ENVIRONMENTAL ASSESSMENT
FOR
HYDROPOWER LICENSE

Bynum Hydroelectric Project
FERC Project Nos. 14858-001, 4093-035
North Carolina

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
888 First Street, NE
Washington, D.C. 20426

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ACRONYMS AND ABBREVIATIONS

APE	area of potential effects
AMSL	above mean sea level
certification	water quality certification
°C	degrees Celsius
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DO	dissolved oxygen
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FERC or Commission	Federal Energy Regulatory Commission
FPA	Federal Power Act
fps	feet per second
FWS	U.S. Fish and Wildlife Service
Interior	U.S. Department of the Interior
kW	Kilowatt
MWh	megawatt-hour
mg/L	milligrams per liter
National Register	Nation Register of Historic Places
NERC	North American Electric Reliability Corporation
NHPA	National Historic Preservation Act
North Carolina SHPO	North Carolina State Historic Preservation Officer
North Carolina DENR	North Carolina Department of Environment and Natural Resources
North Carolina DNR	North Carolina Department of Natural Resources
North Carolina DEQ	North Carolina Department of Environmental Quality
North Carolina DWR	North Carolina Division of Water Resources
North Carolina WRC	North Carolina Wildlife Resources Commission
SCORP	State Comprehensive Outdoor Recreation Plan
USGS	U.S. Geological Survey

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1.0 INTRODUCTION

1.1 APPLICATION

On March 30, 2015, McMahan Hydroelectric, LLC (McMahan Hydro or applicant) filed a license application for the Bynum Hydroelectric Project (Bynum Project, or project) with the Federal Energy Regulatory Commission (FERC or Commission).[1] The 600-kilowatt (kW) project is located on the Haw River near Pittsboro, in Chatham County, North Carolina (Figures 1 and 2). The project does not occupy federal land. The project is currently inoperable, but as proposed by the applicant, it would generate about 2,461 megawatt-hours (MWh) of energy annually.

1.2 PURPOSE OF ACTION AND NEED FOR POWER

1.2.1 Purpose of Action

The purpose of the Bynum Project is to provide a source of hydroelectric power. Under the provisions of the Federal Power Act (FPA), the Commission must decide whether to issue a license to McMahan Hydro for the Bynum Project, and what conditions should be included in any license issued. In deciding whether to issue a license for any hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and developmental purposes for which licenses are issued (such as flood control, irrigation, or water supply), the Commission must give equal consideration

[1] The Bynum Project was previously subject to a 30-year license, which expired on April 30, 2015. For ease of reference, and to account for the complex project history, the Commission is currently processing McMahan Hydro's license application under the former project number (Project No. 4093) and a new project number (Project No. 14858). If a license is issued to McMahan Hydro, all project-related filings following license issuance will be processed under the new project number.

to the purposes of: (1) energy conservation; (2) the protection of, mitigation of damage to, and enhancement of fish and wildlife resources; (3) the protection of recreational opportunities; and (4) the preservation of other aspects of environmental quality.

Issuing a license for the project would authorize McMahan Hydro to refurbish the project facilities, and generate electricity for the term of the license.

This environmental assessment (EA) assesses the environmental and economic effects associated with refurbishing, operating, and maintaining the project. It also makes recommendations to the Commission on whether to issue a license for the project, and if so, recommends measures to become a part of any license issued.

In this EA, we assess the effects of the project: (1) as proposed by McMahan Hydro; and (2) with staff's recommended measures (staff alternative). For the purposes of conducting our environmental analysis, we also consider a no-action alternative. Under the no-action alternative, McMahan Hydro would not refurbish and operate the project, and there would be no change to current conditions.

1.2.2 Need for Power

The Bynum Project would have an installed capacity of 600 kW, and generate an average of about 2,461 MWh per year.

The North American Electric Reliability Corporation (NERC) annually forecasts electrical supply and demand nationally and regionally for a 10-year period. The project is located within the SERC-East subregion (SERC-E) of the NERC. According to NERC's most recent (December 2017) forecast, the total internal demand projected for this region is expected to increase by 1.4 percent from 2018 to 2027.

On a regional basis, therefore, power from the Bynum Project would help meet the need for power in the SERC-E subregion, in both the short- and long-term. The project would provide power that could displace non-renewable, fossil-fired generation and contribute to a diversified generation mix. Displacing the operation of non-renewable facilities may avoid some power plant emissions, thus creating environmental benefits.

Figure 1. Location of the Bynum Project.
(Source: www.nationalatlas.gov, as modified by staff).

Figure 2. Bynum Project.
Source: Google Earth, 2018

1.3 STATUTORY AND REGULATORY REQUIREMENTS

A license for the Bynum Project is subject to requirements under the FPA and other applicable statutes. We describe the major regulatory requirements below.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA, 16 U.S.C. § 811, states that the Commission is to require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretary of the U.S. Department of the Interior (Interior) or the Secretary of Commerce, as appropriate. Interior filed a letter on June 11, 2015, requesting that the license, if issued, include a reservation of authority to prescribe fishways under section 18 of the FPA.

1.3.1.2 Section 10(j) Recommendations

Under section 10(j) of the FPA, 16 U.S.C. § 803(j), each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable laws. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

On April 3, 2017, the North Carolina Wildlife Resource Commission (North Carolina WRC) timely filed recommendations under section 10(j), as summarized in table 9, in section 5.3, *Recommendations of Fish and Wildlife Agencies*. In section 5.3, we discuss how we address the agency recommendations and comply with section 10(j).

1.3.2 Clean Water Act

Under section 401 of the Clean Water Act (CWA), 33 U.S.C. § 1341, a license applicant must obtain certification from the appropriate state pollution control agency verifying compliance with the CWA. On March 3, 2017, McMahan Hydro applied to the North Carolina Division of Water Resources (North Carolina DWR) for a section 401 water quality certification (certification) for the Bynum Project. On March 29, 2017, McMahan Hydro filed correspondence from North Carolina DWR that states that the agency received McMahan Hydro's application on March 3, 2017. On

February 20, 2018, McMahan Hydro withdrew its application and reapplied for certification.[2]

1.3.3 Endangered Species Act

Section 7 of the Endangered Species Act, 16 U.S.C. § 1536, requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. On June 11, 2015, FWS filed a letter stating that the project could adversely affect the federally listed Cape Fear shiner and/or its habitat. FWS filed a letter on April 19, 2017, that recommended a minimum flow schedule to protect the habitat of the Cape Fear shiner. In section 3.3.5, *Endangered Species*, we conclude that the proposed project is not likely to adversely affect the Cape Fear shiner. We came to this conclusion because: (1) with the affected bypassed reach represents less than 0.5 percent of the Haw River, and similar habitat widely available elsewhere in the Haw River; (2) the minimum flow schedule recommended by FWS and North Carolina WRC and proposed by McMahan Hydro would ensure that the habit in the bypassed reach would retain much of its value to the Cape Fear shiner; and (3) Cape Fear shiners are very rare in the Haw River and very unlikely to be habitat limited. Thus, the effect of reduced flow to the bypassed reach is insignificant for the Cape Fear shiner in the Haw River.

Two other federally listed species, the harperella[3] and red-cockaded woodpecker,[4] are found in the county, but are not known to occur in the project area and would not be affected by licensing the project.

1.3.4 Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456(c)(3)(A), the Commission cannot issue a license for a project within or affecting a state's coastal zone, unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

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[2] On March 19, 2018, McMahan Hydro filed a copy of its request to reapply for certification, a draft water quality monitoring plan, and North Carolina DWR's conformation of receipt of McMahan Hydro's request dated February 22, 2018.

[3] A perennial wetland herb.

[4] *See* Interior's official list of threatened and endangered species accessed by staff using the IPaC website (https://ecos.fws.gov/ipac/) on April 30, 2018, and filed on May 9, 2018. The IPaC report identified three species: the Cape Fear shiner, harperella, and red-cockaded woodpecker.

The project is located outside of the state-designated Coastal Management Zone. By letter filed October 14, 2016, the North Carolina Division of Coastal Management confirmed that a CZMA consistency certification is not required for the project.

1.3.5 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA), 54 U.S.C. § 306108, and its implementing regulations, 36 C.F.R. Part 800, requires that every federal agency "take into account" how its undertakings could affect historic properties. Historic properties are districts, sites, buildings, structures, traditional cultural properties, and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (National Register).

Pursuant to section 106, the applicant consulted with the North Carolina State Historic Preservation Officer (North Carolina SHPO) and affected Indian tribes to locate, determine National Register eligibility, and assess potential adverse effects to historic properties associated with the project. By letter dated November 18, 2014, and filed April 23, 2015, the North Carolina SHPO stated that the project would not affect historic properties.

1.4 PUBLIC REVIEW AND COMMENT

The Commission's regulations, 18 C.F.R. § 4.38, require that applicants consult with appropriate resource agencies, tribes, and other entities before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act, the Endangered Species Act, NHPA, and other federal statutes. Pre-filing consultation must be complete and documented according to the Commission's regulations.

1.4.1 Scoping

Before preparing this EA, we conducted scoping to determine what issues and alternatives to address. We distributed a scoping document (SD1) to interested agencies and other stakeholders on September 23, 2016. We published the SD1 Notice in the Federal Register on September 23, 2016. North Carolina WRC filed comments on October 27, 2016. The Commission issued a letter on February 3, 2017, indicating that a revised Scoping Document was not warranted because of the limited number of comments received.

1.4.2 Interventions

On September 23, 2016, the Commission issued a notice accepting for filing McMahan Hydro's application to license the Bynum Project. This notice set November 22, 2016, as the deadline for filing protests and motions to intervene. In

response to the notice, the following entities filed notices of intervention or motions to intervene. PK Ventures stated that it is opposed to issuance of a license for the Bynum Project.

Intervenor	Date filed
North Carolina WRC	October 26, 2016
North Carolina Department of Environmental Quality (North Carolina DEQ)	November 21, 2016
PK Ventures	November 22, 2016

1.4.3 Comments on the License Application

On February 3, 2017, the Commission issued a notice that McMahan Hydro's application was ready for environmental analysis. This notice set April 4, 2017, as the deadline for filing comments, recommendations, terms and conditions, and prescriptions. The following entities commented:

Commenting entities	Date filed
Interior	March 29, 2017
North Carolina WRC	April 3, 2017
FWS	April 4, and April 19, 2017
PK Ventures	April 4, 2017
North Carolina DWR	April 5, 2017

In its April 4, 2017 filing, PK Ventures states that the Commission should deny the license application because PK Ventures owns the water rights necessary to operate the project. In addition, PK Ventures contends that the water rights issue must be determined prior to undertaking the environmental analysis. As a general matter, the Commission does not adjudicate state water rights. The acquisition of property rights (including water rights) needed for a project is not a prerequisite to license issuance. Many applicants obtain such rights after a license is issued.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 NO-ACTION ALTERNATIVE

The existing condition is the Commission's baseline environmental condition for comparison with other alternatives. Under the no-action alternative, the dam and other facilities would remain as is, with all flows passing over the spillway except for insignificant leakage at the intake gates into the canal.

2.1.1 Existing Project Facilities

The Bynum Project is located on the Haw River in Chatham County, North Carolina. The project includes a 900-foot-long, 10-foot-high stone masonry dam (Bynum Dam, or Odell Lake Dam), which forms a 20-acre impoundment (Odell Lake). The dam includes a 750-foot-long uncontrolled spillway section and a 150-foot-long, non-overflow section containing an intake facility with two 6-foot-wide Tainter gates. The Tainter gates control inflow to a 2,000-foot-long, 40-foot-wide power canal. The canal carries flow to a powerhouse containing one 600-kilowatt generating unit. The canal has a drainage gate immediately upstream of the powerhouse. When operating, the project diverts flow around a 0.5-mile-long section (bypassed reach) of the Haw River. Beyond the powerhouse, a 500-foot-long, 50-foot-wide tailrace returns the water to the river, and a 100-foot-long, 0.48-kilovolt transmission line takes the electricity to a utility company's transformer making the grid interconnection. A canoe portage is provided around Bynum Dam. The project has not operated for at least 10 years.

2.1.2 Project History

On May 31, 1985, the Commission issued a 30-year license to Tuscarora Yarns, Inc., authorizing it to operate and maintain the Bynum Project.[5] The Commission approved transfer of the license from Tuscarora Yarns, Inc. to Bynum Hydro Company on January 16, 1986.[6] Bynum Hydro did not file an application for license by the April 30, 2013 deadline.[7]

On June 19, 2013, the Commission issued a notice giving interested entities (other than the licensee) 90 days to file a notice of intent to file an application for a license.[8] On September 16, 2013, McMahan Hydro timely filed a notice of intent to file a license application, and timely filed an application on March 30, 2015.[9]

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[5] *Tuscarora Yarns, Inc.*, 31 FERC ¶ 62,273 (1985).

[6] *Tuscarora Yarns, Inc. and Bynum Hydro Co.*, 34 FERC ¶ 62,155 (1986).

[7] Section 15(c)(1) of the Federal Power Act, 16 U.S.C. § 808(c)(1) (2012), requires that applications to relicense a project be filed at least 24 months before the expiration of the term of the existing license.

[8] *See* 18 C.F.R. § 16.25(a)-(b) (2018).

[9] *See* 18 C.F.R. § 16.25(b) (2018) (a potential applicant that files a notice of intent within 90 days from the date of the public notice issued under section 16.25 of the Commission's regulations may apply for a license within 18 months of the date on which it files its notice). On Sept 30, 2013, Commission staff issued a notice that authorized the use of the Traditional Licensing Process and waived the timing requirement to file a pre-application document. This notice set October 30, 2013 as the deadline for filing the pre-

The license for the Bynum Project expired on April 30, 2015. Prior to expiration of the license, staff determined that Bynum Hydro had been administratively dissolved by the State of North Carolina. As there would be no point in issuing an order directing a dissolved entity to continue project operations, the Commission determined that it was in the public interest to allow the license to expire.[10] Because the Commission allowed the federal license to expire, jurisdiction over the project works currently lies with the State of North Carolina.[11] Unless and until the Commission issues a license for the project, the State of North Carolina retains jurisdiction over the project works.

2.2 APPLICANT'S PROPOSAL

2.2.1 Project Description

McMahan Hydro proposes to use the existing Bynum Project facilities described above, and to rehabilitate the inoperable equipment. Because McMahan Hydro is not the current owner of the existing facilities, it has not had full access to the project to finalize its plans for the project's refurbishment. To make the project operational, McMahan Hydro expects it will need to repair the intake gates, clear the intake canal of vegetation, and refurbish the electrical components in the powerhouse. McMahan Hydro proposes no additions to the project's original capacity and no modifications to the project's facilities.

2.2.2 Proposed Project Operation

McMahan Hydro proposes to operate the Bynum Project in a run-of-river mode, meaning that the combined outflow from the powerhouse and the flow over the dam into the bypassed reach would approximate the inflow to the impoundment. McMahan Hydro also proposes to provide, through spill, a minimum flow of 240 cubic feet per second (cfs) to the bypassed reach from March 1 through April 30, and 120 cfs the rest of the year. McMahan Hydro would maintain an impoundment level necessary to pass the minimum flows over the dam into the bypassed reach through manipulation of the gates at the dam.

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application document. McMahan Hydro's license application was due 18 months later, by April 30, 2015.

[10] *PK Ventures I Ltd. P'ship*, 153 FERC ¶ 61,040 (2015) (explaining that, unlike the circumstances at issue with the Bynum Project, an order directing project operations to continue might be appropriate if there were environmental or safety concerns regarding a project and there was an existing licensee for the Commission to hold responsible).

[11] *Id.* note 13.

2.2.2.1 Operation Compliance

To maintain run-of-river operation, McMahan Hydro proposes to install and operate a water level sensor to trigger an automatic cut-off switch on the turbine so that generation ceases if the impoundment water level drops below that needed to provide the minimum flow to the bypassed reach over the crest of the dam. McMahan Hydro would use the water level sensor to monitor project operation, and compliance with related license requirements. To draw down the intake canal for maintenance or emergencies, McMahan Hydro would close both intake gates at the dam and open the bypass gate located on the intake canal just upstream of the powerhouse.

2.2.3 Project Safety

As part of the licensing process, Commission staff will review the adequacy of the existing project facilities. Special articles will be included in any license issued, as appropriate. Commission staff would also inspect the project after issuing any license. Operational inspections would focus on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance.

2.2.4 Proposed Environmental Measures

McMahan Hydro proposes to operate the Bynum Project with the environmental measures described below.

Geology and Soils

- Prior to project refurbishment, develop an erosion management plan that includes a provision to use best management practices (BMPs) to minimize erosion and sedimentation.

- Develop a plan for impoundment sediment management or dredging, if necessary.

Aquatic Resources

- Develop a flow monitoring plan to ensure maintenance of, and provide a record of, the minimum flows in the project's bypassed reach at all times.[12]

[12] The plan would provide a mechanism to: (1) collect and maintain records of inflow, outflow, and project generation; (2) document run-of-river operation; and (3) document maintenance and emergency drawdowns. Flows at the project would be monitored at the U.S. Geological Survey (USGS) gage No. 02096960, located just downstream of the project. The plan would describe alternative measures to collect flow data should the USGS discontinue maintenance of the gage.

- Monitor for, and maintain, an instantaneous minimum 4.0 milligrams per liter (mg/l) dissolved oxygen (DO) concentration and 5.0 mg/l daily average DO concentration in the bypassed reach and tailrace.

- Develop an intake maintenance plan for the disposal of organic and inorganic waste materials that collect on the intake gates and trashrack.

- Consult with North Carolina DRW, North Carolina WRC, and FWS to develop measures to minimize fish impingement and entrainment.

- Develop an impoundment drawdown and refill management plan to protect environmental resources of the impoundment, bypassed reach, and downstream river reach, should there be a need to drain the impoundment or otherwise interrupt flow into the bypassed reach. McMahan Hydro would complete the plan prior to the first instance that such actions may occur.

Terrestrial Resources

- No measures are proposed.

Threatened and Endangered Species

- Release a minimum flow of 240 cfs over the project dam to the bypassed reach from March 1 through April 30, and 120 cfs the rest of the year to protect Cape Fear shiner Cape Fear shiner[13] spawning habitat.

Recreation, Land Use, and Aesthetics

- Develop a recreation management plan (Recreation Plan), in consultation with appropriate agencies, that includes provisions for: (1) improving the existing portage trail by removing impediments to access and installing a new wooden stair system; (2) improving an existing, but unmaintained, hiking trail from Bynum Dam to the powerhouse to connect the state-maintained trails which exist upstream and downstream of project lands; and (3) installing signs to inform the public of recreational amenities.

2.3 STAFF ALTERNATIVE

Under the staff alternative, McMahan Hydro would maintain the project as proposed, with the modifications and additional measures described below.

[13] The Cape Fear shiner is a federally and state listed endangered species.

- File a report if the impoundment level monitoring system fails to cut-off generation, as designed, in response to a drop in the impoundment level beyond the elevations needed to release the minimum flows.

- Modify the proposed Recreation Plan to include a schedule for constructing the facilities and a program to ensure that the recreation facilities are maintained over the term of any license that may be issued.

- Cease project activities and notify the North Carolina SHPO if archaeological or historic resources are discovered due to operational or other project-related activities.

3.0 ENVIRONMENTAL ANALYSIS

In this section, we present: (1) a general description of the project vicinity; (2) an explanation of the scope of our cumulative effects analysis; and (3) our analysis of the proposed action and other recommended environmental measures. Under each resource area, we first describe historic and current conditions. We compare the environmental effects of the proposed action and alternatives to the existing conditions as the baseline. We assess the effects of proposed mitigation, protection, and enhancement measures, and any potential cumulative effects of the proposed action and alternatives. We discuss our conclusions and recommended measures in section 5.1, *Comprehensive Development and Recommended Alternative*.[14]

3.1 General Description of the Area

The Bynum Project is located at river mile (RM) 12[15] on the Haw River, in the Cape Fear River Basin. The project is located entirely within Chatham County, North Carolina, approximately 4.5 miles north of Pittsboro, 12.5 miles south of Chapel Hill, and 35 miles west of Raleigh, North Carolina.

The Haw River is a major tributary of the Cape Fear River, which has the largest river basin entirely contained within North Carolina, covering 9,149 square miles in 24 counties. The Haw River originates in Guilford County near the border with Forsyth County and initially flows to the northeast into Rockingham County, through Haw River State Park, before assuming a southeasterly flow into Alamance County. The river then passes though Saxapahaw County, and enters Chatham County, before flowing into the Jordan Lake Reservoir, which is impounded by Jordan Lake Dam just below the

[14] Unless otherwise indicated, we took our information from the application for license filed by McMahan Hydro on March 30, 2015, and the response to deficiencies and requests for additional information filed on November 27 and December 24, 2015.

[15] River miles are measured from the confluence of the Haw and Deep Rivers where the Cape Fear River begins.

confluence of the Haw River and New Hope Creek, about nine miles downstream from the Bynum Project. About three miles downstream from Jordan Lake Dam, the Haw River joins the Deep River to form the Cape Fear River, which continues to flow to the North Carolina coast. At the confluence with the Deep River, the Haw River has a drainage area of 1,500 square miles.

3.2 Scope of Cumulative Effects Analysis

According to the Council on Environmental Quality's regulations for implementing NEPA (40 CFR, section 1508.7), cumulative effect is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Through scoping, agency consultation, and our independent analysis we have identified no resources that would be cumulatively affected by refurbishing and operating the Bynum Project. As we discuss in our analysis of water quantity in section 3.3.2, *Aquatic Resources*, the proposed project would operate in a run-of-river mode at all times and would affect only the proportion of flow routed through the project via the turbine and tailrace versus the dam and bypassed reach. The project would not affect the overall downstream flow beyond the point 0.5 miles downstream of the dam where the tailrace and bypassed reach flows would recombine at a flow equal to what originally entered the project from upstream. As we discuss in our analysis of water quality in section 3.3.2, *Aquatic Resources*, the river is well-mixed entering the project so that water quality within and exiting the project would be consistent regardless of which route the water followed through the project. Thus, water quality would not be cumulatively affected. We know of no other reasonably foreseeable future actions that would affect resources in the Haw River.

3.3 Proposed Action and Action Alternatives

In this section, we discuss the effect of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure effects. We then discuss and analyze the site-specific environmental issues.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this EA. Based on this, we have determined that geology and soils, aquatic resources, terrestrial resources, threatened and endangered species, recreation, and cultural resources may be affected by the proposed action and action alternatives. We discuss aesthetics with recreation resources. We have not identified any substantive issues related to socioeconomics associated with the proposed

action and do not include an analysis of socioeconomic resources in this EA. We present our recommendations in section 5.1, *Comprehensive Development and Recommended Alternative*.

3.3.1 Geology and Soils

3.3.1.1 Affected Environment

The Bynum Project is located in the hilly Piedmont region of North Carolina, which lies between the relatively flat Coastal Plain and the Triassic-Jurassic rift basins of the mountainous Blue Ridge and Appalachians. Within the North Carolina Piedmont, the Bynum Project is located in a geological sub-region known as the Carolina Slate Belt (Rogers, 2006). The Slate Belt is composed of acidic igneous (cooled magma) and metamorphic rock formations, formed from an ancient arc of island volcanoes and adjoining marine sediments that were crushed and uplifted when the American and African plates collided approximately 300 million years ago. This compressive movement produced areas of dense, igneous rock. These areas are resistant to erosion and remain as Chatham County's monadnocks.[16] The slate belt is erodible relative to other geological formations in the area (Seal *et al.*, 2001).

The Haw River watershed has a history of intense disturbance from forest conversion and row crop agriculture, urbanization, and dam construction (Macfall *et. al.*, 2014). Although historical records show that the river flow varies greatly from year to year, maximum flows usually occur in the late winter or early spring months. Rocks, ranging from pieces eight inches in diameter to large boulders and bedrock line the riverbed. High flows erode the stream banks, but erosion of the rock-lined riverbed is minimal (Spruill *et al.*, 2006).

3.3.1.2 Environmental Effects

Project Refurbishment

McMahan Hydro proposes to refurbish the project, which would include replacing the seals on the intake gates, clearing vegetation from the canal banks, stabilizing the canal banks if necessary, and revegetating the canal banks with grass to prevent erosion.

[16] Monadnocks are erosion resistant large igneous rock formations created by intrusive (plutonic or igneous rock formed by solidification at considerable depth beneath the earth's surface) or extrusive (volcanic) forces, and appear today as isolated hills that rise above the eroding landscape.

Our Analysis

Clearing vegetation and stabilizing the canal banks could cause erosion and sedimentation. The first step in project rehabilitation would be to seal off the intake gates and, using the sluice gate adjacent to the powerhouse, to dewater the intake gates, canal, and powerhouse, in order to have complete access to the project facilities to work on them. Dewatering the project and applying erosion and sediment control BMPs around the area of project restoration would avoid unnecessary in-water work, in-stream sediment disturbance, and terrestrial erosion during the facilities' refurbishment.

Mode of Operation

McMahan Hydro proposes to operate the project in a run-of-river mode. FWS, North Carolina WRC, and North Carolina DWR recommend that the project be operated as run-of-river at all times, such that outflow approximately equals inflow, except for during operating emergencies beyond the control of the applicant and maintenance drawdowns.

Our Analysis

Operating the project in a run-of-river mode would maintain a stable impoundment elevation that would sustain existing conditions along the project. Limiting changes in water level fluctuations to the expected fluctuations associated with seasonal and daily operation corrections would not increase shoreline erosion beyond existing conditions.

Sediment Management and Control

McMahan Hydro anticipates that, in addition to activities associated with refurbishing the project facility, maintenance activities, or any future impoundment dredging could cause erosion and sedimentation.

McMahan Hydro proposes to develop an erosion management plan to minimize project-induced erosion and sedimentation during the refurbishment, including BMPs. If necessary, McMahon Hydro would develop a separate plan for impoundment sediment management, including dredging, during the term of the license in consultation with North Carolina DRW, North Carolina WRC, and FWS.

No agencies have recommended measures for sediment management.

Our Analysis

Sedimentation can modify substrate surfaces and the morphology of the stream channel, reducing habitat availability and smothering and killing aquatic flora and fauna

(Wood and Armitage, 1997). Chronic levels of suspended sediments also erode fish gills and reduce fish community diversity (Berkman and Rabeni, 1987). If heavy metals and other contaminants are present in the impoundment, they could also be suspended and transported in the water column during project refurbishment, harming downstream fish and wildlife.

In 2011, FWS studied the physical and chemical qualities of the sediment upstream of the Bynum Project, within the impoundment, and downstream from Bynum Dam. FWS assessed the impacts of sediment movement at Bynum on water column chemistry and downstream aquatic life, including sampling at five locations upstream of, and two locations downstream from Bynum Dam.[17] FWS concluded that the Bynum impoundment had not been an effective sediment trap through time, the majority of the trapped sediment was sand and gravel, and sediments in the Bynum impoundment did not contain contaminates that exceeded State standards (Augspurger and Ward, 2011).

The FWS study results suggest that scouring by periodic high flow events has balanced deposition of sediments in the project impoundment during the last 30 years. There does not appear to be an issue with sediment build-up over time, and there is no indication that sediment build-up is likely to occur in the future. Thus, the need for future dredging of the impoundment is unlikely, and a provision within a sediment management plan to manage sediment during impoundment dredging would be unnecessary.

Rehabilitating the project when the intake gates, canal, and powerhouse are dewatered would limit the possibility of erosion and sediment disturbance that could have negative effects on biota and habitat. A standard erosion and sediment control plan would include provisions for implementing BMPs during land-disturbing activities, would provide for timely management of sedimentation at the project, and would reduce the potential for the project to cause erosion and sedimentation.

Maintenance Drawdowns and Refill

McMahan Hydro may need to draw down the impoundment periodically for maintenance, as well as for operating emergencies beyond its control. The intake canal gates, at the dam, are the only means of drawdown of the impoundment. With the gates opened, drawdown flows would pass through the canal and out through the powerhouse or out through the bypass sluice gate located adjacent to the powerhouse. Drawdowns

[17] The 2011 FWS study analyzed whole-sediment samples from within and downstream from the impounded reaches of Swepsonville Dam, Saxapahaw Dam (FERC Project No. 4509), Bynum Dam, and B. Everett Jordan Dam (FERC Project No. 11437) for elemental contaminants and polycyclic aromatic hydrocarbons. The data and surveys of the physical characteristics, volume, and the movement of the sediment samples were used together to infer the short-term impacts on water column chemistry (Augspurger and Ward, 2011).

would temporarily interrupt run-of-river operation and the release of minimum flows into the bypassed reach.

The drawdown process could lead to erosion of the exposed banks of the impoundment and the river downstream from the dam. McMahan Hydro proposes to develop a plan for maintenance and emergency drawdowns in consultation with the agencies.

Our Analysis

A rapid impoundment drawdown could result in sloughing of the banks of the impoundment. Sloughing is an erosional process that occurs when a saturated soil bank is relieved of hydrostatic pressure[18] that otherwise helps hold the bank intact. Bank sloughing, under the right conditions, could lead to suspension of sediments in the water column and an increase in turbidity in the impoundment and downstream from the project.

Rapid release of water can sometimes generate high enough flow velocities downstream from a dam to harm aquatic resources. However, there is little risk of such an event occurring at this project. There are no gates to the bypassed reach. The only way to lower the impoundment level is to use the powerhouse and the sluice gate at the end of the canal (near the powerhouse) to release water. Because the volume of water that the powerhouse and sluice gate can release is restricted, rapid release of water is not possible. For the same reason, this method of release would lower the impoundment gradually enough that the impoundment streambanks should dewater slowly and sloughing should not occur.

Efficiently completing the rehabilitation work would reduce the amount of time the streambanks are exposed to weathering, flows are altered, and the impoundment is drawn down. Refilling the impoundment as soon as possible after rehabilitation is complete would benefit habitat in the impoundment. However, it would be best not to stop all flow to the downstream Haw River while refilling the project after a drawdown. A minimum flow released from the impoundment during refill would prevent the standing of fish and other aquatic resources downstream of the impoundment. As an example, because the impoundment has only 100 acre-feet of storage to refill, it could be refilled in about 4 hours at the lowest mean annual river flow of 370 cfs while still providing a constant release of 69 cfs.[19]

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[18] The force of water against a surface due to gravity.

[19] The lowest 7-day average flow that occurs (on average) once every 10 years or 7Q10 flow (based on North Carolina WRC and USGS data). The 7Q10 flow sometimes is used as an estimate of flow necessary to dilute discharges of pollutants to rivers.

Such a plan would address seasonal timing, length of drawdown, the appropriate minimum flow release during refill, and prevention of erosion and sedimentation during a proposed drawdown. Documenting the maintenance or emergency drawdowns would allow for review of the procedures used, and provide information to revise the plan, if necessary.

3.3.2 Aquatic Resources

3.3.2.1 Affected Environment

Water Quantity

At the project site, the Haw River has a drainage area of about 1,275 square miles. The project impoundment has a surface area of about 20 acres at the normal operating headpond elevation of 315 feet AMSL. It has an estimated gross volume of 100 acre-feet. The impoundment has no usable storage. The estimate of the hydraulic capacity of the project's generating unit extends from 300 to 650 cfs.

The USGS Gage No. 02096960 (Haw River near Bynum), NC, records river flow about 0.5 mile downstream from the project powerhouse. No tributaries enter the Haw River between the project outflow and the gage. The USGS operates the gage in cooperation with the U.S. Army Corps of Engineers (Corps) to provide inflow data to manage the downstream Jordan Reservoir. The period of record for daily discharge for this gage is September 1973 until present (USGS, 2018). The highest average monthly flows occur from January through April and the lowest average monthly flows occur from July through September. Table 1 presents the mean, maximum, and minimum average monthly flows for the Haw River at Bynum.

Table 1. Mean monthly and annual flows in cfs on the Haw River just downstream from the Bynum Hydroelectric Project.

Month	Mean	Maximum	Minimum
Jan	1,870	5,895	262
Feb	1,860	5,465	419
Mar	2,260	6,110	353
Apr	1,660	5,363	380
May	1,070	3,936	171
Jun	865	4,632	109
Jul	728	4,477	135
Aug	558	2,422	113
Sep	802	4,904	83

Month	Mean	Maximum	Minimum
Oct	647	2,906	130
Nov	802	3,136	109
Dec	1,230	5,222	218
Annual	1,198	2,948	370
(Source: USGS, 2018). Period of Record of table January 1, 1993 through December 31, 2017. USGS Station No. 02096960 Haw River near Bynum, North Carolina			

The annual flow duration curve indicates that Haw River flows are less than 500 cfs about 50 percent of the time and at flood stage (over 17,000 cfs) about 2 percent of the time (Figure 3).

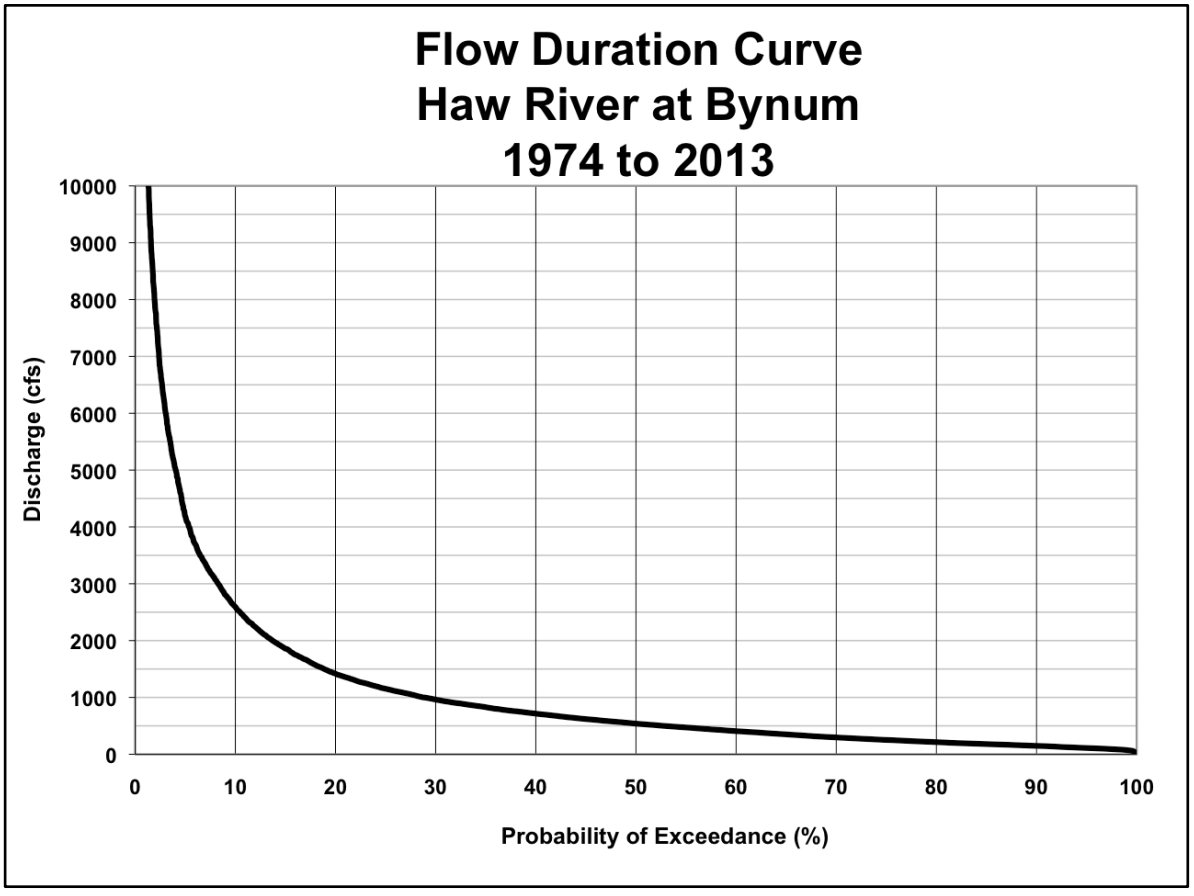

Figure 3. Annual flow duration curve for the Haw River at Bynum. (Source: McMahan Hydro)

Currently, all water flows over the dam because the hydroelectric project is not operating. The surface elevation of the impoundment varies with the natural streamflow

in the river. Prior to the project becoming inoperable, the project operated in a run-of-river mode with a minimum flow spill over the dam of 80 cfs.

Water Quality

The North Carolina Department of Water Quality (North Carolina DWQ)[20] defines the Haw River water quality standards as described in table 2.

Table 2. North Carolina water quality standards relevant to the Bynum Project.

Parameter	North Carolina Water Quality Standard
Temperature	Not to exceed 2.8°C (5.04 °F) above the natural water temperature. Not to exceed 32°C (89.6 °F) for lower piedmont waters.
Dissolved Oxygen	Not less than 5.0 mg/L daily average Not less than 4.0 mg/L instantaneously

Note: mg/L – milligrams per liter.
(Source: North Carolina DWQ, 2007)

According to North Carolina DWQ (2005), the primary water quality issue in the basin is nonpoint source runoff (particularly of sediments and nutrients). Throughout the basin, there is evidence of land development activity, resulting in narrow riparian corridors, sediment deposition in the river, and periphyton[21] growth along the river's edge. Periphyton growth can be an indication of nutrient enrichment. Tributaries upstream of the project convey runoff from forested, agricultural, and residential areas, to the Haw River, as well as discharge from several wastewater treatment facilities.

In the 2005 Cape Fear River Basinwide Water Quality Plan, North Carolina DWQ rated the Haw River in the Bynum area as G (good) and S (supporting) for aquatic life and recreation. The North Carolina 2014 305(b)[22] report indicated that the Haw River in the project area is designated as a WS-V (water supply V), which allows for wastewater discharges (domestic and industrial) with no development activity restrictions or stream buffers required. The project area river reach met the criteria for water temperature and DO concentration. The only measurement that exceeded the standard was the mercury concentration in fish tissue for which the State has a management plan in place and for which a primary source is often the atmosphere.

[20] Recently renamed the North Carolina Water Resources Division.

[21] Periphyton is a combination of living material (usually a mixture of algae and bacteria) and detritus attached to submerged surfaces in aquatic ecosystems.

[22] Under Section 305(b) of the Clean Water Act, the states, territories, and other jurisdictions of the United States are required to submit reports on the quality of their waters to the U.S. Environmental Protection Agency every 2 years.

North Carolina DWR maintains an Ambient Monitoring Station (B2100000 Haw River at SR 1713 near Bynum) that monitors DO, water temperature, and dissolved nutrients.[23] The station is located in the bypassed reach of the Bynum Project.

Fisheries Resources

The 20-acre impoundment is about 600-feet-wide along most of its length, and extends about 4,500 feet upstream of the dam. The impoundment is riverine in nature and surrounded by wooded hillsides. The Haw River mainstem supports a warm water fish assemblage typical of a small, low gradient, Piedmont headwater river. The river supports at least 40 species of freshwater and diadromous fish species (table 4), including American eel, largemouth bass, redbreast sunfish, and spotted bass.

Table 3. Fish Assemblage of the Mainstem Haw River.

Snail bullhead	Yellow bullhead	Brown bullhead
Channel catfish	Margined madtom	American eel
Gizzard shad	Common carp	Highfin shiner
Satinfin shiner	Comely shiner	Spottail shiner
White shiner	Whitefin shiner	Sandbar shiner
Cape Fear shiner	Rosefin shiner	Swallowtail shiner
Creek chubsucker	Bluehead chub	Eastern silvery minnow
White sucker	Notchlip redhorse	Shorthead redhorse
V-lip redhorse	Brassy jumprock	Speckled killifish
Eastern mosquitofish	Piedmont darter	Fantail darter
Tessellated darter	Largemouth bass	Spotted bass
Black crappie	Bluegill	Redear sunfish
Redbreast sunfish	Green sunfish	Pumpkinseed
Yellow perch		

(Source: North Carolina WRC, 2018)

The impoundment is small and shallow, with riparian wetland fringes and little deep-water habitat. The impoundment supports a subset of the fish community in the Haw River that prefer large pool habitats, such as largemouth bass, black crappie, and bluegill sunfish.

The 700-foot-wide bypassed reach downstream from the dam includes about 0.5 mile of islands, exposed rock, and meandering channels, which merge with the project tailrace. Substrates immediately downstream from the dam are mostly large boulders and cobbles. Aquatic habitats include riffles, runs, and shallow riverine pools characterized by bedrock outcrops, boulders, and smaller substrates. These reaches serve

[23] https://www.waterqualitydata.us/provider/STORET/21NCMONITORING/21NCMONITORING-B2100000/. Accessed February 12, 2018.

as nursery habitat, and attract small forage species as well as juvenile gamefish (Howard, 2003).

The habitat in the bypassed reach is typical of the many boulder fields and braided channels found elsewhere in the Haw River. There are several long stretches of these habitats upstream of the project area. The river habitat is braided channel for three miles downstream from the tailrace and bypassed reach.

Special Status Aquatic Species

North Carolina WRC indicated that the following aquatic special status species were in the project area.

Table 4. Special status aquatic species in the Haw River.

Species	**State status**	**Federal Status**
Mussels		
Brook floater	Endangered	Species of concern
Yellow lampmussel	Endangered	Species of concern
Carolina creekshell	Endangered	Species of concern
Eastern creekshell	Significantly Rare	None
Creeper	Threatened	None
Fish		
Carolina Darter	Vulnerable	Species of concern

Brook Floater

The brook floater is a North Carolina State Endangered Species, currently under review for federal listing. It rarely exceeds three inches in length. The brook floater is found in Canada (New Brunswick and Nova Scotia) and the northeastern United States (Maine south to Georgia), and it lives in high relief streams, under boulders, and in sand. Research has shown that it is highly sensitive to increased temperature. The host fish species include the margined madtom, pumpkinseed, golden shiner, and yellow perch. The brook floater is sensitive to habitat loss from development, dams and road crossings, pollution, summer droughts, trampling, sedimentation, flow alteration, and low oxygen conditions.

Yellow Lampmussel

The yellow lampmussel is a North Carolina State Endangered Species and is under review for federal listing. The species is found in Canada (Nova Scotia) and from Maine to Georgia. The lampmussel can grow to a shell length of about 5 inches (Bogan and Alderman, 2004). The shell of the mussel is obovate (egg shaped) and moderately

inflated. The anterior margin of the shell is rounded, the ventral margin slightly curved and the posterior margin bluntly rounded.

The yellow lampmussel occupies many different habitats, including medium to large rivers generally and, to the north, lakes and ponds. The mussel inhabits a variety of substrate types, including sand, silt, cobble, and gravel, though it lives most often in the shifting sands downstream from large boulders in relatively fast flowing, medium sized rivers and medium to large creeks (Parmalee and Bogan, 1998; Strayer and Jirka, 1997).

The only known larval hosts are the white perch and yellow perch (Wick and Huryn, 2002). The yellow lampmussel is bradytictic[24] (Ortmann, 1919; Alderman, 1988).

Carolina Creekshell

The Carolina creekshell is a North Carolina State Endangered Species, and is under review for federal listing. The mussel is sexually dimorphic, with males having a ventral margin that curves from anterior to posterior, producing an elliptical shell shape. On females, the posterior end expands to accommodate the marsupium,[25] so that the shell shape is somewhat trapezoidal. The Carolina creekshell occupies silty sand or clay substrates along the banks of small streams. It has been found occupying substrates of mixed sand and gravel in the main channel of streams and medium rivers. Regardless of the substrate, the species needs to be able to burrow. This species is also bradytictic. The fish hosts are unknown.

The range of the Carolina creekshell includes the Catawba and Yadkin-Pee Dee River basins in North and South Carolina, and the Upper Cape Fear River Basin in North Carolina.

Eastern Creekshell

The eastern creekshell is very similar to the Carolina creekshell, and is currently a North Carolina State Significantly Rare Species. The species also displays sexual dimorphism in shell shape, with the posterior-ventral margin of the female becoming expanded with age, while the ventral margin of the male remains straight. The expansion demonstrated in eastern creekshell is usually more exaggerated than that seen in the Carolina creekshell.

Johnson (1970) described the species' common habitat features as "mud or soft sand, particularly where rich in vegetable detritus, in small rivers and creeks." The

[24] Bradytictic species typically release their glochidia in late winter, spring, and early summer.

[25] A pouch that protects eggs, offspring, or reproductive structures.

eastern creekshell will rest on deep mud as well as occupy sand and boulder fields. It tends to stay close to the bank of streams and rivers, often among tree roots. Observations suggest that the species is sensitive to channel modification, pollution, sedimentation, and low oxygen conditions. Its habitat preference for tree roots along stream banks may cause it to be particularly susceptible to bank erosion and the loss of a forested riparian zone.

The species is bradytictic, with spawning taking place primarily in summer. Glochidia[26] overwinter in females, and females expel the glochidia the following spring. Little else is known about its life history.

Creeper

The creeper is a species of river mussel, and is a North Carolina State Threatened Species. It is native to eastern Canada and the eastern United States (Maine to South Carolina). The mussel has a somewhat flattened, smooth, oval shell, which is thin in young animals and becomes thicker with age. It grows up to 4-inches long. The species lives in a variety of freshwater habitat types, including rivers, streams, ponds, and lakes. It tolerates still water and low to moderate flow gradients, but usually not high flow areas. It lives in mud, sand, and gravel substrates.

The creeper produces a conglutinate[27] that is whitish and rod-shaped, up to 0.5-inch long and contains around 12 glochidia. The glochidia of this species are larger than the glochidia of most other mussels, measuring up to almost 500 micrometers. The conglutinate moves by itself, making a pulsing motion. The motion helps to squeeze out the glochidia, and it may help to attract fish hosts. Sometimes one of the glochidia will attach to a host while remaining attached to the conglutinate. In this case, the host may drag the conglutinate along with it, increasing the opportunity for other glochidia to parasitize the host.

The creeper uses a wide variety of organisms as hosts, especially fish. The hosts include black bullhead, largemouth bass, green sunfish, yellow perch, fathead minnow, spotfin shiner, walleye, bluegill, longnose dace, fallfish, and many others (Gray *et al.*, 2002).

Carolina Darter

The Carolina darter is currently a federal and state species of concern because it exists only in the Piedmont region, from a few dozen localities in Virginia, North Carolina, and further south. The range in North Carolina is restricted to the Yadkin, Pee

[26] A parasitic larva of certain freshwater bivalve mollusks.

[27] A mucilaginous packet containing the glochidia that acts as a lure for fish.

Dee, and Catawba River drainages (Cloutman, 1979). Jenkins and Burkhead (1994) have been are extirpated.[28]

The fish may grow up to 2.4 inches, has a small head and mouth, and a highly arched, incomplete lateral line (Kuehne and Barbour, 1983). The sides are marked with a median dark stripe that breaks into blotches on the peduncle (Eddy and Underhill, 1979).

The Carolina darter inhabits small- to moderate-sized streams in areas of low current velocity. The species usually prefers substrates characterized by mud, sand, and sometimes, bedrock. The darter appears to tolerate fine sediment covering the substrate it inhabits (Kuehne and Barbour, 1983; Rohde *et al.*, 1994). Geographic isolation of the Carolina darter makes it extremely vulnerable to development, pollution, and habitat alterations. The measures proposed to protect the Cape Fear shiner would also protect this species. However, because the range of the darter does not include the project area, we will not discuss it further.

3.3.2.2 Environmental Effects

Water Quantity

McMahan Hydro proposes to maintain run-of-river operation and the agencies recommend the same as previously discussed in section 3.3.1, *Geology and Soils.* McMahan Hydro also proposes to maintain seasonal minimum flow releases of 240 cfs over the project dam to the bypassed reach from March 1 through April 30, and 120 cfs the rest of the year. McMahan Hydro would maintain the minimum flow by keeping the impoundment at the elevation required to release the minimum flow over the spillway through manipulation of the Tainter gates. When project inflows are greater than the sum of the minimum flow and the minimum hydraulic capacity of the turbine (420 cfs through most of the year, or 540 cfs from March through April), the project would operate. Inflows in excess of the sum of the minimum flows and maximum hydraulic capacity of the turbine (770 cfs through most of the year or 890 cfs from March through April), would result in the project spilling flow in excess of the minimum flow. When incoming flow is less than the sum of the minimum flow and the minimum hydraulic capacity, the project would not operate and all water would spill over the dam.

Our Analysis

The minimum hydraulic capacity of the project turbine is 300 cfs, and the maximum hydraulic capacity is 650 cfs. To operate the project with a minimum release of 240 cfs to the bypassed reach from March through April minimum inflow would have to be 540 cfs. To operate the project and 120 cfs from May through February, the minimum inflow would have to be 420 cfs. To operate at full capacity, inflow would

[28] A localized extinction.

have to be at least 890 cfs in March and April, and 770 cfs from May through February. Table 3 shows the percentage of days and the number of days per month that the necessary daily average flow was exceeded historically for each of the operational scenarios

Table 5. The percentage of days (top) and number of days (bottom) that mean daily flows exceeded the minimum inflow required for the Bynum Project to operate and provide the proposed minimum flow of 120 cfs or 240 cfs (March and April) to the bypassed reach.

Month	Percentage of Days the Project Could Operate			
	420 cfs	540 cfs	770 cfs	890 cfs
Jan	88.2		58.8	
Feb	90.2		65.3	
Mar	94.2[a]	81.9	73.3[a]	64.0
Apr	86.0[a]	66.1	55.4[a]	48.8
May	64.8		35.0	
Jun	46.2		23.0	
Jul	34.4		19.0	
Aug	28.5		15.0	
Sep	31.0		19.4	
Oct	27.9		14.5	
Nov	40.9		21.0	
Dec	68.9		42.6	
	Days predicted per month from exceedance percentages			
Jan	27.3		18.2	
Feb	25.3		18.3	
Mar	29.2[a]	25.4	22.7[a]	19.8
Apr	25.8[a]	19.8	16.6[a]	14.6
May	20.1		10.9	
Jun	13.9		6.9	
Jul	10.7		5.9	
Aug	8.8		4.7	
Sep	9.3		5.8	
Oct	8.6		4.5	
Nov	12.3		6.3	
Dec	21.4		13.2	

[a] Using the North Carolina WRC recommended 120 cfs minimum flow.

Note: Period of Record is January 1, 1993 through December 31, 2017. (Source: USGS, 2018, as modified by staff).

Table 3 shows that the project would have sufficient flows to generate electricity during less than 50 percent of the days between June and November. The project would have sufficient flows to generate electricity at maximum capacity most often during the winter and early spring months.

Compliance Monitoring

To verify run-of-river operation, McMahan Hydro proposes to monitor flows daily, and operate a water level sensor controlling an automatic cut-off switch on the turbine so that generation stopped if the impoundment water level dropped below the level needed to provide the minimum flow to the bypassed reach. McMahan Hydro would also provide access to 15-minute interval generation data to the resource agencies.

North Carolina WRC and North Carolina DWR recommend that McMahan Hydro maintain records of inflow and outflow to the Bynum Project to verify run-of-river operation, and to document maintenance and emergency drawdowns. Specifically, North Carolina WRC and North Carolina DWR recommend that McMahan Hydro: (1) collect and maintain records of inflow, outflow, and project generation; (2) document run-of-river operation; and (3) document maintenance and emergency drawdowns. They also recommend that the records of impoundment stage and project generation be available to resource agencies upon request. North Carolina WRC and North Carolina DWR also indicated that McMahan Hydro should replace the USGS gaging station with a similar flow measurement system should the USGS discontinue operating it.

Our Analysis

Given the small size of the project impoundment (20 acres and 100 acre-feet of storage), the project does not have the ability to store water. To maintain compliance with run-of-river operation, McMahan Hydro proposes to use a water level sensor and automatic cut-off system to record and control the impoundment elevation. This control system would document compliance with run-of-river operation by measuring and recording the project response to inflows. When operating properly, it would ensure that the project could not function in any operational mode other than run-of-river by shutting the project off before any deviation occurs.

Using the recorded project data on generation and impoundment elevation level in 15-minute intervals would provide documentation of when, and under what conditions, the project is generating. The Commission could use this information to detect if the project was operating in a mode other than run-of-river. The agencies' recommendations for recording inflow, outflow, and water level, would require installing a gage upstream of the project, a gage in the project tailrace, and the reservoir elevation sensor. Installing and maintaining two extra gages would be more costly and less accurate than the impoundment elevation sensor and would not provide the automatic compliance with

run-of-river operation provided by the impoundment elevation sensor. Gages installed without permanent control structures need regular recalibration, especially after flood flows.

Requiring McMahan Hydro to report when the cut-off system fails, or when the impoundment elevation drops below the level required for releasing the minimum flows over the spillway, would ensure the notification of the Commission and stakeholders of possible deviations from run-of-river operation. The resource agencies' also recommend using the downstream USGS gage to monitor the combined flows from the bypassed reach and tailrace and compare the sum to the flow at the inflow gage. The agencies recommend that McMahan Hydro be required to install a replacement gage if the USGS shuts down its downstream gage. However, under McMahan Hydro's proposal, if the downstream USGS gage was discontinued, run-of-river operation of the project would still be ensured by the turbine cut-off system and the lack of storage in the impoundment. Records from the impoundment elevation sensor and from generation could confirm compliance with run-of-river operation. Information on maintenance and emergency drawdowns would be available through provisions in the proposed Maintenance and Emergency Drawdown Plan.

Water Quality

In section 1.3.2, *Clean Water Act*, we indicated that McMahan Hydro filed a draft water quality monitoring plan to record DO and water temperature monthly as part of their re-application for 401 certification. North Carolina WRC recommended McMahan Hydro develop such a plan to monitor DO and water temperature at the Bynum Project in comments on the draft license application. In its letter[29] in response to the Ready for Environmental Analysis notice (issued February 3, 2017), North Carolina DWR stated that the applicant should develop a water quality monitoring plan to ensure the bypassed reach and tailrace flows maintain the required minimum DO levels.

McMahan Hydro would implement the proposed water quality monitoring plan once the Bynum Project was operational. Under the draft plan, McMahan Hydro would measure DO concentration and water temperature at three sampling sites within the project area, once a month, year-round, for the term of the license. McMahan Hydro would also obtain stream discharge and river stage data from the USGS Gage No. 02096960 (Haw River near Bynum).

The three sampling sites would be located: (1) in the project impoundment immediately upstream of Bynum Dam; (2) in the project tailrace; and (3) in the bypassed reach near the footbridge. McMahan Hydro would maintain digital records of all data,

[29] Letter filed April 4, 2017.

keep a backup of collected data in cloud storage, and would provide the recorded data on an annual basis, or as requested, to North Carolina DWR and other appropriate agencies.

Our Analysis

Low head, run-of-river hydroelectric projects with riverine impoundments, like the proposed Bynum Project, have short water retention times and are not likely to alter the DO concentration or water temperature of the river flows as they pass through the turbine. Additionally, projects with impoundments of a similar size to the Bynum impoundment are generally too small to foster stratification of the water column, which could otherwise contribute to altered temperature and DO concentrations in the project outflows. At the lowest flow at which the turbine would operate under the proposal, which is 420 cfs, water would move through the impoundment in less than three hours. Given that flow over the upstream riffles and shoals characteristic of the Haw River ensures that water entering the impoundment is well mixed, three hours is not enough time for temperature stratification of the water column to develop in the impoundment. There is no indication that either the turbine or the dam face would alter water quality in meaningful or different ways. Therefore, water leaving the impoundment will be consistent in quality, regardless of how it passes through the project, with the quality of the water flowing into the impoundment.

McMahan Hydro analyzed the data collected at the North Carolina Ambient Monitoring Station (located in the bypassed reach) to characterize the conditions specific to the proposed project and its operation. As seen in Figure 3, the DO concentrations did not drop below 6.0 mg/L either during the ten years (1997-2006), when the project operated with a bypassed reach minimum flow of 80 cfs, or during the 9 years (2007-2016) when the project was not operating. The data support the conclusion that operating the project would have minimal effects on DO concentrations and temperature in the Haw River.

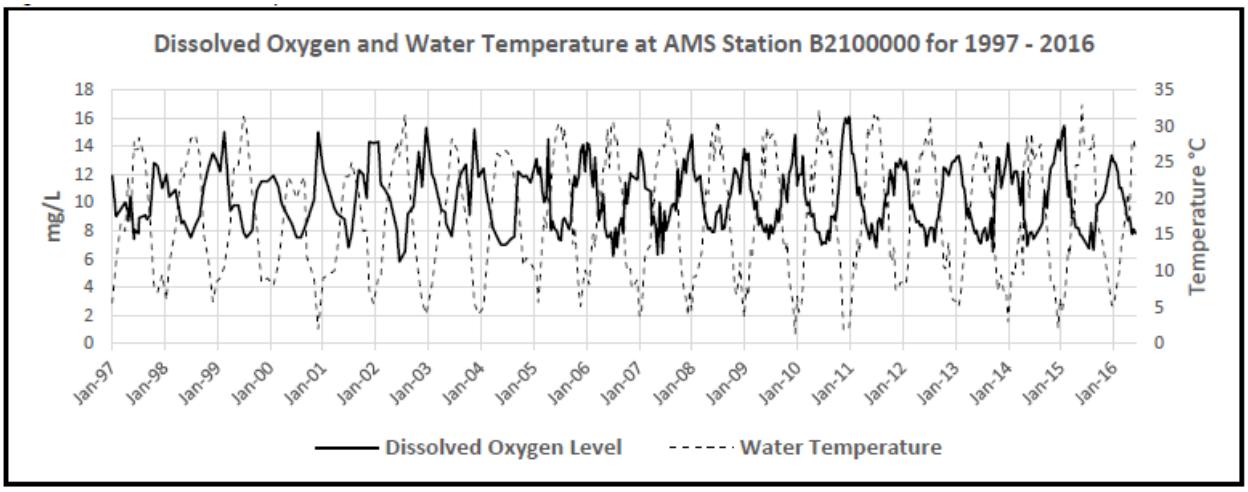

Figure 4. Plot of DO and water temperatures in the Haw River from 1997 through 2016. (Source: McMahan Hydro, Reapplication for 401 certification, 2018).

Based on the data from the Ambient Monitoring Station (Figure 4), further monitoring of DO and water temperature at the Bynum Project, as recommended by North Carolina WRC, would be unlikely to document any new effects on water quality, and therefore, would have little to no project-related value. The proposed minimum flows, of 240 cfs in March and April and 120 cfs for rest of the year, would be 40 to 160 cfs greater than the 80 cfs released under previous operation. Thus, the proposed minimum flow would be more likely to maintain good water quality in the bypassed reach than the previous minimum flow, which itself maintained good water quality in the bypass reach.

McMahan Hydro's proposal to monitor water quality would be inefficient and produce data of little project-related value. First, McMahan Hydro would take the majority of the measurements in relatively cool weather. In cooler weather, DO concentrations naturally would be relatively high and water temperatures relatively low. McMahan Hydro would take fewer measurements in the warmest month(s), when flows are lower and the risk of high water temperature and low DO concentration are greater. (Existing data, however, indicates the water quality is adequate even during the warmer summer months.) Second, the information gained from monthly samples taken instantaneously would be limited because it would not describe minimum and maximum values, or patterns in, water quality parameters. Third, any change in water quality would likely to be the result of a change in the character of the water flowing into the project, resulting not from project operation, but from changes in the watershed upstream of the project over which McMahan Hydro has no control. Finally, monitoring such overall water quality conditions in the river is not a project-related purpose, but rather a purpose of North Carolina's existing Ambient Water Quality Station located in the project's bypassed reach. Regarding recording the data from the USGS gage, the USGS already records and publishes such data itself. Overall, there appears to be little project-related value to the proposed water quality monitoring program.

We previously indicated, in section 3.3.1, *Geology and Soils*, that implementing a plan for maintenance and emergency drawdowns and refills, would help prevent erosion and sedimentation in the project impoundment and the river downstream from the dam. The procedures for refilling an impoundment present a trade-off between minimizing effects on the aquatic habitat in the impoundment and effects on aquatic habitat downstream of the dam. Reducing downstream flows to refill the impoundment would have the greatest adverse effect during hot summer months, when high air and water temperatures can exacerbate the effects of reduced wetted area, which could stress or kill aquatic macroinvertebrates and fish. Implementing a plan for drawing down and refilling the impoundment, developed in consultation with the fishery management agencies, would help to balance and minimize potential negative effects. To ensure that the plan was in place when needed, McMahan Hydro would develop it before beginning operation.

Similarly, a plan to use sediment and erosion control BMPs to minimize effects on water quality and habitat from project restoration activities would protect fish in the impoundment and downstream of the project. To be effective, McMahan Hydro would also need to complete this plan before beginning to refurbish the project.

Debris Management

McMahan Hydro proposes to develop an intake maintenance plan for the disposition of organic and inorganic debris that collects on the project's Tainter gates and trashracks.

Our Analysis

Organic and inorganic debris can collect on the Tainter gates and trashracks of a hydroelectric project. Debris collecting in these locations can present an operations and safety issue requiring management.

To protect project facilities McMahan Hydro could develop an organic and inorganic debris plan. The plan would provide direction on how and when McMahan Hydro would remove debris and how it would handle the debris it removed. Handling of organic debris could include depositing the material downstream of the dam to provide aquatic resource habitat or disposing of material on or off-site if there are safety concerns with placing the debris back in the river. Handling of inorganic debris would typically involve disposal at a waste facility.

Impingement and Entrainment

Water intake structures at hydropower projects can injure or kill fish that come into contact with intake screens, trash racks, or turbines (Bell, 1991). Intake screens and trash racks can trap fish if the openings are smaller than the fish and the approach

velocities[30] are faster than the burst swim speeds[31] of the fish. This process, impingement, can cause physical stress, suffocation, and death of some organisms (EPRI, 2003). Entrainment can occur if fish do not avoid passage into the intake structures, have burst swim speed lower than the intake velocity, and are small enough to pass between trash rack bars. Once entrained, collisions with turbine blades, pressure changes, sheer forces in turbulent flows, or water velocity accelerations created by turbines can injure or kill fish (Rochester *et al*., 1984).

McMahan hydro does not propose measures to address entrainment. For projects without diadromous species, the standard recommendation from North Carolina WRC is for trashrack spacing not to exceed 2.5 inches, and intake velocities not to exceed 1.5 feet per second (fps).[32]

Our Analysis

The project design has an intake structure consisting of trash racks, mounted perpendicular to the intake flow. Table 6 lists the known dimensions of the project facilities associated with the intake.

Table 6. Bynum Project dimensions used to calculate approach velocity.

Width of Intake at Powerhouse	22 feet
Water Depth of Intake at Powerhouse	15 feet
Bar Thickness	0.5 inches
Spacing between Trash Rack Bars	2.75 inches
Total Number of Trash Racks Bars	83 bars
Total Intake Cross Sectional Area	330 square feet
Surface Area of Bars	50 square feet
Surface Area of Clear Space	280 square feet
Minimum Hydraulic Flow for Operation	300 cfs
Maximum Hydraulic Flow for Operation	650 cfs

To determine the risk of impingement, we estimated the range of approach velocities (V_0, [fps]) in front of the trash racks, using the following equation (EPRI, 2000):

[30] Approach velocity is the calculated water flow velocity component perpendicular to the trash rack face.

[31] Burst swimming speed is the maximum swimming speed that a fish exhibits, but only briefly (for a few seconds). Fish often escape danger at their burst speed (Murray, 1974).

[32] North Carolina WRC letter dated February 17, 2014, included in the application.

$$V_0 = \frac{intake\ flow}{intake\ cross{-}sectional\ area}$$

The total surface area of the inundated trashrack openings is 330 square-feet. The clear space surface area (total surface area minus the bar rack surface area) would be 280 square feet. With that amount of surface area, the range in velocity approaching the trashrack is:

1.07 fps	at the minimum turbine capacity of 300 cfs
2.32 fps	at the maximum turbine capacity of 650 cfs

Thus, the approach velocity would be greater than 1.5 fps maximum recommended by North Carolina WRC much of the time that the project was generating.[33]

To place the intake velocity anticipated during generation in the context of fish burst swim speeds, we acquired burst swim speed estimates for nine fish species representative of Haw River fish community in the project area. Table 7 shows that the selected species have burst swimming speeds greater than the maximum estimated trashrack intake velocity. Thus, for these representative fish, burst swim speeds would be sufficient to avoid impingement and entrainment, assuming the fish were behaviorally inclined to doing so. Some fish will enter the intake volitionally.

Table 7. Swim speeds of nine representative species found in the Bynum impoundment.

Target Species	**Notes**	**Swim Speed Burst (fps)**
Bluegill	Leavy and Bonner, 2009	4.3
Redbreast Sunfish	Leavy and Bonner, 2009	4.3
Largemouth Bass	Katopodis & Gervais, 1991	> 2.9
Whitefin Shiner	Used Emerald Shiner as surrogate from Leavy and Bonner, 2009	2.2-2.5
White Sucker or Notchlip Redhorse	White Sucker from Peake, 2008	5.2-6.4

[33] In order to reduce the trashrack approach velocity to 1.5 fps or less for all flows up to the maximum hydraulic capacity of the turbine (650 cfs), the trashrack would require clear-openings between the trashrack bars with a total inundated surface area of at least 433 square-feet. To accommodate the increased area, the trashrack would have to be reconfigured to pitch at an angle of about 40° toward the upstream direction of the flow (to mount the entire rack underwater) and to be 23 feet tall. Currently, the trashrack is vertical.

Target Species	Notes	Swim Speed Burst (fps)
Gizzard Shad	Used Alewife as surrogate from Peake, 2008	3.1-3.6
Channel Catfish	Venn Beecham *et al*., 2007	3.9
Yellow Perch	Critical speed at 10 °C and 20 °C from Nelson, 1989	7.2-8.6

The fact that the existing trashrack bar spacing, at 2.75 inches, is wider than the 2.5 inches recommended by North Carolina WRC, means that slightly larger fish could be entrained. However, larger fish typically have faster burst swim speeds and would be very unlikely to be entrained non-volitionally.

We determined the susceptibility of the target species to entrainment based on their life history characteristics, habitat preferences, and behavior in relation to the location of the intake structures at the project. We summarized this information in table 8.

Table 8. Target fish species in the Haw River typically used for entrainment analysis.

Target Species	Habitat Guild	Likelihood of Proximity to Intake Structure
Bluegill	Littoral Lacustrine Centrarchid (sunfish)	Low – no littoral habitat near intake structure
Redbreast Sunfish	Littoral Riverine Centrarchid	Low – no littoral habitat near intake structure
Largemouth Bass	Littoral Lacustrine Centrarchid (bass)	Low – no littoral habitat near intake structure
Whitefin Shiner	Littoral Cyprinid	Low – no littoral habitat near intake structure
White Sucker or Notchlip Redhorse	Benthic Catostomid	Moderate – due to benthic orientation
Gizzard Shad	Littoral/Pelagic Clupeid	Low – schools unlikely to enter canal through low level intake structure
Channel Catfish	Benthic Ictalurid	Moderate – due to benthic orientation
Yellow Perch	Littoral Percid	Low – no littoral habitat near intake structure

The location of the intake influences the probability of fish entrainment. At the Bynum Project, the intake is low in the water column relative to the littoral habitat

preferred by most of the representative species. In addition, to be entrained, fish would first need to pass under the canal Tainter gates prior to reaching the trashracks protecting the powerhouse intakes. Benthic fish, such as catfishes and suckers, may be more likely to be near the bottom opening of the Tainter gates than fish that tend to travel higher in the water column, which might not pass under the Tainter gates. Taken together, there is a low entrainment risk for the representative littoral species and moderate risk for the representative benthic species (table 8).

For entrained fish, site specific factors determine the risk of turbine mortality at a hydroelectric project. In addition to entrainment, influential site-specific factors include physical characteristics of the project, such as the turbine type as well as the size, age, and movements of fish (EPRI, 1992).

James Leffel & Co. manufactured the Bynum turbine, which is most likely a Francis type, based on the date of installation, orientation, and head.[34] The EPRI 1992 database describes the low head (less than 20 feet), low speed (less than 250 rpm) Francis turbines that have been studied. Winchell *et al*. (2000), found 48-hour entrainment survival rates for fish entrained through slow speed Francis turbines in the Southeast, to be 88 to 90 percent. The survival of smaller individuals is likely to be relatively high because small fish are less prone than larger fish to mechanical injury from turbine passage.

Entrainment studies have shown that the majority of fish entrained are small and many are young (EPRI, 1997). The younger individuals in a fish population generally have high rates of natural mortality, even in the absence of hydropower operations. Fish populations typically withstand losses of large numbers of these smaller and younger individuals with little or no impact to long-term population sustainability. Thus, entrainment and turbine mortality of smaller individuals could occur, but would have minimal consequences to the sustainability of the fish community in the impoundment.

Fish burst speeds, site characteristics, and habitat preferences would reduce the likelihood of impingement or entrainment. Entrainment would result in low mortality rates because most fish entrained would be small. Most fish killed would be of a species that can absorb the loss of many small fish at a population level. Consequently, impingement and entrainment would not have operation of the project would have no adverse effect on the fish community in the project impoundment.

Special Status Aquatic Species

The brook floater, yellow lampmussel, and Carolina creekshell are North Carolina State Endangered Species, the Eastern creekshell is state threatened, and the creeper is

[34] Leffel Turbine Waterwheels, 1916, Bulletin 54, James Leffel and Company, https://bit.ly/2OkmgXu .

significantly rare. McMahan Hydro proposes no measures directly related to the protection of these species. FWS made no recommendations directly addressing these species.

Our Analysis

As stated above, operating the project in a run-of-river mode would maintain good water quality conditions and stable water levels in the project vicinity, which would serve to benefit all aquatic organisms, including the rare mussels. Stable water levels would help avoid unnatural flow disruptions to any spawning and rearing habitat that might exist, both within the project impoundment and in the reach downstream from the project. Maintaining stable impoundment levels would also benefit fish and other aquatic organisms that rely on near-shore habitat for feeding, spawning, and cover on which these mussels rely to complete their reproductive cycle and disperse their young. The proposed minimum flows would maintain constant flow to provide some habitat in the bypassed reach.

Emergency and maintenance drawdowns could have negative effects on habitat and water quality. As we previously indicated in section 3.3.1, *Geology and Soils*, implementing a drawdown and refill plan would help protect all aquatic organisms by maintaining a wetted channel downstream of the project during refill, would protect the relatively special status mussels from desiccation.

McMahan Hydro would minimize erosion and sedimentation occurring during project restoration by doing the work after dewatering the intake structure, canal, and powerhouse. Working in the dry would avoid most adverse effects on aquatic resources, including loss of habitat and poor water quality conditions due to temporary increases in turbidity. Development of an erosion management plan using BMPs to avoid erosion and sedimentation during project refurbishment would further prevent or minimize the adverse effects of erosion and sedimentation during project restoration.

3.3.3 Terrestrial Resources

3.3.4.1 Affected Environment

Vegetation

The Bynum Project is located in the Appalachian – Blue Ridge ecoregion, which is one of the world's richest temperate broadleaf forests. Over 50 genera of plants occur in this region, including magnolias, hickory, sassafras, ginseng, mayapple, skunk cabbage, several species of orchids, coffee-tree, stewartia, witch hazel, dogwoods, persimmons, hollies, and maples. Varying assemblages of species of woody vegetation, corresponding to elevational gradients, cover 79 percent of the Haw River Basin (Homer et al., 2015). At lower elevations (820 to 4,430 feet) mixed oak forests dominate. At

elevations above 4,430 feet, spruce-fir forests occur, with red spruce, Fraser fir, and balsam fir dominating along high elevational ridges (Stephenson *et al.*, 1993).

The Haw River Levees and Bluffs is a 1,180-acre natural area that extends from approximately 0.5 mile upstream of Bynum Dam, downstream to an area approximately 8-miles downstream and located 1.5 miles past US 64 near Jordan Lake. The North Carolina Division of Parks and Recreation owns most of the land in this natural area. The majority of terrestrial vegetation in this area is Mesic Mixed Hardwood Forest on bluffs on both sides of the river, with a mature alluvial forest in much of the floodplain (Hall and Boyer, 1992), and interspersed open grassy areas. The Haw River Levees and Bluffs natural area has floodplain pools that can provide habitat for buttercup phacelia.

Wetlands

Because of the steep surrounding topography, wetlands that occur at the project are limited to a few narrow floodplain areas adjacent to the Haw River and its tributaries.

The FWS National Wetlands Inventory shows that the majority of the project area consists of an Impounded/Lacustrine/Limnetic/Unconsolidated Bottom/Permanently Flooded impoundment upstream of Bynum Dam. Some island sections and riverbanks upstream of the dam are classified as Palustrine/ Forested/Broad-Leaved Deciduous/Temporarily Flooded/and Impounded. The river channels are classified as Riverine/Lower Perennial/Unconsolidated Bottom/Permanently Flooded wetlands. Islands downstream from the dam, as well as sections of eastern riverbank downstream from the dam are classified as Palustrine/Forested/Broad-Leaved Deciduous/Temporarily Flooded/Impounded. One section of wetlands along the eastern riverbank, located just north of the tailrace, is identified as Palustrine/Scrub-Shrub/Broad-Leaved Deciduous/Temporary Flooded.

Broad-leaved woody vegetation that is at least 20 feet in height dominates the forested wetland habitat. Sycamore, river birch, yellow birch, and black willow are typical. Other tree species within the local forested wetlands include red maple, ash, and other willow species. The only emergent wetland within the project boundary is located to the south of the dam. It is vegetated with swamp rosemallow, lizard's tail, arrow arum, broadleaf arrowhead, and broadleaf cattail.

Wildlife

The species likely to be present within forested portions of the project area, which occur upstream of and downstream from the project boundary, include white-tailed deer, red fox, raccoon, Virginia opossum, gray squirrel, and black bear. Open areas or grassland habitats support populations of eastern cottontail and meadow-jumping mouse (NatureServe, 2015).

Beaver, muskrat, and mink live in wetland areas. Small mammals commonly found in the project area include white-footed deer mouse, eastern mole, meadow-jumping mouse, and southeastern shrew. Black bears may be present as transients where heavily forested areas are present. Several species of bats are seasonally common, such as eastern pipistrelle, big brown bat, and eastern red bat, and are wide-ranging throughout North Carolina.

Reptile species representative of open grassy habitat in the project area include northern fence lizard and eastern garter snake. In scrub/shrub habitat southern ringneck snake, rough green snake, northern black racer, and black rat snake are typical species encountered. Woodland reptile species include eastern box turtle, five-lined skink, northern redbelly snake, corn snake, and northern copperhead. Reptile species typically encountered in aquatic habitats include snapping turtle, common musk turtle, yellow-bellied slider, eastern painted turtle, northern water snake, and queen snake.

Typical amphibians of wetlands adjacent to the project area include red-spotted newt, southern two-lined salamander, three-lined salamander, green frog, bullfrog, and pickerel frog. Amphibians found in woodland areas in the project area typically include spotted salamander, American toad, upland chorus frog, and Fowler's toad.

Some of the most common bird species found along the Haw River include Carolina chickadee, yellow-throated vireo, Kentucky warbler, American crows, and mourning doves. Less-common bird species in the area include wood ducks, great blue herons, striated herons, and egrets. Osprey, red-shouldered hawk, bald eagle, Cooper's hawk, and turkey vulture are raptors that may visit the project area. Game birds of the surrounding forest include American woodcock.

Wildlife in the immediate project area will consist of those species that have largely adapted to a suburbanized habitat and are tolerant of human activity. Species less tolerant of human activity will be transient through the project area, generally not making long-term use of available habitats. Species such as squirrels, songbirds, snakes, and some turtles, are tolerant of people and could take up residence in the project area under almost any circumstances.

Terrestrial Special Status Species

Special status terrestrial species are listed in table 9 below.

Table 9. Special status terrestrial species.

Species	State status	Federal Status
Insects		
Septima's clubtail	Significantly Rare	Species of concern
Plants		
Buttercup phacelia	Significantly Rare-throughout its range	Species of concern

Septima's clubtail

Septima's clubtail, a species of dragonfly, is currently a North Carolina significantly rare species and a federal species of concern.[35] Its distribution includes a narrow northeast-southwest band in the eastern Piedmont and the Sandhills having a peculiar, disjunct, or relict range. The species was first known only from North Carolina and Alabama, but it has since been observed as far to the north as New York and New Jersey, and has been found in Pennsylvania, Virginia, and South Carolina (Odonata Central records).[36] It appears to be uncommon, but widespread, within its range, with observations noticeably increasing in the past few years. In North Carolina, the species is primarily in the Cape Fear River basin, including the Haw, Rocky, and Deep sub-basins.

The adults are active from early April to the end of May, and sparingly to mid-June. The peak of activity is during the first half of May. This dragonfly breeds in clean, fast rivers and very large streams (Donnelly and Carle, 2000). The aquatic larval stage can last from one to three years, with the nymph preying on smaller invertebrates and fish.

Buttercup phacelia

Buttercup phacelia, or buttercup scorpion-weed, is a small herbaceous spring ephemeral herb known only from floodplains and adjacent forests in the Cape Fear and Tar River basins in North Carolina, and from the Potomac River area of Maryland, Virginia, and Washington, D.C. (NatureServe, 2015). Though considered rare, it can be locally abundant at some sites, with more than a million individuals. In Chatham County, the species inhabits areas of the Haw River floodplain, and in floodplains along the Deep River (Goldstein, 2011). According to the NC Natural Heritage Program (NCNHP), two occurrences of this species have been found on the floodplain outside of the project area;

[35] Proposed for review in 1991 (FWS, 1991).

[36] *See* https://www.odonatacentral.org, viewed March 8, 2018.

one near the eastern bank of the Haw River, north of the project area, and the other to the south of the project area. Because the species is not found within the project boundaries and the floodplain outside of the project boundaries will be unaffected by the project we do not discuss this species further.

3.3.3.2 Environmental Effects on Terrestrial Resources

Vegetation

McMahan Hydro proposes to remove vegetation in the process of restoring the project facilities. Similarly, McMahan Hydro also proposes to remove vegetation to restore and improve recreation facilities, particularly a trail segment and canoe portage. McMahan Hydro would maintain the vegetation around project facilities and keep the trail and portage clear of vegetation.

The agencies did not file recommendations regarding McMahan Hydro's vegetation management proposal.

Our Analysis

McMahan Hydro would remove the vegetation in the power canal to operate the project. This effort would restore the canal to its previous, maintained condition. McMahan Hydro's rehabilitation of the project works, power canal, and powerhouse would be confined to previously disturbed areas. The transmission line is only 100-feet-long and mostly within lawn and landscaped area. Typical vegetation maintenance procedures would take place occasionally and affect a small area, most of it in the area already or converted to grass or landscaping.

The recreation proposal to connect two hiking trails would require some vegetation clearing and occasional maintenance, as would the upgrading and maintaining of the portage route. Outside of these locations, additional forested lands would not be disturbed. We do not expect that operation and maintenance of the Bynum Project would have a substantial effect on terrestrial botanical resources or habitat.

Wetlands

McMahan Hydro proposes to operate the project in a run-of-river mode, with the bypassed reach minimum flows discussed fully in section 3.3.2, *Aquatic Resources*. No proposals or recommendations were made regarding wetlands.

Our Analysis

As discussed in section 3.3.1, *Geology and Soils*, the proposed operational protocol should continue to minimize erosion by providing stable conditions along the

project shoreline, which would protect the fringe wetlands in the impoundment and avoid project-related sedimentation of downstream riparian habitat.

Operating the project in a run-of-river mode would maintain natural flows and continue to support existing wetland riparian habitat downstream from the project. The minimum flows proposed and recommended would moderate the effects of reduced flow on wetland and riparian vegetation in the 0.5-mile bypassed reach.

Wildlife

As discussed above, McMahan Hydro proposes to rehabilitate the power canal, connect two hiking trails, improve the portage route, and conduct vegetation maintenance around project facilities. No recommendations were made regarding the wildlife resources or habitats at the Bynum Project.

Our Analysis

The project site is in a town setting. The wildlife species that would be disturbed by restoring the power canal, improving the hiking trail and portage route, and periodically maintaining the vegetation are adapted to thrive around human activities. We expect that the operation and maintenance of the Bynum Project would not have a substantial effect on terrestrial wildlife or its habitats.

Special Status Aquatic Species, Septima's clubtail

McMahan Hydro proposes to operate the project in a run-of-river mode, and to release a minimum flow of 240 cfs over the dam from March 1 through April 30, and 120 cfs the rest of the year. No recommendations were made regarding Septima's clubtail dragonflies at the project.

Our Analysis

Septima's clubtail dragonfly larvae, or nymphs, are found in slow moving areas of rivers. The dragonflies may or may not stay near the river as adults as they establish hunting grounds for flying insects.

When the project is operating, there will be some reduction in the availability of aquatic habitats in the bypassed reach. However, during the summer, when water temperatures are higher and DO concentrations lower, the flow in the bypassed reach would be higher than the proposed minimum flow (120 cfs) more than half the time (see section *Water Quantity* in 3.3.2 *Aquatic Resources*). In order to meet the minimum flow, water will not be diverted to the turbine at flows lower than 420 cfs (the sum of the minimum flow plus the minimum hydraulic capacity of the turbine), and the entire inflow will be routed over the dam into the bypassed reach. Dragonfly nymphs are quite mobile

and can move in response to the falling water levels. The bypassed reach represents just a small section the available cobble-bottom habitat in the Haw River. Any negative effects of operating the project as proposed on the Septima's clubtail or its habitat would be limited to the bypassed reach and would be moderated by the minimum flows.

3.3.4 Endangered Species

3.3.4.1 Affected Environment

Cape Fear Shiner

The Cape Fear shiner[37] is a small (about 2 inches long), yellowish minnow endemic to the upper Cape Fear River Basin in the Central Piedmont of North Carolina.

The Cape Fear shiner was listed as Endangered under the provisions of the Endangered Species Act of 1973 (as amended), with Critical Habitat designated on September 25, 1987. FWS designated critical habitat in portions of the Rocky River in Chatham and Lee Counties; Bear Creek and the Deep River in Randolph and Moore Counties; and Fork Creek in Randolph County. The Haw River is not designated as critical habitat.

The Cape Fear shiner swims in schools with other minnow species but is typically the least abundant species (Pottern, 2009). Within their range, adult Cape Fear shiners are restricted to habitat patches characterized by shoals, riffles, or runs with clean flowing water over coarse substrates (Howard, 2003). Adults need high habitat heterogeneity for feeding and spawning (Henderson and Johnston, 2009). Juvenile shiners occupy slack water areas, including around large rock outcrops at midstream, in flooded side channels, and in pools (FWS, 1988). Cape Fear shiner spawning is associated with shallow runs, and slack water areas, including side channels, pools, and slow runs that often support water willow. During the spawning season, May through July, the Cape Fear shiner adults move to slower flowing pools to lay eggs on the rocky substrate.

The Cape Fear shiner is rare in the Haw River, and is difficult to distinguish from other minnows, with its most notable feature being the length and situation of the small intestines. The number of Cape Fear shiners collected in the Haw River in the 26 years spanning from the completion of the Jordan Dam reservoir (built between 1973 and 1983) to 2009 was six individuals (Pottern, 2009). In that period, the only Cape Fear shiners found in the 4.7-mile reach downstream of Bynum Dam and upstream of the top of Jordan Lake were three individuals collected during a 1992 sampling event. Three Cape Fear shiners were collected across three different sampling events in the reach of the Haw River reach running from 4 miles to 2.5 miles upstream of Bynum Dam. In this reach, one Cape Fear shiner was collected in each of the years 1993, 2000, and 2007. A

[37] The Cape Fear shiner was described as a new species in 1971.

2005 survey, carried out between the top of the Jordan dam pool and a point about five miles above Bynum Dam (with Bynum Dam in the middle), revealed no Cape Fear shiners (Pottern, 2009).

Harperella

FWS listed Harperella as endangered on September 28, 1988 (FWS, 1988). In North Carolina, harperella is a perennial herb that grows to a height of 6 to 36 inches. The leaves are hollow, quill-like structures and the small white flowers occur in heads that look like small Queen Anne's lace flower heads. In pond habitats, flowering begins in May, while riverine populations flower much later, beginning in late June or July and continuing until frost.

Harperella occurs in rocky riverbeds, typically on rocky or gravel shoals and sandbars and along the margins of clear, swift-flowing streams in the Piedmont and mountains of North Carolina, Virginia, Maryland, and West Virginia. Harperella is found at only two locations in North Carolina. One population occurs in the Tar River drainage in Granville County. Another population recently was reestablished in the Deep River drainage, after the original population known from that area disappeared. Harperella has not been documented in the Haw River drainage. Therefore, we conclude that the project would have no effect on the species, and do not discuss the species further.

Red-cockaded Woodpecker

The red-cockaded woodpecker (RC woodpecker), which has been listed as endangered since 1970 (FWS, 1970), received federal protection with the passage of the Endangered Species Act in 1973. The RC woodpecker makes its home in mature, open pine forests preferring longleaf pines, but other species of southern pine are also acceptable. While other woodpeckers bore out cavities in dead trees, where the wood is rotten and soft, the RC woodpecker is the only woodpecker that excavates cavities exclusively in living pine trees, generally over 80 years old. The older pines favored by the RC woodpecker often suffer from a fungus called red heart disease which attacks the center of the trunk, causing the inner wood, the heartwood, to become soft. Cavity excavation takes 1 to 6 years. The RC woodpecker requires large continuous tracts of suitable habitat, with a typical family group occupying a home range of 100 to 400 acres (FWS, 2003; Jackson, 1994).

Because there is no preferred habitat for the RC woodpecker within the project area, we conclude that the proposed project would have no effect on the species, and do not discuss the species further.

3.3.4.2 Environment Effects

Cape Fear Shiner

The Applicant proposes to protect spawning habitat in the bypassed reach, based on FWS recommendations, by releasing a minimum flow of 240 cfs during the months of March and April. To protect adult and juvenile nursery habitat in the bypassed reach, the applicant proposes, and FWS and North Carolina WRC recommend, a minimum flow of 120 cfs the rest of the year.

Our Analysis

As discussed in our analysis of water quantity and quality in section 3.2.2, *Aquatic Resources*, with run-of-river operation there would be no effect on water quantity or quality in the Haw River downstream from the bypassed reach. There would also be no effect upstream effects either. Therefore, the Cape Fear shiner, to the extent that it is present, would be unaffected by the proposed operation of the vast majority of the Haw River.

In the 0.5-mile bypassed reach, McMahan Hydro proposes to follow the minimum flow recommendations of FWS and North Carolina WRC. The 240 cfs spawning flow would provide at least two-thirds of the average minimum flow to the bypassed reach in March and April. At flows greater than the average mean flow of 2,260 cfs for April and 1,660 cfs for May, the 650 cfs diverted to the turbine would become small relative to the total flow spilling to the bypassed reach. The 120 cfs flow would exceed two thirds of the average minimum flow for nine of the remaining ten months of the year. In February, 120 cfs would represent one quarter of the average minimum flow. In all twelve months of the year, the proposed minimum flows would exceed the daily minimum flows for each month.

As stated in Section 3.3.2, *Aquatic Resources*, with these minimum flows, the project would operate less than 50 percent of the time between June and November and would generate at maximum capacity primarily during the winter and early spring. The project would spill all of the water over the dam when the flow was not sufficient to both generate and release the minimum flow. Thus the project would have no effect on the bypassed reach when conditions would be the most likely to be stressful for fish, which would be during the warmer months under the lowest flows.

The 0.5 mile bypassed reach would receive reduced flow at least part of the year, but it occupies less than 0.5 percent of the length of the Haw River. There are more than 100 miles of free flowing river upstream of the project and about 4.7 miles of free flowing habitat downstream from the project. Long reaches of suitable habitat, similar to that found in the bypassed reach, are available both upstream of and downstream from the project.

Cape Fear shiners are unlikely to be entrained or impinged because the openings to the project intake gates are lower in the water column than where they typically occupy. In addition, study of a species similar to the Cape Fear shiner, the emerald shiner, indicates that Cape Fear Shiners burst swim speeds likely exceed the intake velocity at the turbine intake.

Project restoration could cause some erosion. However, isolating the canal by closing and sealing the canal gates would avoid sediment release into the water and any associated habitats.

The bypass reach contains Cape Fear shiner habitat. The effect of the proposed project operations on that habitat resulting from a reduction in flow to bypassed reach would be the only effect of the proposed project on Cape Fear shiners. The effect on the bypassed reach would be moderated by the minimum flows recommended by FWS and proposed by McMahan Hydro. The large portion of the river outside of the bypassed reach would provide ample habitat for Cape Fear shiners, reducing the importance of the bypassed reach. Impingement, entrainment, and sedimentation from project activities present very little risk to the Cape Fear shiner. Therefore, we conclude that licensing the Bynum Project, as proposed, is not likely to adversely affect the Cape Fear shiner.

3.3.5 Recreation, Land Use, and Aesthetics

3.3.5.1 Affected Environment

Recreation Overview

Statewide Recreation Plan

The 2015 – 2020 North Carolina State Comprehensive Outdoor Recreation Plan (SCORP) guides recreation planning and development in the state (North Carolina DPR, 2015). The plan has no specific recommendations for the project area; however, it does identify goals for recreation within the state. These goals include: maintaining, protecting, conserving, and enhancing the state's outdoor recreation resources; increasing opportunities for physical activity; improving the visibility of, and public access to public recreation areas, and fostering cooperation between public recreation managers; and increasing public awareness of the state's natural resources and outdoor recreation opportunities through interpretation, education, and outreach. The SCORP also identifies issues associated with recreation supply and demand. The plan indicates there is demand for continuing to operate existing parks and to acquire new parks and open space. It focuses on establishing or expanding linear and nature parks; linking trail networks; and developing or improving trails, picnic shelters, and wildlife/nature observation sites.

Regional Water-Based Recreation Opportunities

Recreation destinations in the region include the American Tobacco Trail,[38] Lower Haw State Natural Area, Jordan Lake State Recreation Area, Jordan Lake Educational State Forest, Deep River State Trail, and Robeson Creek boating access points. These county- and state-managed recreation areas offer opportunities for hiking, camping, fishing, hunting, wildlife viewing, and sightseeing.

Chatham County supports a number of recreational uses and is a regional recreation destination for agritourism,[39] cultural-heritage and outdoor-recreation based tourism (Pittsboro-Siler City Convention & Visitors Bureau, 2017). The Haw River is a recreation destination in Chatham County. People kayak, canoe, fish, swim in, and hike along the river. A commercial outfitter based about 15 miles upstream of the project provides canoe and kayak tours of the Haw River, some of which include the project area upstream of the dam.

Recreation Access at the Bynum Project

The Chatham County Parks and Recreation Parking Area, located just outside of the proposed project boundary, is the primary access point for recreation on the impoundment and the river downstream from Bynum Dam. Operated by the Chatham County Parks and Recreation Department, this gravel parking lot accommodates about 50 vehicles, and is located 300 feet to the east of the dam.

The existing upstream canoe and kayak launching and landing site is located about 200 feet upstream of Bynum Dam, within the proposed project boundary (Figure 5). This feature would become a project recreation facility should McMahan Hydro be granted a license for the project. A 300-foot-long gravel trail connects Chatham County's parking lot to this site. The connector trail is located outside of the proposed project boundary for most of its length, but leads users onto land within the proposed project boundary as it approaches the upstream canoe and kayak launching and landing site.

An approximately 50-foot-long trail, which is within the proposed project boundary, provides portage access from the upstream canoe and kayak launching and landing site to the downstream canoe and kayak launching and landing site, below Bynum Dam. According to McMahan Hydro, the portage route currently is overgrown with vegetation and unsafe because of the presence of unused intake gate control devices

[38] The American Tobacco Trail is a 22-mile Rails-to-Trails project located in Chatham, Durham, and Wake Counties, North Carolina.

[39] Agritourism is a commercial enterprise at a working farm, ranch, or agricultural plant conducted for the enjoyment of visitors that generates supplemental income for the owner.

that interfere within the route. In addition, the current stone portage steps are in disrepair and could be difficult to maneuver for those carrying a canoe or kayak.

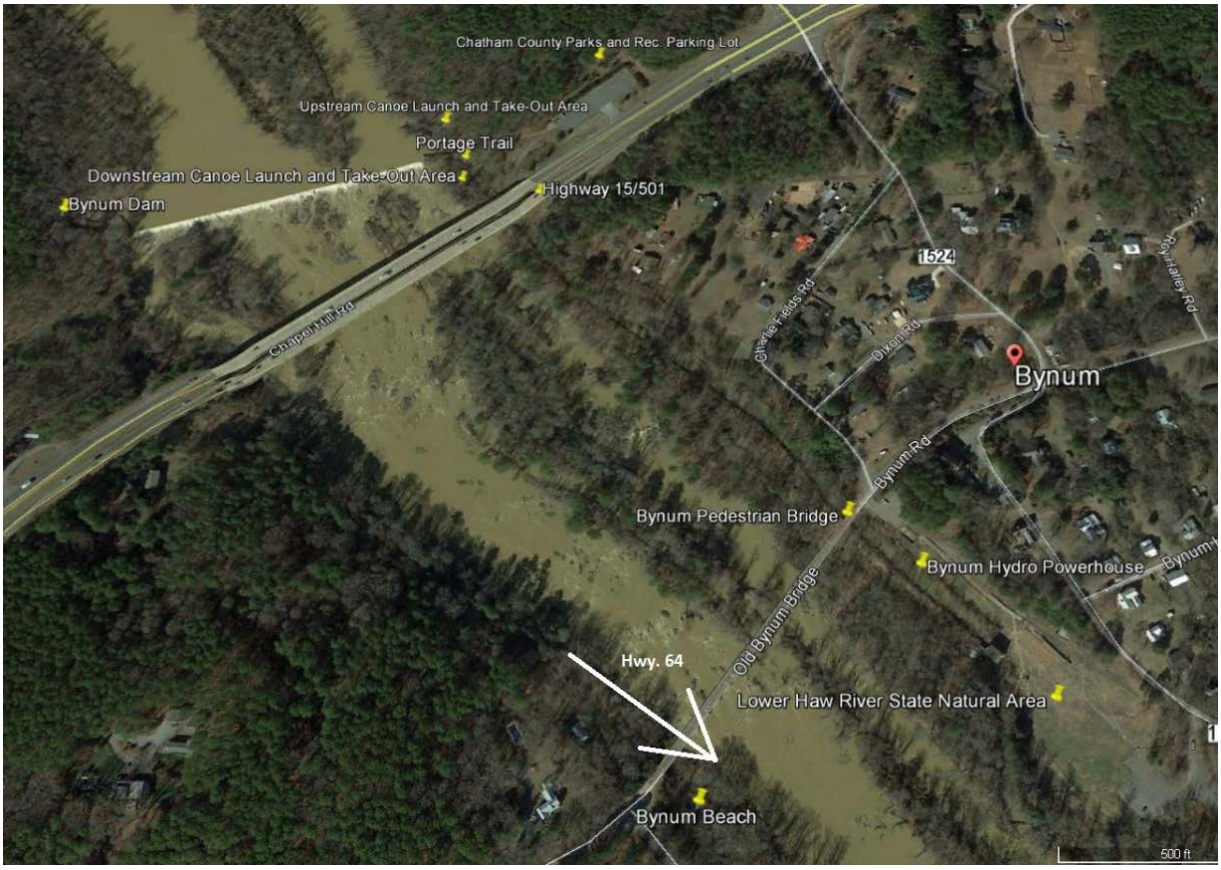

Figure 5. Project vicinity recreation facilities.
(Source: Staff).

The State of North Carolina maintains a bridge (Bynum Bridge) for pedestrian use that also provides access to the river downstream from the dam. Automobile traffic is prohibited on Bynum Bridge, which crosses the Haw River about 1,800 feet downstream from Bynum Dam. People use the bridge to sightsee, bird watch, and fish. While there is no dedicated parking lot associated with the Bynum Bridge, a parking lot originally used for the Bynum Mill allows parking for about five to six vehicles adjacent to the bridge.

Bynum Beach Access Point is a county-maintained canoe and kayak launching and landing site located about 1,500 feet downstream from Bynum Dam, on the western bank of the project's bypassed reach. The site provides access for canoe travel downstream from the project. The site is used for swimming and fishing. No parking lot or other amenities are provided at this site.

The State of North Carolina operates and maintains a trail system that runs along the Haw River from Haw River State Park (upstream of the project) to the Jordan Lake

State Recreation Area (downstream from the project). The trail system passes through the project area and travels parallel to the project canal, but lack of maintenance along the section passing the project affects usability of the trail (Figure 6).

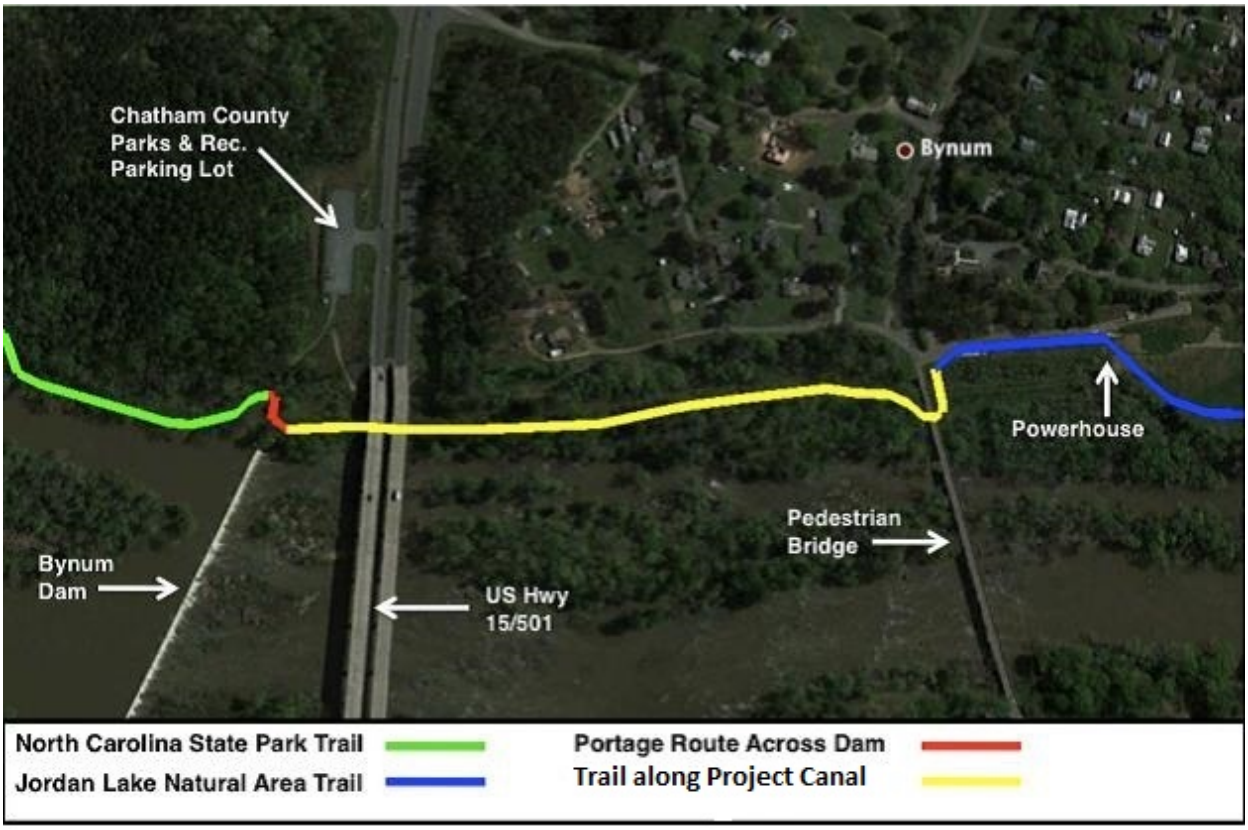

Figure 6. Proposed hiking trail.
(Source: McMahan Hydro).

Recreation Use

McMahan Hydro conducted a recreation use study in 2014 to evaluate existing recreation access and safety at the Bynum Project. The recreation use study was conducted to better understand what types of recreation occur at the project, and if current recreational amenities are sufficient. Based on the findings, McMahan Hydro determined that the facilities are currently inadequate to support existing demand, and McMahan Hydro proposes recreation improvements under a Recreation Management Plan (Recreation Plan).

McMahan Hydro conducted the study using on-site observations, visitor surveys, and a commercial outfitter interview. For the 2002 recreation season, there were 400 annual daytime visits, with a peak weekend average of 10 visits. Visitors used the canoe portage and tailwater fishing area each at about 25 percent of its capacity in the 2002

recreation season.[40] Visitors spent 13,395 recreation days at the project in the 2014 summer recreation season.[41] Weekday users and weekend users split the use nearly equally.

McMahan Hydro also studied recreation use by type. Walking and swimming accounted for approximately 75 percent of all visits, with the remaining visits split nearly evenly between fishing and boating. Haw River Canoe & Kayak Company began offering rental equipment in 2014 from the Chatham County parking lot access. The company rented equipment to 109 water-based recreationists during the period April 1, 2014, to October 31, 2014. While current use data are not available, the company continues to rent equipment from the parking lot. No current FERC Form 80 Reports have been filed for this project because it has not been in use.

Future recreation use at the project will likely increase based on population projections for Chatham County (North Carolina Budget & Management, 2018). The county's population is projected to increase by 45 percent from 2015 to 2035. Assuming that participation rates in recreation activities remain relatively stable, the change in visitor use would be commensurate with the increase in population.

3.3.5.2 Environmental Effects

Recreation Management Plan

McMahan Hydro proposes to develop a Recreation Plan for the project. Under the plan, the company proposes to: (1) improve the canoe portage around the dam by removing the unused intake gate control equipment that blocks the path and installing a new wooden stair system and (2) improve a hiking trail along the power canal between Bynum Dam and the powerhouse to connect existing state-maintained trails at Haw River State Park (upstream) and Jordan Lake State Recreation Area (downstream). McMahan Hydro also proposes to place signage at the project to direct visitors to recreation amenities. McMahan Hydro proposes to develop the Recreation Plan in consultation with appropriate agencies.

North Carolina WRC recommends that, within 6 months after any project license is issued, McMahan Hydro submit a plan that is prepared after consultation with agencies and stakeholders and provides safe portage around the dam, adequate signage, and other ancillary measures.[42] Interior concurs with North Carolina WRC's recommendation.[43]

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[40] FERC Form 80 filed February 2, 2004.

[41] Recreation days are equivalent to the number of people visiting the project to participate in a recreation activity at any time during a 24-hour period.

[42] *See* letter filed April 3, 2017.

[43] *See* letter filed April 24, 2017.

North Carolina DENR commented on safety issues regarding the improvements, including low-hanging utility lines and the need for a fence around the powerhouse. To ensure a safe experience for visitors, North Carolina DENR requests that McMahan Hydro address the safety issues and consult with North Carolina Division of Parks prior to trail construction.[44] The Carolina Canoeing Club requested that the plan include improvement of the portage and canoe and kayak landing access.

Our Analysis

An average of 87 visitors per day used the existing project facilities during the 2014 recreation season, and visitor use is expected to grow over the term of any license issued for the project. McMahan Hydro's proposed recreation enhancements would improve existing recreation amenities in the area by restoring and improving portage around the dam and improving informational and directional signage. The recreation improvements that McMahan Hydro proposes in its Recreation Plan would also help address broader statewide goals identified in the North Carolina SCORP (2015). Improving the hiking trail along the power canal would encourage use of the Haw River as a water trail. Specifically, providing the trail connection would allow for more recreational use in, and through, the project area.

The North Carolina DENR requested consideration of safety improvements, including addressing low hanging utility lines and the need for a fence around the powerhouse could be incorporated into the Recreation Plan during consultation.

Implementing the proposed improvements as part of a Recreation Plan would facilitate the Commission's administration of the license and avoid misunderstandings regarding the licensee's responsibilities for project recreation facilities. Requiring a maintenance program and a schedule for constructing the facilities would help to ensure that the recreation facilities are constructed and maintained.

Effects of Continued Project Operation on Recreation

McMahan Hydro proposes to operate the project in a run-of-river mode and provide minimum instream flows of 240 cfs in March and April and 120 cfs for the remainder of the year to protect habitat for aquatic biota in the bypassed reach. McMahan Hydro proposes to add directional signs, improve the existing portage facilities, and improve the connection between two segments of hiking trail along the east side of the river. McMahan Hydro would carry out occasional maintenance of all project facilities to keep the project operating safely and effectively.

[44] *See* letter dated January 6, 2015 (filed with final license application on March 30, 2015).

North Carolina WRC, supported by Interior, recommends the portage improvements. North Carolina WRC also recommends the trail improvement and signage. North Carolina DENR requests safety improvements accompanying these measures. Carolina Canoe Club recommends improvements to the portage path and improved access to the upstream canoe and kayak launching and landing area.

Our Analysis

Because the project would operate in a run-of-river mode and operation of the project would not alter the total flow passing the dam, there would be no effect on recreation, including canoe and kayak navigation, upstream or downstream from the project. However, diversion of flow to the turbine from the bypassed reach would reduce flow in the 0.5-mile bypassed reach and could make navigation of the bypassed reach difficult under some conditions.

Many paddlers start or end canoe or kayak trips at Bynum Dam and would not generally use the bypassed reach. Those starting at Bynum and heading upstream can put boats in to the impoundment at the upstream canoe and kayak launching and landing area. Those starting at Bynum and heading downstream can avoid the bypassed reach by putting in at Bynum Beach Access Point, which is close to the confluence of the bypassed reach and the tailrace where the full river flow would be restored.

The interest in improvements to the portage route at the dam indicates an interest in through-paddling that would necessitate navigating the bypassed reach. No entity recommended a minimum flow for boating within the bypassed reach and no study of the minimum navigation flow for that reach has been conducted. American Whitewater, a national advocacy group for whitewater paddlers, reports that the minimum flow needed to paddle a canoe or kayak through the 7.5 mile reach upstream of Bynum Dam (the Upper Haw) is 200 cfs and the minimum flow needed to paddle through the 4 mile reach downstream of the Bynum Beach Access Point (the Middle Haw) is 340 cfs. [45] The Haw River Trail, (Haw River Trail, 2017) a regional river trail advocacy group, reports that the minimum paddling flow for the Upper Haw is about 175 cfs and 240 cfs for the Middle Haw.[46] The Haw River Canoe and Kayak Company lists the minimum flows for paddling the unimpounded reaches that it services upstream of Bynum Dam as either 200 or 250 cfs.[47] Without detailed data for the bypassed reach, the minimum flow for navigation through the bypassed reach is likely in the range of 175 to 250 cfs given the channel width and data available for upstream and downstream reaches.

[45] See https://www.americanwhitewater.org/content/River/detail/id/1084/ last viewed 10/22/2018.
[46] See https://www.thehaw.org/ last viewed 10/22/2018.
[47] See http://hawrivercanoe.com/ last viewed 10/22/2018.

Under the minimum flow of 240 cfs for March and April, recommended by FWS and North Carolina WRC for protection of habitat for aquatic biota, the bypassed reach would likely be navigable for boaters. However, under the lower minimum flow requirement of 120 cfs for the remainder of the year, the bypassed reach could be challenging to navigate during much of the typical summer recreation season (May through September). However, as indicated in section 3.3.2, during a large portion of the recreation season, the project would be operational less than 50 percent of the time. During times when the project would not be able to operate, all flows would pass over the dam and through the bypassed reach, resulting in higher flows to the bypassed reach despite lower overall flow in the river.

Overall, rehabilitating and operating the project would improve boating access and safety. Diversion of flow from the bypassed reach for generation would sometimes make navigating the bypassed reach difficult. Modification of, and improvements to, the proposed and existing project recreation sites would mean that some sites, and associated amenities, would be closed temporarily, which would be unavoidable. Occasional maintenance of the portage path, upstream canoe and kayak launch and landing access, and hiking trail, would interrupt recreation for short periods essential for the safe use of those facilities.

Aesthetic Resources

McMahan Hydro proposes to operate the project in a run-of-river mode and provide minimum instream flows of 240 cfs in March and April and 120 cfs for the remainder of the year to protect habitat for aquatic biota in the bypassed reach. When operating, between 300 and 650 cfs of inflow would be diverted through the power canal to the powerhouse and would not spill over the dam. McMahan Hydro also proposes to redevelop a hiking trail along the power canal connecting two existing state-maintained recreation areas.

Our Analysis

Currently the entire inflow to the impoundment spills over the dam all the time. The proposed project would result in periods when the flow over the dam is reduced to the proposed minimum flow of 120 cfs, as discussed in our analysis of water quantity in section 3.3.2, *Aquatic Resources*. The reduction in flow over the dam would be visible to people driving across the State Route 15 Bridge and to people paddling the river and using the portage facilities around the project dam.

Visual impacts to drivers, visitors, or boaters are likely to be minimal. Under natural conditions, flows in the Haw River can drop below 120 cfs at times. Diversion of flow to the powerhouse, while having the effect of reducing flow across the dam and to the bypassed reach would not completely dewater the area. Minimum flows would

continue to produce a veil flow over a large portion of the dam under all operating scenarios.

Under existing conditions, the project dam is located such that most views are impeded. The dam is not located in a place that makes spill over the dam part of the general viewscape of the historic town of Bynum and the dam is not visible from the pedestrian-accessible recreational sites, "Bynum Beach" and the old route 15 pedestrian bridge. Recreation access improvements, including repairs and enhancements to the hiking trail would improve the ability of visitors to see the dam and project.

3.3.6 Cultural Resources

3.3.6.1 Affected Environment

Area of Potential Effects

Under section 106 of the NHPA of 1966, as amended, the Commission must take into account whether any historic properties within a project's area of potential effects (APE) could be affected by the project. The Advisory Council on Historic Preservation defines an APE as the geographic area or areas in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. We define the APE for the Bynum Project as: (1) lands enclosed by the proposed project boundary; and (2) lands or properties adjoining the proposed project boundary, where authorized project uses may cause changes in the character or use of historic properties, if historic properties exist.

Cultural History Overview

The Bynum Project lies in central Chatham County, in the piedmont physiographic province of central North Carolina. Very little information exists about native populations in the region. European settlers began establishing farmsteads in the region during the mid-1700s, including a Quaker settlement formed in 1751. The Colonial Assembly established Chatham County through legislation in 1771. The county was formed from a portion of what was once Orange County (Horton, 1971).

In 1874, Bynum Dam was constructed to provide mechanical power for the equipment inside a cotton mill along the Haw River. In about 1940, the mechanical hydropower equipment was replaced with electrical hydropower equipment. The Bynum Mill remained in operation as a textile manufacturing operation until the early 1980s. The land was then divided into two tracts. One tract contained the hydroelectric powerhouse and all accompanying civil works, while the other tract contained the remainder of the Bynum Mill. In 1986, the property containing the hydroelectric facilities was sold to PK Ventures for producing hydroelectric power.

In 2001, after many years of decay and neglect, a fire destroyed much of the Bynum Mill. In 2007, the State of North Carolina purchased the Bynum Mill property, demolished the remainder of the Bynum mill, and designated the land as part of the Lower Haw State Natural Area. The parcel of land that once housed the Bynum Mill now serves as an access point to the Haw River for the public, providing walking trails along the river and boater access immediately downstream from the project area.

Historic Properties

According to the North Carolina Department of Cultural Resources (North Carolina DCR), the project area is located within the Bynum Mill and Mill Village Complex (CH0685), which was determined eligible for listing in the National Register of Historic Places in 1997. The complex also includes the project canal and powerhouse. As discussed previously, people have used the Haw River at the project site for water-powered mill operations since 1874 and hydroelectric generation since the early 20th century. The facilities have been modified over time to adapt to economic and technological changes.

3.3.6.2 Environmental Effects

By letter filed April 23, 2015,[48] the North Carolina SHPO stated that the proposed project would be within the Bynum Mill and Mill Village Historic District, which was determined eligible for listing in the National Register in 1997. The North Carolina SHPO does not feel that undertaking the refurbishment would adversely affect the historic property; however, the SHPO stated they should be contacted if the scope of work changes.[49] The SHPO also recommended against conducting archaeological investigations within the proposed project area, as there are no known archaeological sites in the project area.

The Eastern Band of Cherokee Indians Tribal Historic Preservation Office reviewed the materials related to the relicensing of the Bynum Project and stated that the proposed undertaking is outside the traditional aboriginal territory of the Cherokee people. The Eastern Band of Cherokee Indians deferred the undertaking to federally recognized tribes whose aboriginal territory fell within the project's APE. Commission staff sent a letter inviting the Catawba Indian Nation to participate in the licensing process for the Bynum Project, and requested a response by December 26, 2014.[50] The Catawba Nation did not respond.

[48] *See* letter dated November 18, 2014 from Ramona Bartos, North Carolina DCR.
[49] *See* letter filed April 23, 2015.
[50] *See* letter filed November 25, 2014.

Our Analysis

Based on the assessment of the North Carolina SHPO and the information in the record for this proceeding, the proposed project would not affect any historic properties. Further, there is no evidence indicating the presence of archaeological sites within the project's APE. However, unknown archaeological or historic resources could be discovered in the future because of project operation or other project-related recreation, construction, or maintenance activities. If McMahan Hydro discovers previously unidentified resources, it should immediately stop work and consult with the North Carolina SHPO to define appropriate treatments and to prevent any harm.

3.4 No-Action Alternative

Under the no-action alternative, the project would not be refurbished and would not operate. All streamflows would continue to spill over the dam as they have for the last 10 years. No new environmental protection, mitigation, or enhancement measures would be implemented.

4.0 DEVELOPMENTAL ANALYSIS

In this section, we look at the project's use of the Haw River for hydropower purposes and assess the effect various environmental measures would have on the project's costs and power generation. Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corp.*,[51] the Commission compares the current project cost to an estimate of the cost of obtaining the same amount of energy and capacity using a likely alternative source of power for the region (cost of alternative power). In keeping with Commission policy as described in *Mead Corp.*, our economic analysis is based on current electric power cost conditions and does not consider future escalation of fuel prices in valuing the hydropower project's power benefits.

For each of the licensing alternatives, our analysis includes an estimate of: (1) the cost of individual measures considered in the draft EA for the protection, mitigation, and enhancement of environmental resources affected by the project; (2) the cost of alternative power; (3) the total project cost (*i.e.*, for operation of the project and environmental measures); and (4) the difference between the cost of alternative power and total project cost. If the difference between the cost of alternative power and total project cost is positive, the project produces power for less than the cost of alternative power. If the difference between the cost of alternative power and total project cost is negative, the project produces power for more than the cost of alternative power. This estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license. However, project economics is only one of many public interest factors the Commission considers in determining whether, and under what conditions, to issue a license.

4.1 POWER AND ECONOMIC BENEFITS OF THE PROJECT

Table 10 summarizes the assumptions and economic information we use in our analysis for the project. McMahan Hydro provided this information in its license application and subsequent submittals. We find that the values provided by the applicant are reasonable for the purposes of our analysis. Cost items common to all alternatives include: estimated capital investment required to develop the project; licensing costs; normal operation and maintenance cost; taxes, and Commission fees.

[51] *See Mead Corp., Publ'g Paper Div.*, 72 FERC ¶ 61,027 (1995). In most cases, electricity from hydropower would displace some form of fossil-fueled generation, in which fuel cost is the largest component of the cost of electricity production.

Table 10. Parameters for the economic analysis for Bynum Project.

Economic Parameter	Value	Source
Proposed capacity (MW)	0.600	McMahan Hydro
Proposed average annual generation (MWh)	2,461	McMahan Hydro
Estimated cost to purchase project ($)	300,000	Staff
Estimated cost to rehabilitate project ($)	150,000	Staff
Estimated annual operation and maintenance (O&M) cost ($/year)	80,000	Staff
Cost to prepare license application ($)	30,000	McMahan Hydro
Period of economic analysis	30 years	Staff
Term of financing	20 years	Staff
Cost of capital (Long-term interest rate)	8.0	Staff
Federal tax rate (%)	35	Staff
Local tax rate (%)	3	Staff
Energy rate ($/MWh)	39.92	Staff
Capacity rate ($/kWh-yr)	192.00	Staff

(Source: McMahan Hydro and Staff.)

4.2 COMPARISON OF ALTERNATIVES

Table 11 summarizes the installed capacity, annual generation, cost of alternative power, estimated total project cost, and the difference between the cost of alternative power and total project cost for each of the action alternatives considered in this draft EA: no-action, McMahan Hydro's proposal, and the staff recommended alternative.

Table 11. Summary of the annual cost of alternative power and annual project costs for alternatives for the Bynum Project.

	McMahan Hydro's Proposal	Staff Alternative
Installed capacity (MW)	0.6	0.6
Annual generation (MWh)	2,461	2,461
Annual cost of alternative power ($/MWh)	$152,000 $61.76	$152,000 $61.76
Annual project cost ($/MWh)	$147,955 $60.12	$145,347 $59.06
Difference between cost of alternative power and project cost ($/MWh)	$4,036 $1.64	$6,669 $2.71

(Source: Staff).

4.2.1 No-Action Alternative

Under the no-action alternative, McMahan Hydro would not rehabilitate the Bynum Project; the project would not generate electricity; and no environmental protection, mitigation, or enhancement measures would be implemented. There are no costs associated with this alternative, other than applicant's costs for preparing the license application.

4.2.2 McMahan Hydro's Proposal

Under McMahan Hydro's proposal, the Bynum Project would have an installed capacity of 0.6 MW and generate an average of 2,461 MWh of electricity annually. The average annual cost of alternative power would be $152,000, or $61.76/MWh. In total, the average annual project cost would be $147,955, or about $60.12/MWh. Overall, the project would produce power at a cost that is $4,036, or $1.64/MWh, less than the cost of alternative power.

4.2.3 Staff Alternative

Under the staff recommended alternative, the Bynum Project would have an installed capacity of 0.6 MW and generate an average of 2,461 MWh of electricity annually. The average annual cost of alternative power would be $152,000, or $61.76/MWh. The average annual project cost would be $145,347, or about $59.06/MWh. Overall, the project would produce power at a cost that is $6,669, or $2.71/MWh, less than the cost of alternative power.

4.3 COST OF ENVIRONMENTAL MEASURES

Table 12 gives the cost of each of the environmental enhancement measures considered in our analysis. We convert all costs to equal annual (levelized) values over a 30-year period of analysis to give a uniform basis for comparing the benefits of a measure to its cost.

Table 12. Cost of environmental mitigation and enhancement measures considered in assessing the environmental effects of the proposed Bynum Project.

(Source: Staff.)

Enhancement/mitigation measure	Entities	Capital cost (2018$)	Annual cost (2018$)	Levelized cost (2018$)	Notes
Geology and Soils					
Prior to project refurbishment, develop an erosion management plan to minimize erosion and sedimentation, including best management practices (BMPs), in consultation with North Carolina DWR, North Carolina WRC, and FWS, and Develop a plan for impoundment sediment management or dredging, if necessary, in consultation with North Carolina DWR, North Carolina WRC, and FWS.	McMahan Hydro, Staff, North Carolina WRC, North Carolina DWR	$2,500	$0	$197	a
Aquatic Resources					
Operate the project in a run-of-river mode.	McMahan Hydro, Staff, Interior	$0	$0	$0	b
Instantaneous run-of-river mode may be temporarily modified if required for emergencies, necessary	McMahan Hydro, Staff,	$0	$0	$0	b

Enhancement/mitigation measure	Entities	Capital cost (2018$)	Annual cost (2018$)	Levelized cost (2018$)	Notes
repairs and maintenance, or short periods agreed upon by McMahan Hydro, the Commission, and resource agencies.	Interior, North Carolina WRC, North Carolina DWR				
Visually monitor flow daily to ensure run-of-river operation.	McMahan Hydro, Staff	$0	$0	$0	b
Operate an impoundment elevation sensor and cut-off switch on the turbine so that generation would be taken off line when the water level drops below the crest of the dam.	McMahan Hydro, Staff, North Carolina WRC, North Carolina DWR	$2,000	$50	$190	
Provide access to 15-minute interval generation data upon request of the Commission.	McMahan Hydro, Staff	$0	$0	$0	b
Maintain records of inflow and outflow to ensure run-of-river operation and document maintenance and emergency drawdowns.	North Carolina WRC, North Carolina DWR	$4,000	$50	$347	
Install and operate a flow gage to record inflow to the project, if the USGS discontinues operation of gage number 02096960.	McMahan Hydro, North	$25,000	$1,000	$2,617	c

Enhancement/mitigation measure	Entities	Capital cost (2018$)	Annual cost (2018$)	Levelized cost (2018$)	Notes
	Carolina WRC, North Carolina DWR				
Maintain records of impoundment water stage, and make information available to resource agencies.	McMahan Hydro, Staff, North Carolina WRC, North Carolina DWR, Interior	$500	$50	$72	a
File a report if the cut-off system fails, or if the water level in the impoundment drops below the level needed to release the minimum flow.	Staff	$0	$0	$0	b
Develop, in consultation with resource agencies, a drawdown and refill plan for emergency and maintenance activities.	McMahan Hydro, Staff, Interior, North Carolina WRC, North Carolina DWR	$2,000	$0	$157	a
Develop a water quality monitoring plan in consultation with resource agencies to ensure that	North Carolina WRC, North	$19,000	$2,500	$3,120	a

Enhancement/mitigation measure	Entities	Capital cost (2018$)	Annual cost (2018$)	Levelized cost (2018$)	Notes
water quality standards are maintained in the bypassed reach and tailrace.	Carolina DWR, Interior				
Recreation, Land Use, and Aesthetics					
Operate and maintain existing recreation facilities.	McMahan Hydro, Staff	$0	$500	$325	a
Improve a hiking trail to connect state trails.	McMahan Hydro, Staff, North Carolina DWR	$2,500	$250	$359	
Install portage signs.	McMahan Hydro, Staff, North Carolina DWR	$3,000	$250	409	d, e
Install portage steps.	McMahan Hydro, Staff, North Carolina WRC	$2,000	$150	228	f
Develop a recreation management plan (Recreation Plan) with agencies and stakeholders.	McMahan Hydro, Staff, North Carolina	$5,000	$500	426	a

Enhancement/mitigation measure	Entities	Capital cost (2018$)	Annual cost (2018$)	Levelized cost (2018$)	Notes
	DEQ, North Carolina WRC, Chatham County Parks and Recreation Department, Carolina Canoe Club, Stakeholders				
Install railing for the dam.	McMahan Hydro, Staff	$6,000	$100	537	
Remove non-operational intake gate cranks.	McMahan Hydro, Staff	$1,000	$0	79	
Construct fence around powerhouse.	McMahan Hydro, Staff	$25,000	$175	2,081	
Cultural Resources					
Cease project activities and notify the North Carolina SHPO if any unknown archaeological or historic resources are discovered during project operation or other project-related activities.	Staff	$0	$0	$0	b

a. We have not assigned a capital cost for these measures because North Carolina WRC and North Carolina DWR did not specify the types of measures that would be included in a sediment management plan.
b. Staff estimates that the cost to implement this measure would be negligible.
c. Cost estimated by staff. Gage operated by USGS in cooperation with the Corps.

d. $3,000 capital cost every 10 years.
e. While not a recreation measure, this measure was proposed as a recreational/safety improvement cost. The cost is included as a rehabilitation, rather than a recreation measure.
f. $2,000 capital cost every 15 years.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to the power development purposes, and to the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. Any license issued shall be such as in the Commission's judgment, best adapted to a comprehensive plan for improving or developing waterway or waterways for all beneficial public uses. This section contains the basis for, and a summary of, our recommendations for licensing the Bynum Project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

Based on our independent review of agency comments filed on the project and our review of the environmental and economic effects of the proposed project and project alternatives, we selected the staff alternative as the preferred alternative. We recommend the staff alternative because: (1) issuing a license for the project would allow McMahan Hydro to operate the project as a dependable source of electrical energy; (2) the 600 kW of electric capacity would come from a renewable resource that does not contribute to atmospheric pollution; (3) the public benefits of this alternative would exceed those of the no-action alternative; and (4) the proposed and recommended measures would protect or enhance geology and soils, aquatic, terrestrial, recreation, and cultural resources.

In the following sections, we make recommendations as to which environmental measures recommended by agencies or other entities should be included in any license issued for the project. We also recommend additional environmental measures to be included in any license issued for the project.

5.1.1 Measures Proposed by McMahan Hydro

Based on our environmental analysis of McMahan Hydro's proposal discussed in section 3, and the costs discussed in section 4, we conclude that the following environmental measures proposed by McMahan Hydro would protect and enhance environmental resources and would be worth the cost. Therefore, we recommend including the following measures in any license issued for the project:

- Operate the project in a run-of-river mode.

- Release a minimum flow of 240 cfs over the project dam to the bypassed reach from March 1 through April 30, and 120 cfs the rest of the year to protect Cape Fear shiner habitat.

- Develop an impoundment drawdown and refill management plan to protect the environmental resources of the impoundment, bypassed reach, and downstream river reach, in the event there is a need to lower the impoundment or otherwise interrupt flow into the bypassed reach.

- Develop an erosion control plan with best management practices (BMPs) to minimize erosion and sedimentation from project refurbishment activities.

- Develop a plan for impoundment sediment management or dredging, in consultation with North Carolina DWR, North Carolina WRC, and FWS, if sedimentation in the impoundment becomes problematic.

- Provide access to 15-minute interval impoundment elevation and generation data to resource agencies and the Commission, upon request.

- Develop a debris disposal plan for the disposal of organic and inorganic waste materials that accumulate on intake structures, including the trashrack.

- Develop a Recreation Plan, in consultation with appropriate agencies to improve, operate, and maintain the existing recreation facilities at the project, which include a canoe portage trail with canoe and kayak launching and landing areas, a stair system for portaging around the intake structure, a plan for signage, and the improvement of a trail to connect two state-maintained trails.

5.1.2 Additional Measures Recommended by Staff

In addition to McMahan Hydro's proposed measures noted above, we recommend the following measures in any license issued to McMahan Hydro.

- Document the implementation of the impoundment drawdown and refill management plan, to facilitate review of the procedures used, and allow for revision to the plan, if necessary.

- File a report if the impoundment level monitoring system, as designed, fails to cut-off generation in response to a drop in the impoundment level below the elevations needed to release the minimum flows.

- Implement additional Recreation Plan measures, including a schedule for constructing the facility improvements and a maintenance program, and to help ensure that recreational use is managed effectively throughout the term of a license.

- Cease project activities and notify the North Carolina SHPO if archaeological or historic resources are discovered during project operation or other project-related activities.

Below, we discuss the rationale for modifying McMahan Hydro's proposal, and the basis for our additional staff-recommended measures.

Maintenance Drawdown and Refill Plan

McMahan Hydro proposes to develop an impoundment drawdown and refill plan for emergency and maintenance activities, in consultation with the resource agencies. North Carolina WRC and North Carolina DWR recommend that McMahan Hydro develop an impoundment drawdown and refill plan in consultation with resource agencies, prior to any actions to lower the impoundment level substantially below the crest of the dam.

As discussed in sections 3.3.1, *Geology and Soils,* and 3.3.2, *Aquatic Resources,* McMahan Hydro may periodically need to draw down the project impoundment for maintenance or emergencies. Drawdowns would temporarily interrupt run-of-river operation and minimum flows in the bypassed reach. Water levels in the impoundment would be reduced, with potential negative effects on aquatic biota. The refill of the impoundment following a drawdown could also disrupt flows downstream from the project and affect water quality and aquatic habitat.

We recommend that an impoundment drawdown and refill plan be required in any issued license; that it include measures to ensure that drawdowns are completed quickly; and that, during the impoundment refill, a downstream flow (of a volume to be determined) be maintained. The plan would be developed, as recommended by the Interior, North Carolina WRC, and North Carolina DWR and in consultation with these agencies. The plan would include a provision to document the maintenance or emergency drawdowns to facilitate review of the procedures used, and allow for revision to the plan, if necessary.

In section 4.0, *Developmental Analysis*, we determined that there would be no increase in the levelized annual cost as a result of developing the plan or implementing the impoundment drawdown and refill procedures or reporting on drawdown and refill plan implementation outcomes.

Operation Compliance Monitoring

McMahan Hydro proposes to operate the project in a run-of-river mode. To ensure run-of-river operation, McMahan Hydro proposes to: (1) visually monitor flows daily; (2) operate an impoundment elevation sensor and cut-off switch on the turbine so that generation would cease when impoundment levels fall below the elevation(s), over

the dam crest, needed to provide the bypassed reach minimum flows; and (3) provide access to 15-minute interval impoundment elevation and generation data to resource agencies and the Commission.

As discussed in section 3.3.2, *Aquatic Resources*, operation of the project in a run-of-river mode would maintain suitable water quality and habitat for aquatic biota. The measures proposed by McMahan Hydro to monitor compliance with run-of-river operation are sufficient to ensure compliance with the proposed run-of-river operation. In addition to the applicant's proposed measures, we recommend that McMahan Hydro file an incident report with the Commission and resource agencies if the cut-off system fails, and/or if the water level drops below the level needed to provide the minimum flow(s) to the bypassed reach. Filing such a report would document when the project operates outside of a run-of-river mode. There would be no additional cost incurred for filing a report with the Commission and resource agencies.

Recreation Management Plan

McMahan Hydro proposes measures to improve existing recreation amenities as part of implementing its proposed Recreation Plan. The proposed recreation enhancements include: (1) improving the canoe portage around the dam and installing a new stair system to facilitate access to the portage; (2) improving a hiking trail to connect two state-maintained trails; and (3) installing signage. To ensure that the proposed improvements are completed timely and are maintained over the term of any license issues, we recommend that the Recreation Plan include: (1) a schedule for constructing the proposed recreation amenity enhancements; and (2) a maintenance program. There would be no additional cost for incorporating our recommended measures into the Recreation Plan.

Cultural Resources

The project area is located within the Bynum Mill and Mill Village Complex (CH0685), which was determined eligible for listing in the National Register of Historic Places in 1997. The complex includes the project canal and powerhouse. As discussed in section 3.3.6, *Cultural Resources,* the North Carolina SHPO does not feel that the undertaking would adversely affect the historic property. The SHPO does state that they must be contacted if the scope of work is to change. There is a possibility that unknown archaeological or historic resources may be discovered during project operation or other project-related activities. To ensure proper treatment of any unknown cultural resources that may be discovered at the project, we recommend that, in the case of any such discovery, McMahan Hydro notify and consult with the North Carolina SHPO. In addition, we recommend that McMahan Hydro: (1) cease project-related activities and determine if the discovered archaeological or historic resource is eligible for the National Register; (2) determine if continued operation of the project would adversely affect the

resource; and (3) if the resource would be adversely affected, obtain guidance from the North Carolina SHPO on how to avoid, lessen, or mitigate for any adverse effects. In addition, we recommend that McMahan Hydro inform the Commission of any discovery of an unknown cultural resource, and any protection measures proposed if the resource is eligible for the National Register and affected adversely by project construction or operation. There is no additional cost associated with this measure.

5.1.3 Measures Not Recommended by Staff

Operation Compliance Monitoring

McMahan Hydro proposes measures to ensure that the project operates in a run-of-river mode. North Carolina WRC and North Carolina DWR recommend that if the impoundment level drops below the level required to release the minimum flow(s) to the bypassed reach, the turbine should be shut down so that all streamflow spills over the dam. The agencies also recommend that McMahan Hydro maintain records of inflow and outflow to verify run-of-river operation, as well as to document activities associated with maintenance and emergency drawdowns. Specifically, North Carolina WRC and North Carolina DWR recommend that McMahan Hydro: (1) install a stream gage to record inflow, if the USGS gage number 02096960 is no longer maintained; (2) maintain records of impoundment stage and project generation; and (3) make records of impoundment stage and project generation available to the resource agencies.

As discussed in section 3.3.2, *Aquatic Resources*, the agencies' recommendations to maintain records of inflow and outflow data, and impoundment stage data could be used to monitor compliance with run-of-river operation, and, thereby, help maintain flow, water quality, and habitat for aquatic biota that exists currently with the natural flow regime and pattern of the Haw River. However, McMahan Hydro could use project generation data, in 15-minute intervals, to document when the project is generating, as well as the flows passing through the facility. McMahan Hydro also could use the impoundment elevation sensors it proposes to demonstrate that the project is operating in a run-of-river mode. The proposed configuration would ensure that McMahan Hydro operates the project run-of-river. In particular, an impoundment elevation sensor and automatic cut-off switch would ensure that the project could not generate power in any operational mode other than run-of-river.

The levelized annual cost of installing a gage to measure inflow would be $325. The agencies' recommendation would also require installation of a gage to measure outflow from the project. The levelized annual cost of that gage also would be $325. Finally, the agencies' recommendation would require the installation of a water level logger, which would have a levelized annual cost of $139.

The ability to record the flow in the Haw River downstream from the project is currently available at USGS gage number 02096960. However, if USGS were to

discontinue operation of the gage, North Carolina WRC and North Carolina DWR recommend that McMahan Hydro install a gage to record streamflow. Because the operation of the project in a run-of-river mode is implicit in the project design and control system, the run-of-river operation of the project would still be verifiable. In addition, the Corps currently uses the USGS gage to manage Jordan Lake, and therefore, discontinuing the gage is unlikely. We estimate the levelized annual maintenance costs of this measure to be $2,617.

McMahan Hydro's proposal to install and operate an impoundment elevation sensor and cut-off switch would prevent the impoundment water level from falling below the elevation(s) needed to provide the proposed minimum flows over the crest of the dam, and, thereby, avoid disruptions in downstream flows, including in the bypassed reach. The elevation sensor and cut-off switch would also ensure that the project could not function in any operation mode other than run-of-river. The agencies' recommendations for recording inflow, outflow, and water level, would be more costly and would not provide a more accurate record of the project's run-of-river operation at the project. We estimate the levelized annual maintenance costs of the impoundment sensor and cut-off switch to be $33.

McMahan Hydro also proposes to monitor flows visually every day, which would ensure the impoundment elevation sensor and cut-off switch were operating properly. If that system is working properly, the impoundment levels will not fall below the level needed to release the minimum flow(s) over the crest of the dam. These visual observations, when coupled with our recommendation that McMahan Hydro file a report should the cut-off system fail, would provide sufficient means to document any deviation from run-of-river conditions at the project. There would be no levelized annual cost associated with these measures. Finally, McMahan Hydro would provide access to project generation data to determine whether the project is operating in a mode other than run-of-river (*i.e.*, peaking). There also is no cost associated with this measure.

We consider the costs and benefits of the proposed and recommended measures, the ability of each measure to protect run-of-river conditions at the project, as well as the limited ability of the project to operate in a mode other than run-of-river. Based on our considerations of the measures, we conclude that the measures included in the staff alternative best balance the benefits and costs of monitoring project operations. The measures included in the staff alternative would require McMahan Hydro to: (1) visually monitor flows daily; (2) operate an impoundment elevation sensor and cut-off switch on the turbine so that generation would cease when impoundment levels fall below the elevation(s), over the dam crest, needed to provide the bypassed reach minimum flows; (3) file a report with the Commission if the cut-off system fails, and/or if the impoundment levels fall below the elevation(s), over the dam crest, needed to provide the bypassed reach minimum flows; and (4) provide access to the impoundment elevation

and generation data (collected in 15-minute intervals) to resource agencies and the Commission.

Water Quality Monitoring

In response to recommendations from North Carolina WRC and North Carolina DWR, McMahan Hydro submitted a draft Water Quality Monitoring Plan as part of their re-application for 401 certification. McMahan Hydro proposed to record DO and water temperature monthly for the term of the license. Measurements would be taken in the impoundment, tailrace, and bypassed reach.

The proposed water quality monitoring plan would provide little useful information, because most of the measurements would be made at times of year during which the risk of poor DO and temperature conditions would be low. More importantly, it is unlikely that the project would result in water quality problems because of the short water residence time in the small impoundment, proposed run-of-river operation, and proposed minimum flow releases. Furthermore, North Carolina DWR already monitors overall water quality at its Ambient Monitoring Station located in the proposed project's bypassed reach. For these reasons, we conclude that requiring McMahan Hydro to develop a water quality monitoring plan would not be worth the estimated annual levelized cost of $3,120.

5.2 UNAVOIDABLE ADVERSE EFFECTS

During any maintenance or emergency drawdowns or refills, there would be a temporary interruption of run-of-river operation, where water levels would be reduced in the impoundment, and water levels would fluctuate in both the impoundment and tailrace. However, the maintenance events are temporary and infrequent. Thus, maintenance and emergency drawdowns are likely to have only a minor adverse effect on aquatic resources.

Operation of the project would result in some unavoidable fish entrainment. However, as documented in section 3.3.2, *Aquatic Resources*, the survival of smaller individuals is likely to be relatively high because they are less prone to mechanical injury from turbine passage than larger fish and population-scale effects are very unlikely.

Operation of the project would reduce flow in the bypassed reach as a result of diverting water to the turbine to generate power. At times reduced flow in the bypassed reach would make navigation of canoes and kayaks through the bypassed reach challenging. However, as discussed in section 3.3.5, *Recreation and Land Use*, this would be limited to low-flow periods when the project is operating. Further, portage past the dam would be improved as would access to the upstream canoe and kayak launching and landing site on the Haw River at Bynum.

5.3 FISH AND WILDLIFE AGENCY RECOMMENDATIONS

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission believes that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

In response to our February 3, 2017, notice that the license application was ready for environmental analysis and soliciting comments, recommendations, terms and conditions, and prescriptions, North Carolina WRC filed four recommendations for the proposed project on April 3, 2017. We separated their recommendations into five individual items and found four of the five recommendations to be within the scope of section 10(j). We recommend all four of these section 10(j) recommendations.

Table 13 lists the recommendations filed pursuant to section 10(j), and indicates whether the recommendations are included under the staff alternative.

Table 13. North Carolina WRC section 10(j) recommendations for the Bynum Project. (Source: Staff).

Recommendation	Agency	Within Scope of Section 10(j)	Annualized Cost	Recommend Adopting
Operate the project in a run-of-river mode, such that outflow equals inflow at all times. Run-of-river mode may be temporarily modified if required for emergencies, necessary repairs and maintenance, or short periods agreed upon by McMahan Hydro, the Commission, and resource agencies.	North Carolina WRC	Yes	$0[a]	Adopted.
Maintain the impoundment elevation during normal operations within 0.1-feet of the crest elevation of 315 feet AMSL so if the project shuts down water can immediately spill over the dam to protect the bypassed reach aquatic habitats.	North Carolina WRC	Yes	$0[a]	Adopted.
Provide a minimum flow to the bypassed reach of 120 cfs or inflow to the impoundment. The minimum flow may be temporarily modified, if required for emergencies, necessary repairs and maintenance, or short periods agreed upon by McMahan Hydro, the Commission, and resource agencies.	North Carolina WRC	Yes	$0[a]	Adopted.
Develop an Operation Compliance Plan to: 1) monitor and maintain records (logs) of run-of-river operation and minimum flow releases, 2) describe the location, type and recording intervals of the monitoring devices, 3) describe the maintenance and calibration methods of these devices, 4) and, schedule for installation and implementation of the monitoring system.	North Carolina WRC	Yes	$325[b]	Adopted.

Recommendation	Agency	Within Scope of Section 10(j)	Annualized Cost	Recommend Adopting
Develop a Recreation Management Plan for a canoe portage and associated signage.	North Carolina WRC	No[c]	$400[b]	Adopted.

[a] Staff estimates this cost would be negligible.
[b] Cost estimated by staff.
[c] Not a specific fish and wildlife measure.

5.4 CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2)(A) of the FPA, 16 U.S.C. § 803(a)(2)(A), requires the Commission to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. We reviewed eight comprehensive plans that are applicable to the project. We found no inconsistencies.

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6.0 FINDING OF NO SIGNIFICANT IMPACT

Based on our independent analysis, the issuance of a license for the Bynum Project, with our recommended environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

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