FEDERAL ENERGY REGULATORY COMMISSION
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OFFICE OF ENERGY PROJECTS

Project No. 2466-034 – Virginia
Niagara Hydroelectric Project
Appalachian Power Company

VIA FERC Service

Mr. Jonathan Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation
P.O. Box 2021
Roanoke, VA 24022-2021

Reference: Study Plan Determination for the Niagara Hydroelectric Project

Dear Mr. Magalski:

Pursuant to 18 C.F.R. § 5.13(c) of the Commission's regulations, this letter contains the study plan determination for the Niagara Hydroelectric Project (Niagara Project) located on the Roanoke River in Roanoke County, Virginia. 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 July 9, 2019, Appalachian Power Company (Appalachian) filed its Proposed Study Plan (PSP) for eight studies covering water quality, aquatic habitat and fishery resources, terrestrial resources, recreation resources, and cultural resources in support of its intent to relicense the project.

Appalachian held its initial Study Plan Meeting on August 1, 2019. Comments on the PSP were filed by Commission staff, Friends of the Rivers of Virginia, the U.S. Fish and Wildlife Service (FWS), Dr. Paul Angermeier of Virginia Tech's Department of Fish and Wildlife Conservation (Dr. Angermeier), Roanoke Valley Greenway Commission, the Virginia Department of Environmental Quality (Virginia DEQ), Roanoke River Blueway Committee, the Environmental Protection Agency (EPA), and the Virginia Department of Game and Inland Fisheries (Virginia DGIF).

On November 6, 2019, Appalachian filed a Revised Study Plan (RSP) that includes revisions to six of the eight studies in the PSP. Comments on the RSP were filed by FWS, Bill Tanger on behalf of Friends of the Rivers of Virginia, Dr. Angermeier, and EPA.

Study Plan Determination

Appalachian's RSP is approved with the staff-recommended modifications discussed in Appendix B. As indicated in Appendix A, of the eight studies proposed by Appalachian, four are approved with staff-recommended modifications and four are approved as filed by Appalachian. This determination also addresses three additional studies requested by stakeholders, not adopted by Appalachian, and not required by this determination (see Appendix A). In Appendix B, we explain the specific modifications to the study plan and the bases for modifying, adopting, or not adopting requested 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.

Studies for which no issues were raised in comments on the RSP are not discussed in this determination. Unless otherwise indicated, all components of the approved studies not modified in this determination must be completed as described in Appalachian'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 December 5, 2020.

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, Appalachian 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 Allyson Conner at allyson.conner@ferc.gov or (202) 502-6082.

Sincerely,

Terry L. Turpin
Director
Office of Energy Projects

Enclosures: Appendix A – Summary of determinations on proposed and requested study modifications and studies requested but not adopted by Appalachian
Appendix B – Staff's recommendations on proposed and requested study modifications and studies requested

Project No. 2466-034

APPENDIX A

SUMMARY OF DETERMINATIONS ON PROPOSED AND REQUESTED STUDY MODIFICATIONS AND STUDIES REQUESTED BUT NOT ADOPTED BY APPALACHIAN

Study	Recommending Entity	Approved	Approved with Modifications	Not Required
Flow and Bypass Reach Aquatic Habitat Study	Appalachian		X	
Water Quality Study	Appalachian		X	
Fish Community Study	Appalachian		X	
Benthic Aquatic Resources	Appalachian		X	
Wetlands, Riparian, and Littoral Habitat Characterization Study	Appalachian	X		
Shoreline Stability Assessment Study	Appalachian	X		
Recreation Study	Appalachian, Virginia DGIF	X		
Cultural Resources Study	Appalachian	X		
Benthic Habitat Quality Assessment in the Bypass Reach and Downstream Areas	FWS			X
Fish Protection and Upstream and Downstream Passage Studies	FWS, Virginia DGIF			X

Hydrodynamics and Fish Behavior to Improve Roanoke Logperch Passage at Niagara Dam	Dr. Angermeier			X

APPENDIX B

STAFF'S RECOMMENDATION ON PROPOSED AND REQUESTED STUDY MODIFICATIONS AND STUDIES REQUESTED

The following discusses staff's recommendations on studies proposed by Appalachian, requests for study modifications, and requests for additional studies. We base our recommendations on the study criteria outlined in the Commission's regulations [18 C.F.R. section 5.9(b)(1)-(7)].

I. Required Studies

Flow and Bypass Reach Aquatic Habitat Study

Applicant's Proposed Study

Appalachian proposes to conduct a flow and habitat study for the Niagara Project's tailwater and bypassed reach using a combination of a desktop assessment, field surveys, and hydraulic modeling. The desktop assessment would include a literature review of available information and mapping of mesohabitats (e.g., pool, riffle, run, shoal) and Manning's roughness coefficient using aerial photography. Light detection and ranging (LiDAR) and photogrammetry data would be collected and used to produce a topographic map of the bypassed reach. Appalachian would then develop and calibrate a two-dimensional (2-D) hydraulic model that would be used in conjunction with an operations model [the Computerized Hydro Electric Operations Planning Software (CHEOPS) platform] to assess how aquatic habitat (depth and flow velocity) in the tailrace and bypassed reach varies across flows and project operation scenarios.

Hydrology data from the U.S. Geological Survey (USGS) gage (No. 05026000) in the Roanoke River at Niagara, Virginia (years 1926 through 2019) would be used to develop the CHEOPS model, which would be used to simulate flow releases under various inflow conditions and operating requirements. Appalachian would calibrate and validate the 2-D hydraulic model with flow and water depth measurements collected in the bypassed reach and tailwater under multiple flow scenarios. Test flows in the bypassed reach would range from the existing minimum flow requirement of 8 cubic feet per second (cfs) up to 200 cfs. For each flow scenario, incremental changes in depth and wetted area in the bypassed reach and tailrace would be determined, and Wolman pebble counts would be conducted along one to two transects before and after each controlled flow release scenario. Substrate and mesohabitat maps, and depth and velocity simulations would be used in combination with habitat suitability indices for species guilds to evaluate potential available habitat under each modelled flow scenario.

Flow Release

Comments on the Study

In comments on the PSP, the U.S. Fish and Wildlife Service (FWS) recommends that hydraulic modeling also be performed with water spilling over the dam instead of only through the sluice gate to see how this changes the available habitat within the bypassed reach. In the RSP, FWS further explains that given sufficient inflow, it may be possible to provide a controlled flow release over the crest of the dam through reduced turbine operations or project shutdown with the sluice gate closed.

Discussion and Staff Recommendation

In section 4.1 of the RSP, Appalachian notes that the sluice gate is the only operational control of the water level at the dam (other than the powerhouse intake), so it may not be possible to provide a controlled flow release beyond the capacity of this outlet. However, in section 4.6.3 of the RSP it states that the 2-D model would be capable of simulating different flow release points to the bypassed reach including through the sluice gate and over the spillway crest. Appalachian further states that calibration flows will be released into the tailwater and bypassed reach for purposes of collecting depth and wetted area data under various powerhouse and spillway flow regimes and spillway flow release points (i.e., either through the existing sluice gate or across the crest of the spillway). While it does not specify the details for how it would provide flow over the spillway, it appears that Appalachian has sufficiently addressed FWS' concern in the RSP.

Velocity and Water Quality Measurements

Comments on the Study

Appalachian proposes to measure velocity at an established cross-section during the test flow releases and to use these measurements to calibrate or verify modeled velocities. In comments on the RSP, FWS requests that a table of the velocity measurements for each evaluation flow be included in the project report.

In addition, in comments on the PSP and RSP, FWS requested collection of water temperature and dissolved oxygen at an established cross-section during the evaluation flow releases. It similarly requests that a table with water quality measurements under the different flow releases be included in the project report.

Discussion and Staff Recommendation

As Appalachian will already be collecting other information within the established cross-section under different flow releases, collecting dissolved oxygen (DO) and temperature measurements should require minimal additional cost and effort and would help illustrate potential changes in these parameters under the range of flows. We recommend that this water quality data be collected, and that the velocity and water quality measurements be included in the project report as requested by FWS.

Species of Interest

Comments on the Study

In the RSP, Appalachian proposes to use species guilds and habitat relationships previously developed for the upper Roanoke River to evaluate habitat suitability (Vadas and Orth 2001).[1] Appalachian refined the specific species included in each of the four rheophilic[2] (fast riffle, riffle-run, fast generalist, shallow rheophilic) and three limnophilic[3] (pool-run, open pool, pool cover) guilds developed by Vadas and Orth (2001). Selected species include those that were observed in previous surveys, protected species, and those of management concern, including Roanoke logperch, which is federally listed as endangered under the Endangered Species Act. In comments on the RSP, FWS suggests several additional changes to which species are included in the guild groupings (e.g., including a darter species in the "Fast Riffle" guild).

Although Roanoke logperch is included in one of the proposed species guilds, in the RSP, Appalachian states that peer-reviewed habitat suitability index curves specific to Roanoke logperch are not available and does not propose to develop them as part of this study. In comments on the RSP, FWS states that individual habitat suitability analyses are also needed for Roanoke logperch and suggests that Appalachian use a previously

[1] Vadas, R. L., Jr., and D. J. Orth. 2001. Formulation of Habitat Suitability Models for Stream Fish Guilds: Do the Standard Methods Work? Transactions of the American Fisheries Society 130:217-235.

[2] "Rheophilic" fish species prefer fast moving water.

[3] "Limnophilic" fish species prefer slow moving to stagnant water.

developed habitat suitability index for Roanoke logperch (Ensign and Angermeier, 1994; Ensign et al., 2000; Anderson and Angermeier, 2015).[4,5,6]

Discussion and Staff Recommendation

Evaluating habitat suitability within the bypassed reach for species guilds following Vadas and Orth (2001) is a reasonable approach, especially for a situation like here where individual habitat suitability curves are not available for all species. There are similarities among the species at the guild level sufficient to analyze the relationships between flow and habitat for all of the affected species. We recommend that Appalachian incorporate FWS' suggested minor changes to the species guild groupings.

Although Appalachian states that peer-reviewed habitat suitability indices are not available for Roanoke logperch, in section 6.6.2 of the RSP (Task 1b – Roanoke Logperch Study within the Fish Community Study), it proposes to evaluate habitat suitability for Roanoke logperch within targeted survey areas, including two areas within the bypassed reach using a previously developed habitat suitability index. Appalachian does not explain why this index would be inappropriate to use to evaluate changes in available Roanoke logperch habitat in the bypassed reach under different flow regimes as FWS suggests. Given the resource agencies noted management goals for Roanoke logperch and the availability of a species-specific habitat suitability index that Appalachian proposes to apply in section 6.6.2 of the RSP, evaluating habitat suitability for this species would refine the information on potential aquatic habitat in the bypassed reach provided by the guild approach for logperch noted above with minimal additional effort [(section 5.9)(b)(7)]. Therefore, Appalachian should evaluate habitat suitability for both species guilds and Roanoke logperch as part of the Flow and Bypass Reach Aquatic Habitat Study.

[4] Ensign, W. E., and P. L. Angermeier. 1994. Summary of population estimation and habitat mapping procedures for the Roanoke River Flood Reduction Project. Final Report to the Wilmington District, U. S. Army Corps of Engineers, Wilmington, NC.

[5] Ensign, W. E., and P. L. Angermeier. 1994. Summary of population estimation and habitat mapping procedures for the Roanoke River Flood Reduction Project. Final Report to the Wilmington District, U. S. Army Corps of Engineers, Wilmington, NC.

[6] Anderson, G. B., and P. L. Angermeier. 2015. Assessing impacts of the Roanoke River Flood Reduction Project on the endangered Roanoke Logperch. 2015 Annual Report to the Wilmington District, U. S. Army Corps of Engineers, Wilmington, NC.

Water Quality Study

Applicant's Proposed Study

Appalachian proposes to conduct a Water Quality Study to assess the effects of project operation on water quality parameters, including water temperature and DO. The single year study would be conducted from May 1, 2020 through September 30, 2020. Continuously recording data sondes would be placed at seven sites to measure water temperature and DO at 15-minute intervals. These sites include: (1) upstream of the confluence of the Roanoke River with Tinker Creek; (2) Tinker Creek; (3) the upper end of the impoundment; (4) the forebay; (5) the upper bypassed reach; (6) the lower bypassed reach; and (7) the tailrace (see figure 5-1 of the RSP).

At this time, the exact location of the forebay monitoring location has not been determined. A reconnaissance of the forebay area would be made prior to selection of a suitable/representative monitoring location. Two sondes would be deployed at discrete depths in the forebay to assess the extent of DO and temperature stratification in the project's impoundment. Data would be downloaded from the sondes every month; during these monthly downloading events, surface measurements of water temperature, DO, pH, and specific conductance would also be taken at each site. Additionally, monthly depth profiles of temperature and DO would be collected at each forebay site. Appalachian notes that, based on the results of the monthly depth profiles, it may adjust the deployment depths of the sondes in the forebays, if needed.

Length of Study

Comments on the Study

Appalachian proposes to deploy the continuously monitoring data sondes May 1, 2020 through September 30, 2020. In its comments on the RSP, FWS states that high air and water temperatures and low-flow conditions can extend beyond September 30 and therefore recommends the data sondes be deployed through October 31, 2020.

In its comments on the RSP, FWS requests that if the water quality data show that a low temperature or DO plume is present downstream of the powerhouse, an additional year of monitoring may be needed to define the vertical, lateral, and longitudinal extent of this plume. Further, they state that a second year of monitoring may be required if abnormally high flows are experienced during 2020, or if data cannot be collected during an extended low-flow period when water quality would be expected to be affected the most.

Discussion and Staff Recommendation

Streamflow data at the U.S. Geological Survey (USGS) Gage No 02056000, located on the Roanoke River just downstream of the Niagara Project, indicates that in some years, including 2019, relatively low flow was observed into mid-October. Therefore, we recommend that the study plan be modified to extend the water quality monitoring through October 31.

If weather conditions in 2020 are unusually wet and cool, then the Water Quality Study may need to be repeated in 2021 as Appalachian notes in its RSP. On the other hand, if summer weather conditions are unusually dry and hot (e.g., a worst-case scenario for water quality parameters) and water quality parameters are consistent with state water quality standards, there would be no need to collect an additional year of data. Consistent with the ILP regulations (18 C.F.R section 5.15), the need for a potential second study season will be evaluated based upon review of the water quality study results presented in the Initial Study Report (due December 5, 2020). Therefore, at this time, it is premature to recommend a second study season.

Deployment Depths of Data Sondes in the Forebay

Comments on the Study

In the RSP, as described above, Appalachian proposes to place the upper and lower data sondes at one-third and two-thirds depth below normal pond elevation. Further, it states that the depths of the forebay sondes may be adjusted, if necessary, during the study period based on a comparison of the continuous temperature and DO results with the monthly depth profile measurements.

Discussion and Staff Recommendation

It is likely that the onset of stratification (to the extent stratification occurs in the impoundment) will not begin until well after the proposed start date (May 1) for the Water Quality Study, perhaps not until mid-summer. Adjusting the depths of the sondes mid-study (e.g., based on monthly vertical profiles) could bias and complicate interpretation of the study results. The greatest (vertical) differences in temperature and DO in the forebay would be expected between the surface and bottom water rather than the middle portions of the water column within which Appalachian proposes to monitor. Although the exact location of the forebay monitoring site has not yet been determined, Appalachian states that the maximum depth of the impoundment is 10 feet, which translates to the upper and lower sondes being deployed at depths of approximately 2 to 3 and 6 to 7 feet, respectively. As such, we recommend that the study plan be modified to specify that the sondes will be placed as close to the surface and bottom of the water column as is feasible, and that their locations remain fixed to ensure the data collected is

representative of the maximal degree of stratification that occurs in the forebay. Placing sondes as vertically far apart as possible would obviate the need to continuously re-evaluate and possibly re-adjust the location of the sondes to ensure they are above and below any thermoclines that develop.

Continuous Water Quality Monitoring Site Locations

Comments on the Study

In comments on the RSP, FWS states that if the results of the continuous monitoring show that temperature and DO are "affected by the presence of the reservoir" compared to the most upstream location, then additional instruments would need to be deployed farther downstream of the currently proposed site locations to determine the downstream extent of the impact. In its comments on the RSP, the Environmental Protection Agency (EPA) recommends that Appalachian monitor temperature and DO in the stream reach downstream of the impoundment.

Discussion and Staff Recommendation

FWS does not clarify how it would define temperature and DO to be "affected by the presence of the reservoir" nor did FWS or EPA recommend specific locations for additional downstream sampling sites. In addition, adding instrumentation to additional sites midway through the sampling season as FWS suggests would result in an incomplete record at those locations. Currently, Appalachian proposes to monitor temperature and DO at a total of three sites downstream of the impoundment. If water quality parameters are inconsistent with state standards in the tailrace and/or bypassed reach during the 2020 season, then consistent with the ILP regulations (18 C.F.R. 5.15), the need for additional downstream monitoring can be evaluated during review of the Initial Study Report.

Fish Community Study

Applicant's Proposed Study

Appalachian proposes to conduct a Fish Community Study that includes three main components or sub-studies[7]: (1) a Fish Community Survey sub-study, (2) a Roanoke Logperch sub-study, and (3) an Impingement and Entrainment Desktop sub-study.

[7] The term 'sub-study' is used herein by staff to help differentiate and describe the multiple studies contained within the broad Fish Community Study and Benthic Aquatic Resources Study.

For the Fish Community Survey sub-study, Appalachian proposes to conduct electrofishing surveys across 15 sites in the impoundment, tailrace, and bypassed reach between August and October of 2020 to characterize the fish community at the Niagara Project. Seven sampling locations would be selected to overlap with historical sampling locations to facilitate temporal comparisons. Supplemental sampling locations would be selected in riffle/run habitat at three sites to augment potential collections of Roanoke logperch. Daytime backpack electrofishing would be conducted at seven riverine (non-impoundment) sites, including the tailrace and bypassed reach (see figure 6-2 of the RSP). The non-wadeable[8] impoundment would be divided into reaches (upper, middle, lower) and two parallel transects would be established within each reach along the shoreline. Appalachian would enumerate, measure (total length), and weigh fish collected at each site and also measure temperature, DO, pH, specific conductance, and record Secchi disk depths at each sampling site.

In the RSP, Appalachian proposes to conduct a Roanoke logperch sub-study in order to further evaluate the abundance and distribution of larval, young-of-the year (YOY), and adult Roanoke logperch in the project area. Appalachian would coordinate with FWS and Virginia Department of Game and Inland Fisheries (Virginia DGIF) to obtain necessary permits prior to initiating sampling. Electrofishing would be conducted to sample adult Roanoke logperch between August and October of 2020 at paired sites at each of four locations (see figure 6-3 of the RSP). The proposed sampling locations, which include the Roanoke River upstream of the project impoundment, the lower reach of Tinker Creek, and downstream of the Niagara tailrace, were selected based on records of prior observation of either Roanoke logperch individuals or potentially suitable riffle habitat. Subject to waiver of seasonal sampling restrictions for Roanoke logperch by Virginia DGIF and FWS, Appalachian would conduct an additional sampling event within the bypassed reach between May and June of 2020. Habitat variables (water depth, velocity, silt coverage, and pebble counts) would be recorded at each sample site and used to evaluate the habitat suitability at each site based on a previously developed habitat suitability index. As YOY Roanoke logperch often occur in different habitats than adults (e.g., sandy, backwater, shallow) and are not effectively sampled by electrofishing, Appalachian would conduct seine and visual surveys for YOY Roanoke logperch at five sites with preferred YOY habitat (see figure 6-3 of the RSP).

Appalachian proposes to conduct weekly driftnet surveys to collect larval Roanoke logperch between early April and early June 2020. Nocturnal surveys targeting larval Roanoke logperch would be performed at five sites, including upstream, within, and

[8] "Non-wadeable" as defined by: U.S. Environmental Protection Agency (EPA). 2019. National Rivers and Streams Assessment 2018/19 Field Operations Manual Non-Wadeable Version 1.2. EPA-841-B-17-003b. Washington, DC.

downstream of the Niagara impoundment (see figure 6-3 in the RSP). Morphometric characteristics would be used to first separate larval darters from other fish families, and then to identify larval darters to the lowest taxonomic resolution, following recently developed methods by Virginia Tech's College of Natural Resources and Environment (Buckwalter et al., In review; Hallerman et al. 2017).[9,10] However, Appalachian expresses some concern that Roanoke logperch larvae cannot be identified accurately and in a cost-effective manner. Specifically, it notes that potential confusion with a similar species, the chainback darter, could lead to an overestimation of Roanoke logperch larvae in the project area. In a recent study, Buckwalter et al. (In review) found that approximately 10 percent of chainback darter individuals were misclassified as Roanoke logperch. Appalachian proposes to develop a Quality Assurance Plan for laboratory processing and would send 20 percent of larval samples to an independent laboratory specializing in fish taxonomy for verification.

The Impingement and Entrainment Desktop sub-study would include a standard desktop evaluation of entrainment and impingement risk, including blade strike mortalities, of selected target species—the list for which would be based on the results of the Fish Community Survey sub-study (i.e., species common in the impoundments) and those species of conservation and management interest based on consultation with the resource agencies. In addition, approach velocities would be measured in front of each development's intakes with an Acoustic Doppler Current Profiler (transect sampling approach) when operating at both its maximum and efficient generation rates.

Roanoke Logperch Adult and YOY sampling

Comments on the Study

In comments on the RSP, FWS and Dr. Angermeier recommend changes to Appalachian's proposed sample design to survey adult Roanoke logperch. Dr. Angermeier states that Appalachian's proposal to survey "paired sites" means that both sites in a pair would be located in the same riffle but on opposite sides of the river. Because fish like the Roanoke logperch use the entire riffle, the sites would be considered pseudoreplicates rather than independent sites. FWS recommends conducting only one survey in each habitat feature and reallocating the second site to different habitat features in order to provide enough replicates for statistical analysis (i.e., eight independent sites

[9] Buckwalter, J., Angermeier, P. and Hallerman, E. In review. Drift of larval darters (Family Percidae) in the upper Roanoke River basin, USA, characterized using phenotypic and DNA barcoding markers. Fishes.

[10] Hallerman, E., Wolf, S., Argentinia, J., Angermeier, P. and Grant, T. 2017. Phenology and habitat use of larval darters in the upper Roanoke River basin. Final Report to Virginia Department of Game and Inland Fisheries.

rather than four paired sites). FWS further provides several specific suggestions for additional locations containing potential Roanoke logperch habitat to which the sites could be moved to.

FWS states that the proposed five sampling sites for YOY Roanoke logperch are insufficient and suggests adding a second site to each of Tinker Creek and the bypassed reach, respectively. In addition, FWS suggests relocating the site within the reservoir to a location downstream of the project.

Discussion and Staff Recommendation

FWS' recommendation to modify the sampling design for adult Roanoke logperch to sample eight independent sites rather than the four paired sites that Appalachian proposes is consistent with generally accepted practices in the scientific community [section 5.9(b)(6)]; and should require minimum effort/cost to implement since the same number of sites would be surveyed. We recommend that Appalachian make FWS' suggested changes to the sampling design.

The FWS-suggested changes for the YOY survey would require the addition of three sites (one each in Tinker Creek, the bypassed reach, and the reach downstream of the tailrace, respectively), or two if Appalachian relocates the proposed site in the reservoir. If Appalachian has identified potential habitat for Roanoke logperch YOY in the reservoir, then this habitat would be important to survey in order to assess potential effects of the project on the species. If appropriate habitat is not identified in the reservoir, it would be reasonable to move this site as FWS suggests. Currently, the only proposed site for YOY sampling downstream of the dam is in the tailrace. An additional site within the bypassed reach, if suitable habitat is identified, and downstream in the river reach where sampling for adult Roanoke logperch is proposed would provide valuable information on the distribution of YOY Roanoke logperch in the project area. It is unclear why an additional site would be needed further upstream in Tinker Creek, as this would likely be outside of the influence of the project. Hence, we don't recommend requiring Appalachian to survey an additional site in Tinker Creek but do recommend that the study plan be modified to include the above-noted two additional sites downstream of the dam.

Roanoke Logperch Larvae Sampling

Comments on the Study

As noted above, Appalachian expresses some concern that Roanoke logperch larvae can be confidently identified to the species level due to potential confusion with a similar species, the chainback darter. However, in comments on the RSP, Dr. Angermeier notes that the Roanoke logperch is more abundant than the chainback darter

in the Roanoke River, and chainback darter larvae are present in the river earlier in the spring, so the number of misclassifications is likely to be less than what was found by Buckwalter et al. (In review).

In comments on the RSP, FWS, EPA, and Dr. Angermeier support Appalachian's proposal to conduct driftnet surveys for Roanoke logperch larvae. FWS states that information on all lifestages of Roanoke logperch is needed to determine how continued operation of the project may affect the species over the next license term, to estimate incidental take, and to recommend relevant protection, mitigation, and enhancement (PM&E) measures. FWS, EPA, and Dr. Angermeier suggest that DNA barcoding be used to verify the taxonomic classifications. Specifically, FWS recommends a two-step approach where larvae are first separated by morphometric features and then DNA barcoding would be used to separate Roanoke logperch and the chainback darter. Specific cost estimates were not provided for DNA barcoding, but FWS notes that the cost of a recent genetic study of Chesapeake logperch was approximately $10,000 for around 300 samples.

Discussion and Staff Recommendation

Roanoke logperch have been observed in the project area,[11,12] as well as at locations further upstream in the Roanoke River.[13] Larvae are thought to drift downstream for several kilometers before settling in shallow, nearshore habitats, but whether larvae from upstream locations drift as far downstream as the Niagara Project is unknown. Appalachian's proposed driftnet surveys, in conjunction with the fish community sampling and targeted sampling for Roanoke logperch adults and YOY, would provide information on the status of the species in the project area.

The use of morphometric, meristic, and genetic tools to identify fish larvae are consistent with generally accepted practices in the scientific community [section 5.9(b)(6)]. Appalachian's proposal to have a subset of larval samples independently verified is reasonable. Therefore, we recommend that Appalachian have the subsample verified either by morphometric methods, DNA barcoding, or other standard

[11] Appalachian Power Company and American Electric Power Service Corporation. 1992. An Assessment of the Roanoke Logperch in the Roanoke River Downstream of Niagara Hydroelectric Project. December, 1992. 5 pp.

[12] Appalachian Power Company and American Electric Power Service Corporation. 1991. The Status of Fish Populations in the Vicinity of Niagara Hydroelectric Project. April 11, 1991. 37 pp.

[13] Rosenberger, A. and P. Angermeier. 2003. Ontogenetic shifts in habitat use by the endangered Roanoke Logperch (*Percina rex*). Freshwater Biology 4: 1563-1577.

methodology. Compared to the total cost of the study, the difference in cost of the available methods to conduct the independent verification would be relatively minor.

Benthic Aquatic Resources Study

Applicant's Proposed Study

Appalachian proposes to conduct a Benthic Aquatic Resources Study that includes three main components or sub-studies: (1) a Macroinvertebrate and Crayfish Community sub-study, (2) a Benthic Habitat Assessment sub-study, and (3) a Mussel Habitat and Community Survey sub-study.

For the Macroinvertebrate and Crayfish Community sub-study, Appalachian proposes to conduct two field sampling events, one in the spring (March 1 through May 31) and another in the fall (September 1 through November 30) of 2020. Surveys would be conducted within the lower reaches of streams entering the reservoir, the reservoir, tailrace, and bypassed reach (see figure 7-1 in the RSP). Crayfish would be targeted by sampling in appropriate habitats using kick-netting, seine hauling, and dip-netting techniques. Other macroinvertebrates would be collected following Virginia DEQ's methods to sample single habitats (e.g., riffle/run) and multihabitats and the data analyzed using common indices to evaluate benthic macroinvertebrate community health and similarity (e.g., the Hilsenhoff Biotic Index,[14] percent intolerant species, etc.).

A Benthic Habitat Assessment would be performed at all survey locations for macroinvertebrates/crayfish following Virginia DEQ's "Methods for Habitat Assessment for Streams" protocol.[15] A suite of habitat characteristics, including substrate and cover availability, substrate embeddedness, flow velocity, depth, sedimentation, frequency of riffles, bank stability, vegetative protection, and riparian zone would be scored on a scale of 0-10 in order to evaluate the quality of benthic habitat in the survey areas. Results from the Benthic Habitat Assessment surveys would be used to evaluate patterns in species composition, abundance, or distribution throughout the study area. Additionally, the Benthic Habitat Assessment within the bypassed reach would be reviewed along with

[14] The Hilsenhoff Biotic Index estimates the overall tolerance of the macroinvertebrate community in a sampled area by weighting the relative abundance of various taxonomic groups.

[15] Virginia DEQ. 2008. Biological Monitoring Program Quality Assurance Project Plan for Wadeable Streams and Rivers. Division of Water Quality, Richmond, VA.

the results of the Flow and Bypass Reach Aquatic Habitat Study to evaluate how aquatic habitat may be increased under various flow scenarios.

The Mussel Habitat and Community Survey sub-study would include a combination of qualitative timed searches (i.e., abbreviated surveys) and systematic transect searches conducted between April 1 and October 31 of 2020 following methods modified from the "Draft Freshwater Mussel Guidelines for Virginia."[16] Abbreviated surveys would be conducted in reaches ranging from 315 to 500 meters in length in Tinker Creek, Wolf Creek, the Roanoke River upstream of the reservoir, the bypassed reach, and below the tailrace (see Figure 7-2 in the RSP) using view-bottom buckets, snorkeling, SCUBA and/or surface supplied air. Surveyors would target habitat suitable for freshwater mussels and record the location, species, and count of observed mussels. Transect surveys would be performed at 8 linear transects spaced every 500 meters within the reservoir using SCUBA and/or surface supplied air. The location, species, counts, and lengths (up to 50 individuals per species) would be recorded.

Mussel Survey Methodology

Comments on the Study

In comments on the RSP, EPA expresses concern about Appalachian's proposal to use modified mussel survey protocols and recommends that Appalachian work with Virginia DGIF and FWS to finalize the study plan and methods.

In comments on the RSP, FWS recommends that Appalachian contract with a qualified mussel surveyor from a list of pre-approved surveyors. Should Appalachian select a surveyor that is not pre-approved, FWS requests that Appalachian submit the proposed surveyor's qualifications and survey design to FWS and Virginia DGIF at least 30 days prior to the survey initiation. FWS notes that the yellow lance (*Elliptio lanceolata*) is federally listed as threatened and that freshwater mussel surveys should include the invasive Asiatic clam (*Corbicula fluminea*). In regards to the abbreviated surveys, FWS states that it is unclear whether the level of effort is sufficient to document the presence of listed species and that a typical approach would be to develop species richness curves. It recommends that Appalachian work with FWS and Virginia DGIF to develop an approach to survey mussels.

Discussion and Staff Recommendation

EPA does not state which modifications to Appalachian's adaptation of the mussel survey protocol it is concerned with. However, as FWS notes, Appalachian does not

[16] FWS and Virginia DGIF. 2018. Draft Freshwater Mussel Guidelines for Virginia. Virginia Field Office, Gloucester, Virginia.

provide the length of time or other measure of effort that will be used in the abbreviated surveys nor articulate how target habitats in the sampling reach would be identified. We recommend that Appalachian modify the study plan to include this information for the qualitative timed-search surveys.

In the RSP, Appalachian notes that if a federally listed species is encountered, FWS and Virginia DGIF would be contacted within 24 hours. In addition to the listed species mentioned in the RSP, the yellow lance should be included in this group of listed species. FWS does not recommend a specific protocol to survey for Asiatic clams. Due to the lack of information on the presence of this species in the project area, we recommend that any Asiatic clam individuals observed as part of the mussel survey, be identified and counted.

In the PSP, Appalachian states that a qualified, approved mussel surveyor for the Virginia Atlantic Slope would be used to conduct the mussel surveys. However, this information was not included in the RSP. We recommend that Appalachian modify the study plan to clarify that it will use an approved surveyor.

II. Studies Requested but Not Adopted by Appalachian

Benthic Habitat Quality Assessment in the Bypass Reach and Downstream Areas (Sediment Study)

Study Request

FWS requests an assessment of the quality of the benthic habitat in the bypassed reach and areas downstream of the Niagara Project to determine how much aquatic habitat could be gained by increasing the sediment released downstream. FWS proposes that information about sediment and substrate in the bypassed reach collected during this study be compared to an upstream reference reach to determine the impacts of the project on sediment transport and benthic habitats in the bypassed reach and the Roanoke River downstream of the project. The goal of the study would be to assess whether the project is affecting benthic habitat in the bypassed reach and downstream, and if the project is having an effect, determine how to increase the quality and diversity of benthic habitats downstream of the project in order to support a greater diversity and abundance of aquatic species, including the federally endangered Roanoke logperch. FWS notes that age 1+ logperch have been observed to inhabit and spawn in areas with gravel and small cobble substrates. FWS states that lack of appropriate sediment types in the river can affect whether logperch can use the area and successfully reproduce.

Discussion and Staff Recommendation

Appalachian has incorporated aspects of the requested study into the Flow and Bypass Reach Aquatic Habitat Study, including the characterization and quantification of existing benthic habitat in the bypassed reach, substrate measurements, and mesohabitat/substrate mapping. However, Appalachian has not adapted FWS' larger study request. It states that the existing outlet structures at the project do not provide a means to pass reservoir sediment beyond that which is passed through the turbines or in spills at the dam during periods of high inflow. In the RSP, Appalachian states that maintaining a supply of coarse sediment in the bypassed reach is not feasible due to the turbulent and high velocity hydraulic conditions that occur as a result of the high gradient of the natural streambed in the vicinity of the project and periodic high-flow events. Appalachian believes that any gravel added to the system would likely be moved downstream to Smith Mountain Lake during the next high-flow event under present-day conditions and that adding sediment in one-time, large volume applications has the potential to smother substrates that support mussels, macroinvertebrates, and provide spawning substrates for fish. Lastly, Appalachian does not believe that aquatic resources are being significantly impacted by current project operation.

FWS does not explain how Appalachian's proposed Flow and Bypass Reach Aquatic Habitat Study does not fulfill their overall goal to assess the quality of benthic habitat within the bypassed reach [(section 5.9)(b)(7)]. The substrate data collected as part of that study along with habitat suitability modelling should provide the necessary information to inform any needed gravel augmentation, for instance. Therefore, we do not recommend requiring the Sediment Study.

Fish Protection and Upstream and Downstream Passage Studies

Study Request

FWS states that because Appalachian has not proposed measures to ensure safe, timely, and effective upstream and downstream fish passage, it is requesting that upstream and downstream passage protection studies be undertaken. FWS indicates that its species of concern include smallmouth bass, largemouth bass, redhorse, channel catfish, and Roanoke logperch, as well as unspecified fish species that serve as hosts for freshwater mussels. Virginia DGIF indicates that its resource management goal is to restore connectivity in this segment of the Roanoke River for resident and migratory fish species, including Roanoke logperch. The proposed study would include a literature search of available passage designs for as well as information on the relative effectiveness of each design. FWS also recommends that site-specific data (flows, velocities, water depths, and substrates) be collected to aid in the design of protection and passage facilities.

Appalachian states an updated baseline of the existing fish community in the vicinity of the project and potential for fish entrainment or impingement will be evaluated as part of the Fish Community Study. It notes that fish passage facilities are not currently available at several downstream hydroelectric projects on the Roanoke River, including Smith Mountain Lake, and that migratory diadromous fish species are not known to be present in the vicinity of the Niagara Project. Appalachian indicates that, based on the results of the Fish Community Study, additional fish protection and passage measures may be considered, but are not being proposed at this time.

Discussion and Staff Recommendation

Once completed, the proposed desktop entrainment and impingement study should provide information on the magnitude of impingement and entrainment mortality of resident fishes at the project. In addition, the information collected from the fish community survey would inform potential population-level effects of the project (e.g., a lack of particular size or age classes suggestive of reduced spawning success and/or failed recruitment of resident fishes). Collectively, these studies should provide information that would determine the need for species-specific fish passage and/or protection measures at the project. As such, at this time we do not recommend that Appalachian be required to conduct the Fish Passage and Downstream Protection Studies requested by FWS and Virginia DGIF.

Coupling Studies of Hydrodynamics and Fish Behavior to Improve Roanoke Logperch Passage at Niagara Dam

Study Request

Dr. Angermeier requests a study to characterize the hydrodynamics of the flow fields upstream and downstream of Niagara Dam and powerhouse to relate observed physical conditions with Roanoke logperch spatial distribution and behavior. An Acoustic Doppler Current Profiler would be used during multiple field surveys to collect bathymetric and velocity data upstream and downstream of the dam, including the reservoir. Velocity would be measured over a range of annual flow and operating conditions. In addition, velocity and stage sensors would be installed near the dam to continuously monitor velocity and water stage over the study duration (one year). The data collected would be used to conduct computational fluid dynamics (CFD) simulations to obtain detailed information about the velocity field, streamlines,[17] and turbulence levels of water flow upstream and downstream of Niagara Dam across a wide range of flow conditions.

[17] In CFD, streamlines are lines that are instantaneously tangent to the velocity vector of the flow.

Fish behavior studies (Roanoke logperch and other species) would be conducted as an additional task in this study. Underwater observations collected from stationary cameras would be used to observe and quantify Roanoke logperch's spatial associations with the dam and associated structures or flow conditions over time. The CFD model-generated maps of flow-fields near the dam would be correlated with Roanoke logperch behavior and abundance data from the fish surveys, with the goal of determining the specific hydrodynamic conditions that attract or repel Roanoke logperch and informing a recommendation for where and how to alter the flow fields to promote Roanoke logperch passage.

Discussion and Staff Recommendation

As previously described, the Roanoke logperch has been observed in surveys further upstream in the Roanoke River as well as downstream of the Niagara dam,[11] but the status of the species in the project area is unknown. While isolated specimens have been observed in coves of Smith Mountain Lake, the species is most frequently associated with riffle and run habitat in the Roanoke River.[18] Information from several tasks in the Fish Community Study (Fish Community Survey, Roanoke Logperch Study, and Impingement and Entrainment desktop substudy) will provide baseline information on the abundance and distribution of Roanoke logperch upstream and downstream of the Niagara dam, including the reservoir and bypassed reach. Until the Fish Community Study is completed, it would be premature to conduct a study to inform downstream passage of Roanoke logperch at the Niagara Project. Therefore, we do not recommend that Appalachian be required to conduct this study.

[18] Rosenberger, A. E. 2007. An Update to the Roanoke Logperch Recovery Plan. Report to the U.S. Fish and Wildlife Service, Gloucester, VA. 84 pp.

Document Content(s)