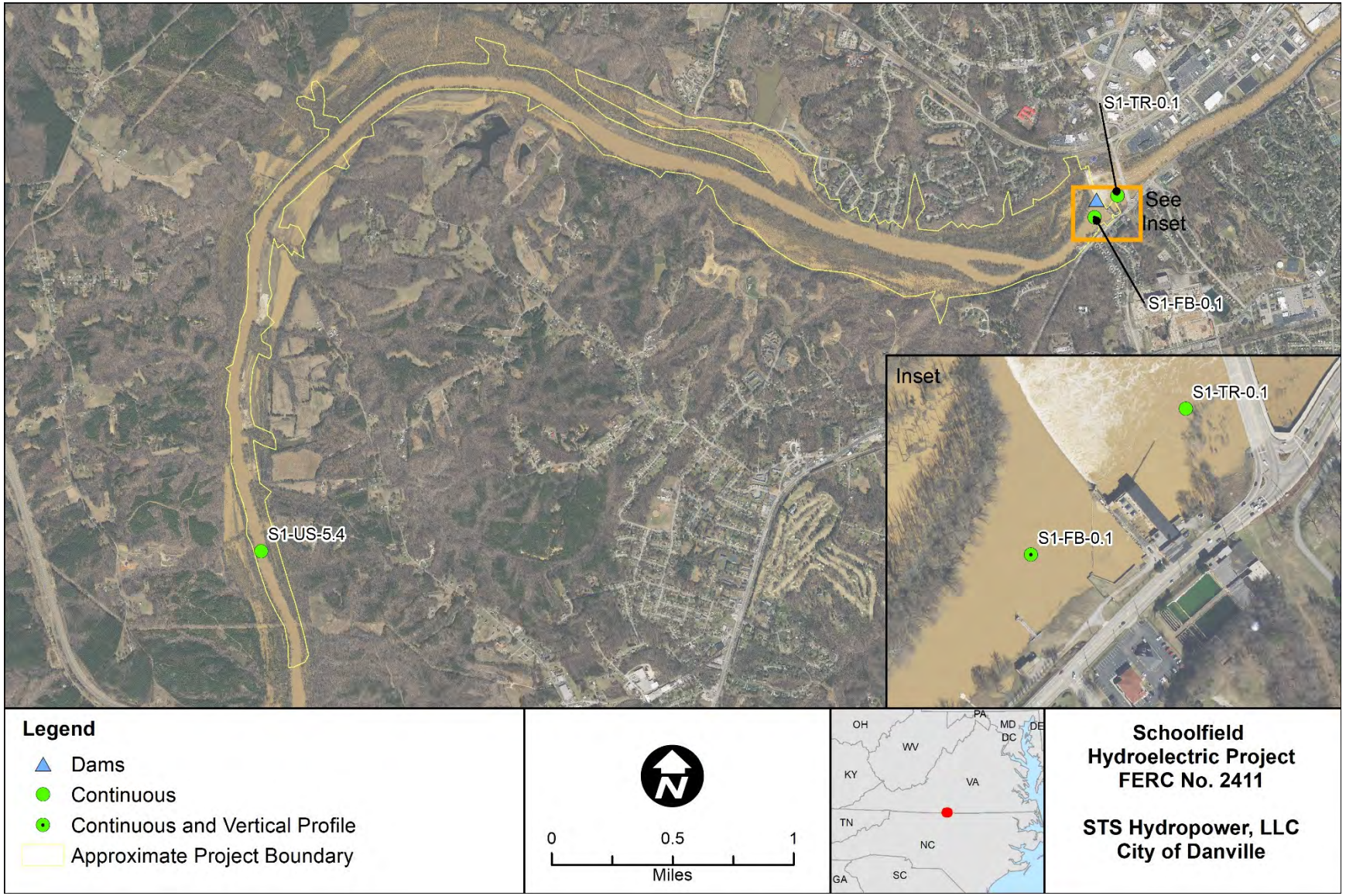

Figure 3.1.4-1. Proposed water quality monitoring study area and monitoring stations.

3.2 Operations and Inflow Assessment Study

3.2.1 *Goals and Objectives*

The goal of the Operations and Inflow Assessment Study is to document the effect inflows have on Project operations. To accomplish this goal, the study has the following objectives:

1) Describe how the Project's six fixed-output turbines and three generators are typically operated;

2) Collect continuous water level data at a representative location upstream of the Project reservoir, and downstream of the Project dam; and,

3) Characterize and compare water levels of the Dan River upstream of the Project reservoir, with operations and water levels downstream.

3.2.2 *Existing Information and Need for Additional Information*

Downstream data collected at the USGS Gage 02075045 Dan River at STP near Danville, VA indicate that the Project potentially causes flows in the Dan River to fluctuate downstream of the Project. However, the apparent flow fluctuations may be an artifact of inflows to the Project and the nature of the Project's run-of-river operations. To discern the difference, a need exists to monitor water levels in the Project area.

3.2.3 *Project Nexus*

Aquatic habitat downstream of the Project may be affected by Project operations and fluctuating discharges. Results from this study could be used to inform the development of protection, mitigation, and/or enhancement measures for aquatic resource protection in the Project tailwater.

3.2.4 *Methodology*

Study Area

The proposed study area is the Dan River upstream of the Project reservoir through the Project tailwater (Figure 3.2.4-1).

Describe Existing Operations and Operations Data

The Project has three generators and six, fixed-output turbines. The Licensees will describe the operating regime of the six turbines and will summarize: headwater (ft), tailwater (ft), turbine discharge (cfs), and generation (kW) data for the study period June 1 through September 30.

Collect Water Level and Flow Data

The Licensees will collect upstream and downstream water level data on 15-minute continuous basis from June 1 through September 30. Exact site locations will be determined in the field, but the two water level monitoring locations will be located at sites that exhibit similar channel morphology (e.g., width, depth, etc.), so that upstream and downstream water levels would be

comparable. Water levels will be monitored in situ by deploying a U20-001 HOBO® Water Level Recorder at each station. Data from each water level recorder will be offloaded on a near bi-weekly basis (i.e., every two weeks) concurrent with other field studies. At the beginning and end of each deployment period (i.e., bi-weekly period) reference water level measurements will be made relative to a benchmark established in the vicinity of each station that has an arbitrary elevation of 100 feet. Because the selected water level recorders collect absolute water pressure data, which changes in response to variability in air pressure, a separate water level recorder will be installed at the powerhouse to collect atmospheric barometric pressure data so water levels will be accurate.

Data Analysis

Water levels will be expressed as water surface elevations relative to the respective benchmark. Water surface elevation of each location and operations time series will be plotted at weekly intervals to depict spatial and temporal trends in water surface fluctuations and operations.

Reporting

Results of the Operations and Inflow Assessment Study will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment. The report would provide the study methods and results.

3.2.5 *Consistency with Generally Accepted Scientific Practice*

Water elevation data will be collected in accordance with methods generally accepted by the scientific community, and typically used in other hydroelectric project relicensing studies.

3.2.6 *Study Schedule*

The Licensees anticipates this study would be implemented during the 2020 study season, and would target June 1 through September 30 for field work. Further, the Licensees also anticipate to provide the draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

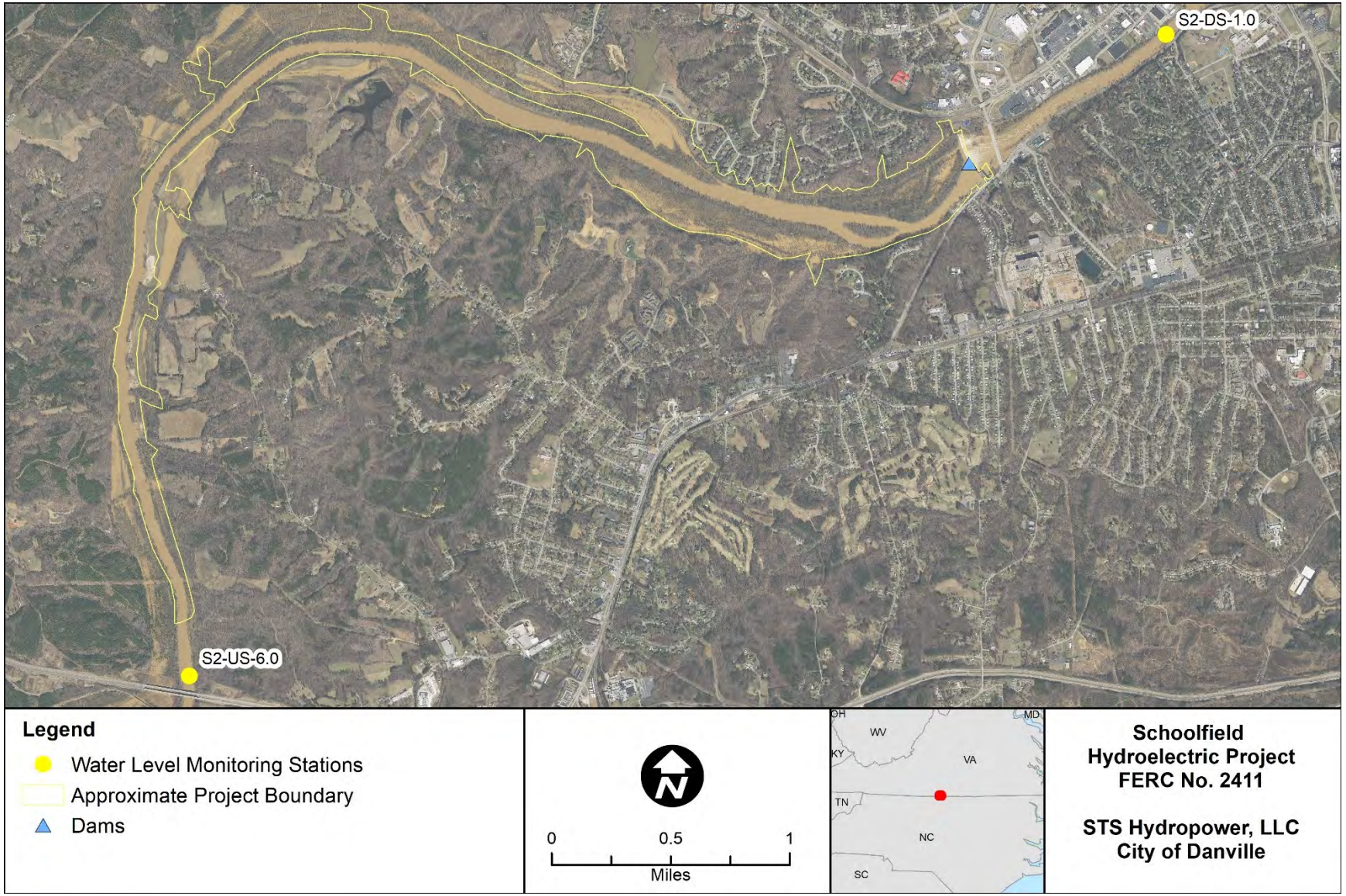

Figure 3.2.4-1. Operations and inflow assessment study area.

3.3 Desktop Entrainment and Turbine Mortality Study

3.3.1 *Goals and Objectives*

The goal of the Desktop Entrainment and Turbine Mortality Study is to evaluate the seasonal and annual fish entrainment and turbine mortality at the Project. The goal of the study will be met by achieving the following objectives:

1) Describe the existing physical, operational, and environmental characteristics of the Project;

2) Characterize the species composition of the fish community in the vicinity of the Project;

3) Select target species and life-stages in consultation with the Agencies;

4) Describe species specific information that includes life-history and habitat requirements, and swimming performance criteria for the target species and life stages;

5) Qualitatively assess entrainment and impingement potential for each target species and life stage by comparing physical, operational and environmental attributes of the Project with species-specific information;

6) Estimate the potential seasonal and annual entrainment for each target species;

7) Estimate the seasonal and annual turbine mortality for each target species based on turbine mortality estimates from similar projects; and,

8) Discuss impacts to the fish community and populations of the Dan River resulting from entrainment, impingement, and turbine mortality.

3.3.2 *Existing Information and Need for Additional Information*

There is no known existing data that quantifies the level of impingement, entrainment and turbine mortality at the Project. A Desktop Entrainment and Turbine Mortality Study will fill this data gap.

3.3.3 *Project Nexus*

The fish community and population structure of the Dan River in the Project area may be affected by operation of the Project through entrainment, mortality from impingement or passage through the Project turbines. Results from this study could be used to inform fisheries protection, mitigation, and/or enhancement measures.

3.3.4 *Methodology*

Study Area

The proposed study area includes the Project reservoir, intake/forebay area, and powerhouse.

Entrainment and Turbine Mortality Evaluation

The Entrainment and Turbine Mortality Study will follow a step-wise process:

1) Describe and discuss the Project characteristics that may influence entrainment and turbine mortality. This includes: the physical characteristics of the trashracks, turbines specifications, river hydrology, Project operations, and water quality and aquatic habitat near the intakes.

2) Characterize the existing fish community and select target species in consultation with the Resource Agencies. Characterizing the fish community typically involves summarizing existing fishery survey data (species and abundance) collected by the Agencies or the Licensees in the Project area. For the Dan River, this information is available from Duke (2019). After the species community is characterized, target species will be proposed and submitted to the Agencies for their concurrence. The target species will typically be either those of ecological significance or recreationally important. The target species will be a suite of species that undergo the subsequent entrainment and turbine mortality evaluations.

3) Perform a qualitative entrainment and impingement evaluation to determine the overall susceptibility of the target species to entrainment and impingement on the trashracks. The purpose of this qualitative evaluation is to winnow down the number of target species that could be susceptible to entrainment. The information compared typically is the overall size, habitat requirements, life history, and swimming ability of the target species to the habit near the intakes, the intake velocity, and the trashrack configuration. Based on these factors, the susceptibility is qualitatively determined to be none, low, moderate, or high. Only those target species that have an entrainment susceptibility of low to high are considered for the quantitative entrainment and turbine mortality assessment.

4) Estimate the number of target species entrained at the Project on a seasonal and annual basis. This step is completed by first selecting representative projects within the EPRI 1997 entrainment database that are similar to the Project. The EPRI 1997 database has entrainment rates based on actual field studies, expressed as number of fish per unit volume passed through the turbine. These entrainment rates would then be used to estimate the number of fish by multiplying the entrainment rate of the selected projects by the flow through the Project turbines.

5) Estimate the number of target species that experience turbine mortality at the Project. The first step to determine number of fish that experience turbine mortality is to review the EPRI 1997 turbine survival database and select representative projects that are similar to the Project to obtain a turbine mortality rate. Then, the turbine mortality rate is multiplied by the entrainment estimate to yield the number of fish that would experience turbine mortality.

Data Analysis and Reporting

Data analysis is implicit in the methods discussed above and would be detailed in the study report. Results of the Desktop Entrainment and Turbine Mortality Study will be presented in a

draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

3.3.5 *Consistency with Generally Accepted Scientific Practices*

This study involves the application of known fish community data with entrainment and impingement data following the methods and procedures generally accepted by the scientific community.

3.3.6 *Study Schedule*

Because the study is a desktop exercise, the Licensees anticipate performing the study during the first quarter of the 2021 study season. Further, the Licensees also anticipates to provide the draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

3.4 Downstream Roanoke Logperch Assessment

3.4.1 *Goals and Objectives*

The goals of the Downstream Roanoke Logperch Assessment are to: 1) determine whether suitable RLP habitat is present downstream between the Project dam and the upper extent of the Union Mills dam impoundment; 2) evaluate the presence/absence of the RLP is present between the Project dam and the upper extent of the Union Mills dam impoundment; and 3) collect information to support the Endangered Species Act (ESA) Section 7 consultation process. To attain these goals, the study has the following objectives:

1) Examine aerial photography and recent site photographs to select target areas between the Project dam and the upper extent of the Union Mills dam impoundment that may have potential RLP suitable habitat;

2) Perform a habitat assessment of the target areas identified in Objective 1; and,

3) Perform a reconnaissance-level survey for RLP at the targeted areas identified in Objective 1.

3.4.2 *Existing Information and Need for Additional Information*

Duke (2019) and Roberts (2012) indicate that RLP are very unlikely to occur in the Project area. Nonetheless there has been no survey for the RLP on the mainstem of the Dan River downstream of the Project dam. This information is needed to support the Section 7 ESA consultation process.

3.4.3 *Project Nexus*

If RLP are downstream of the Project dam, Project operations may impact the species and its habitat.

3.4.4 *Methodology*

Study Area

The proposed study area is the Dan River from the Schoolfield Dam downstream to the upper extent of the Union Mills dam impoundment (Figure 3.4.4-1).

USFWS Approved Surveyor

The Virginia Field Office of the FWS requires that any habitat assessments and sampling for endangered species, such as the RLP, must be performed by an approved surveyor. The Licensees have retained Alderman Environmental Services, Inc. who employs biologists that have collected RLP in the past and qualify as an approved surveyor.

Obtain VA Threatened & Endangered Species Collections Permit

VDGIF issues Threatened & Endangered Species Collections Permit only for individual projects. The Licensees will apply for the required collections permit immediately after the development of the Final Study Plan to allow for VDGIF's three to four-week application processing time prior to any field sampling.

Downstream RLP Habitat Assessment

The purpose of this assessment is to determine if suitable RLP habitat is present downstream of the Project dam. This assessment will be completed following a step-wise process. The first step would be to select potential habitat assessment sites based on RLP general habitat requirements. In the Roanoke River basin, RLP usually occupy runs and riffles greater than 20 cm in depth with exposed, silt-free gravel-boulder substrate (Lahey and Angermeier, 2006; FWS, 2010). This site selection would be done using aerial imagery and other site photographs (e.g., Google street view; obtained from other site-specific studies) between the Schoolfield Dam and upper extent of the Union Mills Dam impoundment. The approved surveyor would then review existing aerial imagery and recent photographs of the downstream river reach to identify possible run and riffle areas that appear consist with RLP habitat requirements. At the targeted areas field staff and the approved surveyor will collect depth (ft), velocity (fps at 0.6 depth), substrate, and percent silt-covered at the targeted areas of potential suitable habitat. This sampling will likely occur between September and October near suitable (base flow) and safe flow conditions (wadeable) (USGS, 2012; Anderson et al., 2014).

RLP Reconnaissance Survey

Concurrent with the habitat assessment, the approved surveyor would perform a reconnaissance-level survey for the RLP. This would involve employing either SCUBA, bathyscopes, and potentially electrofishing and seining to determine the presence/absence of the species. Observed species would be noted, but not measured or enumerated. Prior to this survey, VDGIF would be notified as per the VA Threatened & Endangered Species Collections Permit requirements.

Data Analysis

Data analysis would consist of calculating habitat suitability index (HSI)e scores from the habitat assessment and summarizing the list of fish species observed during the RLP reconnaissance survey. The calculated HSI scores for each potential habitat site would follow Anderson (2016), which consist of taking the product of the four preference values (from Appendix B in Anderson (2016)) for depth, velocity, substrate, and silt raising the product to the 0.25 power; and multiplying the outcome by 100. Then, associating the HSI score with the corresponding habitat suitability category: Unsuitable (HSI = 0), Poor (HSI = >0-25), Fair (HSI = >25-50), Good (HSI = >50-75) and Excellent (>75). Summarizing the fish observed from the RLP reconnaissance survey would involve a tally of the species observed by location and noting whether RLP are present or absent downstream of the Project.

Reporting

The report will present the methods, analyses, and results of the study. Results of the Downstream Roanoke Logperch Assessment will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

3.4.5 *Consistency with Generally Accepted Scientific Practice*

This study involves the survey of RLP habitat, and recording observation of RLP following methods and procedures generally accepted by the scientific community.

3.4.6 *Study Schedule*

The Licensees anticipates this study would be implemented during the 2020 study season. The study will commence by June 1, or as soon as flow conditions allow, and will continue through October. Further, the Licensees also anticipate to provide the draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

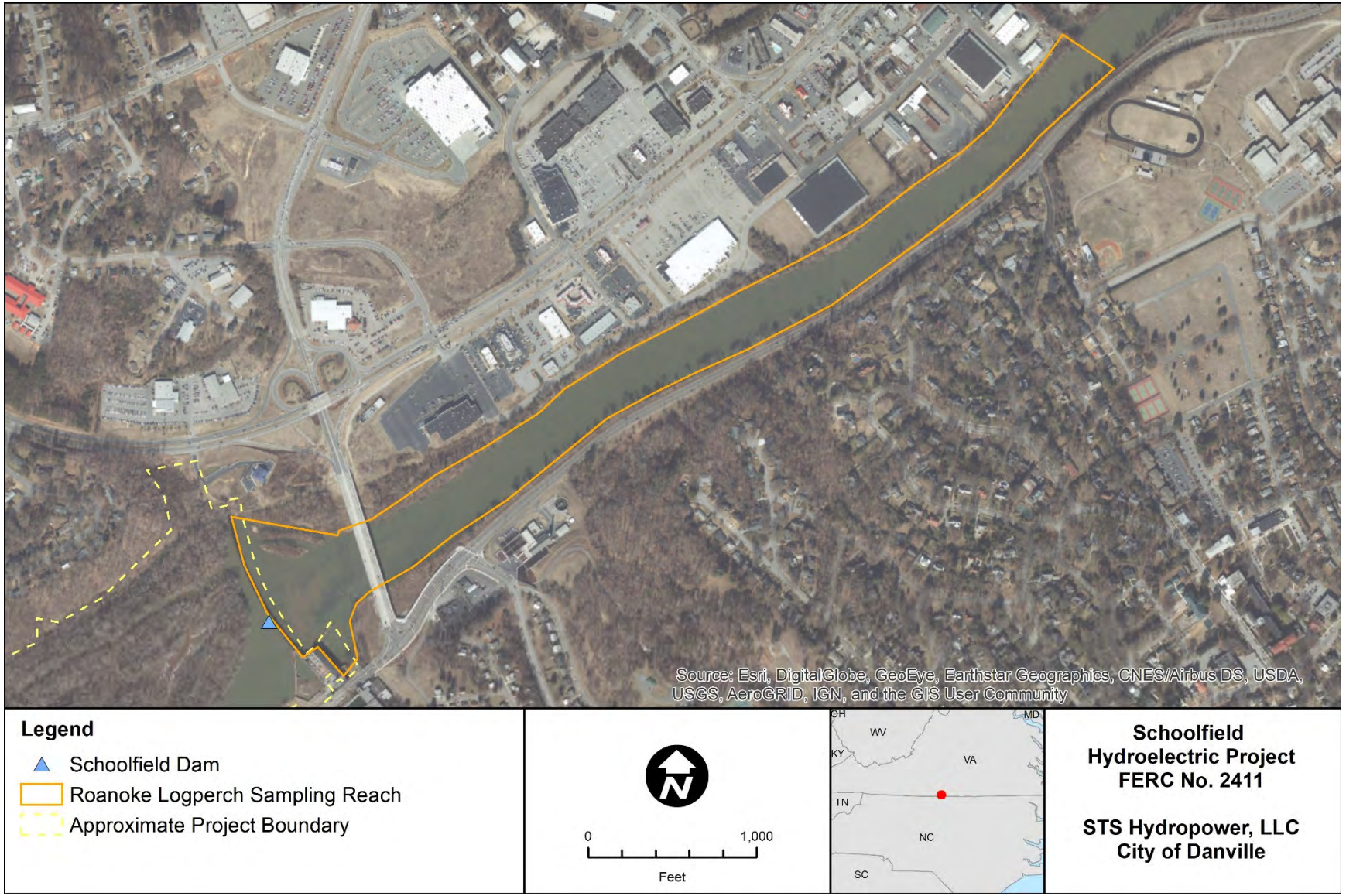

Figure 3.4.4-1. Proposed Roanoke logperch sampling reach.

3.5 Bald Eagle Nest Survey

3.5.1 *Goals and Objectives*

The goal of the Bald Eagle Nest Survey is to determine whether bald eagles nest within the Project boundary. The study goal will be achieved by accomplishing the following objective:

1) Document the location, condition, and status, of nesting pairs on lands within an approximate 0.5-mile buffer of the Dan River centerline within the Project boundary.

3.5.2 *Existing Information and Need for Additional Information*

The VDGIF's Bald Eagle Search Map, indicates a potential nest with unknown activity is adjacent to the Project boundary (Figure 3.5.2-1). This potential nest suggests that bald eagles may occur in the Project area. Information is needed to determine if bald eagles are present and nesting in the Project area.

3.5.3 *Project Nexus*

Bald eagles are protected under the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. These Acts require eagles to be protected from disturbance, including human-induced alterations around nesting sites. Actions associated with normal maintenance and operation of the hydroelectric projects have the potential to disturb bald eagle nesting. Therefore, measures may be needed to protect eagles from Project operations and activities.

3.5.4 *Methodology*

Study Area

The proposed study area includes lands within a 0.5-mile buffer around the Dan River center line including the Project boundary (Figure 3.5.2-1).

Bald Eagle Survey

The Licensees retained The Center for Conservation Biology at the College of William and Mary to survey all lands, within an approximate 0.5-mile buffer surrounding the Project for evidence of eagle presence (Figure 3.5.2-1). A high-wing Cessna 172 aircraft will be used to systematically overfly the land surface at an altitude of approximately 100 m to detect eagle nests. Flights will systematically move between the shoreline and approximately 0.5 miles inland to cover the most probable breeding locations. All nests detected will be plotted using a GPS-enabled notebook loaded with recent aerial photography and will be given a unique alpha-numeric code. Each nest will also be examined to determine its structural condition, the type and condition of nest tree, and the condition of the surrounding landscape. The nest survey will be conducted between mid-March and late April. Surveys during this period will coincide with the expected nesting chronology of late incubation through chicks prior to fledging.

Data Analysis

Data analysis would consist of providing information such as nest and tree condition, other habitat characteristics, and mapping nesting locations.

Reporting

The report will present the methods, analyses, and results of the study. Elements to be included in the report are 1) a record and associated maps of all known active pairs of bald eagles, 2) a table of nest condition, and nest tree condition, 3) and a record of any significant habitat characteristics or disturbances pertinent to future bald eagle management. Results of the study will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

3.5.5 *Consistency with Generally Accepted Scientific Practice*

The study involves the survey of the Project area using a ged aircraft operated by authorized biologists trained in survey techniques, which is consistent with generally accepted scientific practice and National Bald Eagle Management Guidelines (FWS, 2007).

3.5.6 *Study Schedule*

The study is anticipated to commence as soon as approved by the Resource Agencies during the 2020 study season. Results of the study will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

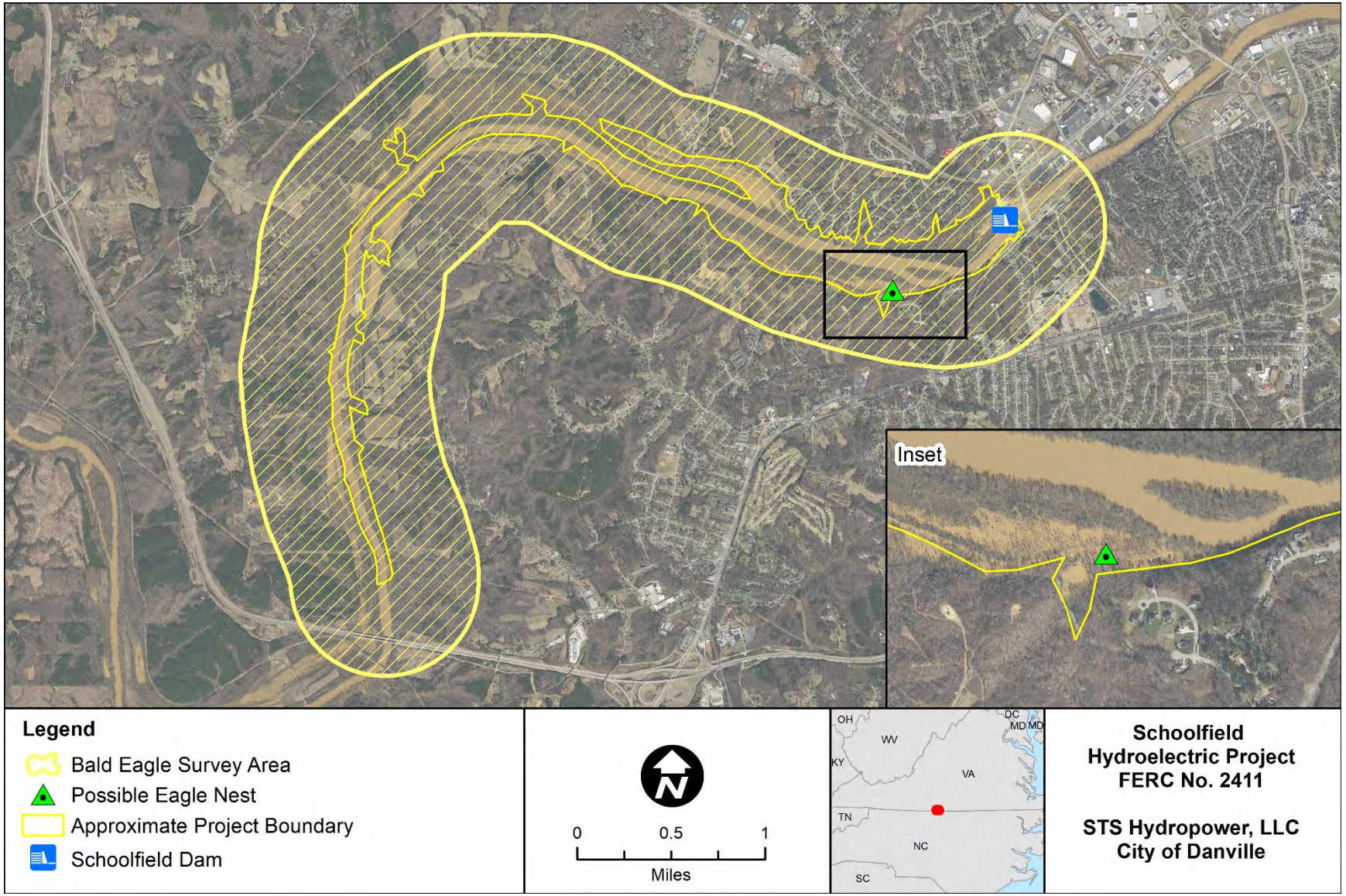

Figure 3.5.2-1. Proposed Bald Eagle survey area.

3.6 Freshwater Mussel Survey

3.6.1 *Goals and Objectives*

The goal of the Freshwater Mussel Survey is to document potential mussel habitat, determine the species of freshwater mussels present and their relative abundance in the Project area. These goals will be accomplished by achieving the following study objectives:

1) Conduct a literature review to determine the freshwater mussel species likely to occur within the Dan River in the Project area and describe their physical habitat requirements;

2) Describe exiting potential mussel habitat within the Project reservoir and downstream of the Project based on Alderman (2014);

3) If suitable mussel habitat potentially occurs in the Project area, as determined from Objective 2, identify a single representative sampling location within the Project reservoir and downstream of the Project dam to the upper extent of the Union Mills Dam impoundment;

4) Conduct a qualitative mussel survey to determine the presence and abundance of freshwater mussels at the location selected in Objective 4; and,

5) Describe the physical habitat surveyed.

3.6.2 *Existing Information and Need for Additional Information*

A freshwater mussel survey was performed throughout the Dan River by Alderman (2014) as a part of Duke Energy's coal ash spill response. However, the Alderman survey did not include the Project reservoir or the area downstream of the Project dam. Therefore, a need exists to document the existing mussel community within the Project reservoir and downstream of the Project dam.

3.6.3 *Project Nexus*

Freshwater mussel distribution and abundance is dependent on suitable habitat. Some mussel species, such as the Atlantic pigtoe, are sensitive to sedimentation, sediment scour, and water quality alterations that may result from hydropower operations. Operation of the Project impounds and utilizes flows of the Dan River for electrical generation, which may affect water quality and aquatic habitat suitable for freshwater mussels. Therefore, the distribution and abundance of freshwater mussels may be affected within Project-affected reaches of the Dan River.

3.6.4 *Methodology*

Study Area

The proposed study area includes the Project reservoir and downstream of the Project dam (Figure 3.6.4-1).

Literature Review

A review of relevant scientific literature will be performed to identify and develop a list of the freshwater mussel species likely to occur in the Dan River in the Project area. For the freshwater mussel species identified, their habitat requirements will be described, which will guide field data collection efforts.

Selection of Sampling Locations

Based upon the habitat requirements of the freshwater mussel species that are likely to occur in the Project area and the aquatic habitat available in the Project reservoir and tailwater, a qualified malacologist will identify and propose two representative sampling locations for a field survey (Carlson et al. 2008). One location will be in the upper reservoir and the other downstream of the Project dam. The selected sampling locations will be communicated to the Resource Agencies for comment and their concurrence. However, the final site selection will be determined in the field based on the professional judgment of a qualified malacologist. In the field, the spatial expanse of the sampling locations will be determine using a handheld GPS.

Qualitative Mussel Survey and Physical Habitat Descriptions

To perform the qualitative mussel survey, a scientific collections permit will be obtained from VDGIF upon approval of the study plan (USFWS and VDGIF, 2018).

Qualitative mussel surveys are presence/absence surveys using tactile and visual search methods, where a catch-per-unit-effort (CPUE) can be calculated based on the search area and time spent searching. A qualified malacologist will perform a qualitative survey for freshwater mussels at each sampling location along a 100-m transect when water conditions are of appropriate clarity (Carlson et al. 2008; USFWS and VDGIF, 2018). The transects will be parallel to shore in waters no deeper than 15 feet. The qualitative survey will include a visual examination along the transect for dead shells, as well as along shorelines and exposed areas (Carlson et al. 2008). Along each transect the survey will be conducted by visually examining the substrate and/or gentle probing (1 to 2 inches deep) and feeling the substrate for mussels. Depending on water depth, snorkeling or SCUBA will be used to examine the substrate; in general, water depths greater than one arm's length would require SCUBA (Carlson et al. 2008). All mussels discovered, either live or dead, will be identified to species and counted. The first 100 live individuals of each species encountered will be measured for total length, defined as the maximum distance between the posterior and anterior shell margins, with calipers to the nearest 0.1-mm and recorded (Carlson et al. 2008). Representative photographs of each species collected at each sampling location will be taken. All mussels (live or dead) that are collected will be re-bedded into the substrate in a posterior up position or gently placed on the substrate surface so as to allow the mussel to burrow and orient itself in the correct direction (Carlson et al. 2008). In addition, the total amount of time each person spent searching, weather, discharge at the beginning and end of sampling, and generation will be recorded.

Concurrent with the qualitative survey, the physical habitat along the survey transects will be described and representative site photographs will also be taken. Physical habitat descriptions would consist of: the mesohabitat type (run, riffle, pool), approximate total area of run, riffle, and

pool habitat, average depth, typical water velocity, and substrate (boulder, cobble, pebble, gravel, sand, silt and clay).

Data Analysis

Species richness will be determined for each sampling location and catch-per-unit-effort (CPUE) will be calculated for each species encountered by location. Basic summary statistics will be calculated based on the size data collected for each species and location. Length-frequency histograms will also be prepared to illustrate variations in species, size, and location.

Reporting

Results of the Freshwater Mussel Survey will be presented in a draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment. The report will present the methods, analyses, and results of the study.

3.6.5 *Consistency with Generally Accepted Scientific Practice*

This study involves the collection of freshwater mussel presence/absence and abundance data following the methods and procedures generally accepted by the scientific community.

3.6.6 *Study Schedule*

The Licensees anticipate this study would be implemented during the 2020 study season, targeting between April 1 and October 31, during conducive and safe flow conditions (USFWS and VDGIF, 2018). Further, the Licensees also anticipates to provide the draft study report to the agencies during the first quarter of 2021 for a 30-day period of review and comment.

Figure 3.6.4-1. Proposed freshwater mussel sampling locations.

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APPENDIX A:
FISH COMMUNITY DATA FOR THE PROJECT AREA

Table A-1: Fish taxa collected from the Project reservoir by Duke (2019) in 2015, 2016, and 2017.

Scientific Name	Common Name	2015		2016		2017		Total N
		N	%	N	%	N	%	
Lepisosteidae								
Lepisosteus osseus	Longnose Gar	1	0.1	0	0	0	0	1
Clupeidae								
Dorosoma cepedianum	Gizzard Shad	45	5	73	8.1	76	8.5	194
Cyprinidae								
Nocomis leptocephalus	Bluehead Chub	0	0	2	0.2	0	0	2
N. raneyi	Bull Chub	11	1.2	1	0.1	9	1	21
Notropis amoenus	Comely Shiner	14	1.6	78	8.7	38	4.2	130
N. hudsonius	Spottail Shiner	146	16.3	90	10	99	11	335
Cyprinus carpio	Common Carp	40	4.5	80	8.9	54	6	174
Hybognathus regius	Est. Silvery Minnow	2	0.2	0	0	0	0	2
Notemigonus crysoleucas	Golden Shiner	1	0.1	2	0.2	1	0.1	4
C. analostana	Satinfin Shiner	8	0.9	10	1.1	4	0.4	22
Lythrurus ardens	Rosefin Shiner	33	3.7	12	1.3	0	0	45
Luxilus albeolus	White Shiner	27	3	17	1.9	3	0.3	47
Ctenopharyngodon idella	Grass Carp	0	0	0	0	1	0.1	1
Unidentified cyprinids	Unknown	51	5.7	0	0	0	0	51
Catostomidae								
Carpiodes cyprinus	Quillback	3	0.3	96	10.7	24	2.7	123
Catostomus commersonii	White Sucker	6	0.7	2	0.2	0	0	8
Unidentified Maxostoma	Unknown	0	0	0	0	1	0.1	1
M. erythrurum	Golden Redhorse	82	9.2	134	15	183	20.4	399
M. collapsum	Notchlip Redhorse	1	0.1	11	1.2	1	0.1	13
M. pappillosum	V-Lip Redhorse	4	0.4	3	0.3	13	1.5	20
Hypentelium nigricans	Northern Hog Sucker	5	0.6	0	0	0	0	5
Ictaluridae								
Ameiurus brunneus	Snail Bullhead	0	0	7	0.8	3	0.3	10
A. catus	White Catfish	0	0	6	0.7	5	0.6	11
A. nebulosus	Brown Bullhead	2	0.2	4	0.4	7	0.8	13
Ictalurus furcatus	Blue Catfish	0	0	0	0	1	0.1	1
I. punctatus	Channel Catfish	15	1.7	48	5.4	65	7.3	128

Scientific Name	Common Name	2015		2016		2017		Total N
		N	%	N	%	N	%	
Poeciliidae								
Gambusia holbrooki	Eastern Mosquitofish	1	0.1	0	0	1	0.1	2
Centrarchidae								
Lepomis macrochirus	Bluegill	158	17.6	212	23.7	248	27.7	618
L. cyanellus	Green Sunfish	2	0.2	11	1.2	3	0.3	16
L.gibbosus	Pumpkinseed	1	0.1	1	0.1	1	0.1	3
L. auritus	Redbreast Sunfish	94	10.5	180	20.1	135	15.1	409
L. microlophus	Redear Sunfish	39	4.4	138	15.4	95	10.6	272
L. (Hybrid)	Sunfish (Hybrid)	1	0.1	4	0.4	0	0	5
L. gulosus	Warmouth	1	0.1	2	0.2	0	0	3
Micropterus salmoides	Largemouth Bass	67	7.5	63	7	58	6.5	188
M. dolomieu	Smallmouth Bass	1	0.1	3	0.3	6	0.7	10
Pomoxis nigromaculatus	Black Crappie	28	3.1	29	3.2	0	0	57
P. annularis	White Crappie	5	0.6	8	0.9	1	0.1	14
Percidae								
Perca flavescens	Yellow Perch	1	0.1	6	0.7	3	0.3	10
Number of Taxa		**33**	**–**	**31**	**–**	**29**	**–**	**39**
Total Catch		**896**	**–**	**1,333**	**–**	**1,139**	**–**	**3,368**

Source: Appendices II, JJ, and KK in Duke (2019), as modified by the Licensees.

APPENDIX B:
BENTHIC MACROINVERTEBRATE DATA FOR THE PROJECT AREA

Table B-1. Benthic macroinvertebrate descriptive metrics of the Project area for 2015, 2016, and 2017.

Descriptor	Year		
	2015	2016	2017
Total number of taxa	44	42	43
Total number of *Ephemeroptera*	6	6	8
Total number of *Plecoptera*	0	0	1
Total number of *Trichoptera*	3	4	2
Total number of EPT	9	10	11
Percent EPT of total taxa	20.5%	23.8%	25.6%
Total number of Intolerant taxa (0.0 - ≤ 3.3 TV)	3	2	2
Percent Intolerant taxa of total taxa	6.8%	4.8%	4.7%
Total number of Intermediate taxa (3.3 - ≤ 6.7-TV)	15	16	20
Percent Intermediate taxa of total taxa	34.1%	38.1%	46.5%
Total number of Tolerant taxa (6.8 - ≤ 10-TV)	13	12	11
Percent Tolerant taxa of total taxa	29.5%	28.6%	25.6%
Number of taxa with no established TV	13	11	14
Percent total taxa with no TV	29.5%	26.2%	32.6%
Number of EPT with no TV	1	2	2

Source: Appendix HH in Duke (2019).