American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

Via Electronic Filing January 11, 2021

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

Subject: Niagara Hydroelectric Project (FERC No. 2466-034)
Filing of Initial Study Report and Schedule for Virtual ISR Meeting

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD). On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. These delays pushed the start of the 2020 field season into early August 2020 and resulted in some of the spring and summer 2020 field work being rescheduled for 2021. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

During the restricted 2020 field season, Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC's SPD. In accordance with 18 CFR §5.15, Appalachian is hereby filing the ISR with the Commission. The ISR describes the Licensee's overall progress in implementing the study plan and schedule, summarizes available data, and describes any variances from the study plan and schedule approved by the Commission.

The Commission's regulations at 18 CFR §5.15(c) require Appalachian to hold a meeting with participants and FERC staff within 15 days of filing the ISR. **Accordingly, Appalachian will hold**

an ISR Meeting via Webex from 10 AM to 3 PM on Thursday, January 21, 2020. An agenda for the ISR Meeting is provided in Attachment 2. Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

Appalachian respectfully requests that the stakeholders interested in participating in the Virtual ISR Meeting contact Maggie Yayac at maggie.yayac@hdrinc.com on or before close of business Tuesday, January 19, 2021 to obtain instructions to join the virtual meeting.

If there are any questions regarding this filing, please do not hesitate to contact me at (614) 716-2240 or jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation, Environmental Services

cc: Distribution List
Elizabeth Parcell (AEP)

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Federal Agencies

Mr. John Eddins
Archaeologist/Program Analyst
Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, DC 20001-2637
jeddins@achp.gov

Blue Ridge National Heritage Area
195 Hemphill Knob Road
Asheville, NC 28803

Park Headquarters
Blue Ridge Parkway
199 Hemphill Knob Road
Asheville, NC 28803-8686

Ms. Kimberly Bose
Secretary
Federal Energy Regulatory Commission
888 1st St NE
Washington, DC 20426

FEMA Region 3
615 Chestnut Street
One Independence Mall, Sixth Floor
Philadelphia, PA 19106-4404

George Washington and Jefferson National Forest
5162 Valleypointe Parkway
Roanoke, VA 24019

Mr. John Bullard
Regional Administrator
NOAA Fisheries Service
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive
Gloucester, MA 01930-2276

Mr. John A. Bricker
State Conservationist
US Department of Agriculture
Natural Resources Conservation Service
1606 Santa Rosa Road, Suite 209
Richmond, VA 23229-5014

Mr. Harold Peterson
Bureau of Indian Affairs
US Department of the Interior
545 Marriott Dr, Suite 700
Nashville, TN 37214
Harold.Peterson@bia.gov

Office of the Solicitor
US Department of the Interior
1849 C Street, NW
Washington, DC 20240

Ms. Lindy Nelson
Regional Environmental Officer, Office of Environmental Policy & Compliance
US Department of the Interior, Philadelphia Region
Custom House, Room 244
200 Chestnut Street
Philadelphia, PA 19106

Ms. Barbara Rudnick
NEPA Team Leader - Region 3
US Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. Martin Miller
Chief, Endangered Species - Northeast Region (Region 5)
US Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035

Ms. Cindy Schulz
Field Supervisor, Virginia Field Office
US Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Mr. John McCloskey
US Fish and Wildlife Service
John_mcCloskey@fws.gov

Mr. Richard C. McCorkle
Fish and Wildlife Biologist, Pennsylvania Field Office
US Fish and Wildlife Service
110 Radnor Road, Suite 101
State College, PA 16801
richard_mccorkle@fws.gov

Ms. Elizabeth Merz
US Forest Service
3714 Highway 16
Marion, VA 24354

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. Mark Bennett
Center Director of VA and WV Water Science Center
US Geological Survey
John W. Powell Building
12201 Sunrise Valley Drive
Reston, VA 20192
mrbennet@usgs.gov

Hon. Ben Cline
US Congressman, 6th District
US House of Representatives
10 Franklin Road SE, Suite 510
Roanoke, VA 24011

Mr. Michael Reynolds
Acting Director, Headquarters
US National Park Service
1849 C Street, NW
Washington, DC 20240

Ms. Catherine Turton
Architectural Historian, Northeast Region
US National Park Service
US Custom House, 3rd Floor
200 Chestnut Street
Philadelphia, PA 19106

Hon. Tim Kaine
US Senate
231 Russell Senate Office Building
Washington, DC 20510

Hon. Mark Warner
US Senate
703 Hart Senate Office Building
Washington, DC 20510

Mr. Matthew Lee
US Environmental Protection Agency
lee.matthew@epa.gov

<u>State Agencies</u>

Dr. Elizabeth Moore
President
Archaeological Society of Virginia
PO Box 70395
Richmond, VA 23255

Blue Ridge Soil and Water Conservation District
1297 State Street
Rocky Mount, VA 24151

Mr. Jess Jones
Freshwater Mollusk Conservation Center
Virginia Tech
1B Plantation Road
Blacksburg, VA 24061

Mr. Ralph Northam
Governor
Office of the Governor
PO Box 1475
Richmond, VA 23218

Mr. Paul Angermeier
Assistant Unit Leader
Virginia Cooperative Fish and Wildlife Research Unit
Department of Fisheries and Wildlife Conservation - Virginia Tech
106 Cheatham Hall
Blacksburg, VA 24061
biota@vt.edu

Mr. Benjamin Hermerding
Secretary of the Commonwealth
Virginia Council on Indians
PO Box 2454
Richmond, VA 23218
benjamin.hermerding@governor.virginia.gov

Ms. Robbie Rhur
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
Robbie.Rhur@dcr.virginia.gov

Ms. Rene Hypes
Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
rene.hypes@dcr.virginia.gov

Mr. Clyde Cristman
Division Director
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Ms. Lynn Crump
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
lynn.crump@dcr.virginia.gov

Mr. Tyler Meader
Locality Liasion - Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
nhreview@dcr.virginia.gov

Mr. Matthew Link
Water Withdrawal Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
matthew.link@deq.virginia.gov

Mr. Andrew Hammond
Water Withdrawal Permitting & Compliance Manager
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23218
andrew.hammond@deq.virginia.gov

Mr. Tony Cario
Water Withdrawal Permit Writer, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
anthony.cario@deq.virginia.gov

Mr. Scott Kudlas
Director, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
scott.kudlas@deq.virginia.gov

Mr. Brian McGurk
Water Withdrawl Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
Brian.McGurk@deq.virginia.gov

Blue Ridge Regional Office
Virginia Department of Environmental Quality
3019 Peters Creek Road
Roanoke, VA 24019

Mr. Chris Sullivan
Senior Area Forester
Virginia Department of Forestry
900 Natural Resources Drive
Charlottesville, VA 22903

Mr. Scott Smith
Region 2 Fisheries Manager
Virginia Department of Game and Inland Fisheries
1132 Thomas Jefferson Road
Forest, VA 24551
scott.smith@dgif.virginia.gov

Ms. Julie Langan
Director and State Historic Preservation Officer
Virginia Department of Historic Resources
2801 Kensington Avenue
Richmond, VA 23221

Local Governments

Ms. Anita McMillan
Town of Vinton
amcmillan@vintonVA.gov

Mr. Christopher Whitlow
County Administrator
Franklin County Administration
1255 Franklin Street
Rocky Mount, VA 24151

Mr. Sherman P. Lea, Sr.
Mayor
City of Roanoke
Noel C. Taylor Municipal Building
215 Church Avenue
Roanoke, VA 24011

Mr. Richard Caywood
Assistant County Administrator
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
rcaywood@roanokecountyva.gov

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. David Henderson
Engineering
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
dhenderson@roanokecountyva.gov

Mr. Phil North
Hollins Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Mr. David Radford
Windsor Hills Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Ms. Paula Shoffner
Executive Director
Tri-County Lakes Administrative Commission
400 Scruggs Road #200
Moneta, VA 24121
paulas@sml.us.com

Mr. Doug Blount
Director
Roanoke County Parks, Recreation and Tourism
1206 Kessler Mill Road
Salem, VA 24153
dblount@roanokecountyva.gov

Ms. Lindsay Webb
Parks Planning and Development Manager
County of Roanoke
1206 Kessler Mill Road
Salem, VA 24153
LWEBB@roanokecountyva.gov

Mr. Joey Hiner
Town of Vinton
311 S. Pollard St.
Vinton, VA 24179
jhiner@vintonVA.gov

Mr. Bo Herndon
Town of Vinton
312 S. Pollard St.
Vinton, VA 24180
wherndon@vintonVA.gov

Mr. Kenny Sledd
Town of Vinton
313 S. Pollard St.
Vinton, VA 24181
ksledd@vintonVA.gov

Western Virginia Water Authority
601 South Jefferson Street
Roanoke, VA 24011

Tribes

Wenonah G. Haire
Catawba Indian Nation
Tribal Historic Preservation Office
1536 Tom Stevens Road
Rock Hill, SC 29730
caitlin.rogers@catawba.com

Eric Paden
Director of Historic Preservation
Delaware Nation
31064 State Highway 281
Anadarko, OK 73005
epaden@delawarenation-nsn.gov

Chief Kenneth Branham
Monacan Indian Nation
PO Box 960
Amherst, VA 24521
TribalOffice@MonacanNation.com

Terry Clouthier
Cultural Resources Director
Pamunkey Indian Tribe
1059 Pocahontas Trail
King William, VA 23086
terry.clouthier@pamunkey.org

Non-Governmental

American Canoe Association
503 Sophia Street, Suite 100
Fredericksburg, VA 22401

Mr. Kevin Richard Colburn
National Stewardship Director
American Whitewater
PO Box 1540
Cullowhee, NC 28779
kevin@americanwhitewater.org

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Headquarters
Appalachian Trail Conservancy
416 Campbell Ave SW #101
Roanoke, VA 24016-3627

Blue Ridge Parkway Foundation
717 South Marshall Street, Suite 105 B
Winston-Salem, NC 27101

Ms. Audrey Pearson
Executive Director
Friends of the Blue Ridge Parkway
PO Box 20986
Roanoke, VA 24018
audrey_pearson@friendsbrp.org

Friends of the Rivers of Virginia
257 Dancing Tree Lane
Hollins, VA 24019

Mr. Bill Tanger
Chair
Friends of the Rivers of Virginia
257 Dancing Tree Lane
Hollins, VA 24109
bill.tanger@verizon.net

Ms. Juanita Callis
Director
Friends of the Roanoke
PO Box 1750
Roanoke, VA 24008-1750

Mr. Mike Pucci
President
Roanoke River Basin Association
150 Slayton Avenue
Danville, VA 24540

Roanoke River Blueway
313 Luck Avenue SW
Roanoke, VA 24016
roanokeriverblueway@gmail.com

Blue Ridge Land Conservancy
27 Church Ave SW
Roanoke, VA 24011-2001

Initial Study Report

Niagara Hydroelectric Project
(FERC No. 2466)

January 11, 2021

Prepared by:

Prepared for:

Appalachian Power Company

Contents

Tables

Attachments

Appendices

Acronyms and Abbreviations

2-D	two-dimensional
Appalachian or Licensee	Appalachian Power Company
AEP	American Electric Power
APE	Area of Potential Effects
CFR	Code of Federal Regulations
cfs	cubic feet per second
DO	dissolved oxygen
EDGE	Edge Engineering and Science, LLC
EPRI	Electric Power Research Institute
FERC or Commission	Federal Energy Regulatory Commission
GIS	Geographic Information System
HDR	HDR Engineering, Inc.
HSC	Habitat Suitability Criteria
Hydrolab	Hach Hydrolab® MS5
ICM	Integrated Catchment Model
ILP	Integrated Licensing Process
ISR	Initial Study Report
KOP	key observation point
mg/l	milligrams per liter
NOI	Notice of Intent
NRHP	National Register of Historic Places
PAD	Pre-Application Document
Project	Niagara Hydroelectric Project
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD	Scoping Document
SHPO	State Historic Preservation Office
SPD	Study Plan Determination
Terracon	Terracon Consultants, Inc.
USR	Updated Study Report
USFWS	U.S. Fish and Wildlife Service
VDEQ	Virginia Department of Environmental Quality
VDCR	Virginia Department of Conservation and Recreation
VDHR	Virginia Department of Historic Resources
VDWR	Virginia Department of Wildlife Resources
YES	Young Energy Services

1 Project Introduction and Background

1.1 Introduction

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD). This Initial Study Report (ISR) describes the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021. These delays pushed the start of the 2020 field season into early August 2020 and resulted in some of the spring and summer 2020 field work being rescheduled for 2021. FERC letters of correspondence are included in Attachment 1.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This ISR describes the Licensee's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule.

The Commission's regulations at 18 CFR §5.15(c) require Appalachian to hold a meeting with participants and FERC staff within 15 days of filing the ISR. Accordingly, **Appalachian will hold an ISR Meeting via Webex from 10 AM to 3 PM on January 21, 2020.** An agenda for the ISR Meeting is provided in Attachment 2. Participants are free to join the meeting in part based on interests or availability, but please note that the agenda is intended as an approximation and more or less time may be spent on individual studies, as needed.

Appalachian respectfully requests that those planning on joining the ISR Webex Meeting RSVP by emailing Maggie Yayac at maggie.yayac@hdrinc.com on or before close of business Tuesday, January 19, 2021. Additional information, including instructions to join the virtual meeting, will be provided in response to the RSVP.

1.2 Background

On January 28, 2019 Appalachian initiated the ILP by filing a Pre-Application Document (PAD) and Notice of Intent (NOI) with the Commission. Major ILP milestones to-date are presented in Table 1-1.

Table 1-1. Major ILP Milestones Completed

Date	Milestone
January 28, 2019	Appalachian Filed NOI and PAD (18 CFR §5.5, 5.6)
March 26, 2019	FERC Issued Notice of PAD/NOI and Scoping Document 1 (SD1) (18 CFR §5.8(a))
April 24-25, 2019	FERC Conducted Scoping Meetings and Site Visit (18 CFR §5.8(b) (viii))
May 25, 2019	Stakeholders Submitted Comments on the PAD, SD1, and Study Requests (18 CFR §5.9)
July 9, 2019	FERC Issued Scoping Document 2 (SD2) (18 CFR §5.10)
July 9, 2019	Appalachian Filed Proposed Study Plan (PSP) (18 CFR §5.11(a))
August 1, 2019	Appalachian Held Study Plan Meeting (18 CFR §5.11(e))
October 7, 2019	Stakeholders Submitted Comments on the PSP (18 CFR §5.12)
November 6, 2019	Appalachian Filed RSP (18 CFR §5.13(a))
November 21, 2019	Stakeholders Submitted Comments on the RSP (18 CFR §5.13(b))
December 6, 2019	FERC Issued the SPD (18 CFR §5.13(c))
July 27, 2020	Appalachian Submitted First Quarterly Report, ILP Study Update, and Request for Extension of Time File ISR
August 10, 2020	FERC Issued Order Granting Appalachian Extension of Time for Filing of ISR
August – November 2020	Appalachian Conducted First Season of Field Studies (18 CFR §5.15(a))
October 27, 2020	Appalachian Submitted Second Quarterly Progress Report (18 CFR §5.15(b))
January 11, 2020	Appalachian Submitted ISR (18 CFR §5.15(c)(1))

Appalachian has continued consultation with stakeholders regarding approved studies as required by the Commission's SPD. In accordance with the schedule presented in the RSP, Appalachian has also provided stakeholders with Quarterly ILP Study Progress Reports that include a description of study activities conducted during the previous quarter, activities expected to occur in the next quarter, and identified variances from the approved study plan. The next quarterly progress report is expected to be filed with FERC in April 2021.

1.3 Study Plan Implementation

On December 6, 2019 the Commission issued the SPD for the Project. The SPD directed Appalachian to conduct 8 studies:

1. Bypass Reach Flow and Aquatic Habitat Study
2. Water Quality Study
3. Fish Community Study
4. Benthic Aquatic Resources Study
5. Wetlands, Riparian, and Littoral Habitat Characterization Study
6. Shoreline Stability Assessment Study

7. Recreation Study
8. Cultural Resources Study

Section 2 of this ISR describes Appalachian's overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule, including those previously reported by Appalachian in the ILP quarterly progress reports (July 27, 2020 and October 27, 2020). Technical reports for studies that have been completed or partially completed are attached as appendices to this ISR. Note that the Preliminary Cultural Resources Study Report (Appendix F) is being filed separately as Privileged pursuant to 18 C.F.R § 388.112(b) because this report contains information regarding the specific location and nature of historic and archaeological resources which is not for public disclosure. Studies that have not yet commenced are discussed briefly in Section 2 and study reports will be included in the Updated Study Report (USR).

1.4 Proposals to Modify Ongoing Studies or for New Studies

At this time, Appalachian is not proposing any modifications to the studies approved and modified in the Commission's December 6, 2019 SPD or any new studies. Minor variances to the study plans have been previously reported in the ILP quarterly progress reports (July 27, 2020 and October 27, 2020) and are detailed in the sections that follow, as well as within the individual study reports provided as appendices.

2 Status and Summaries of Studies

This section describes Appalachian’s overall progress in implementing the study plan and schedule, the data collected, and any variances from the study plan and schedule. Study methods and available study results are summarized for each of the eight studies approved in the Commission’s SPD. An updated schedule for completed and remaining study activities is included in Table 2-1.

Table 2-1. Updated Study Schedule for the Niagara Project (FERC No. 2466)

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 Update	January 2021 update
Bypass Reach Flow and Aquatic Habitat Study	Topographic Mapping and Photogrammetry Data Collection	Fall 2019	Completed (January 2020)	Completed (January 2020)
	Desktop Habitat Assessment	Spring 2020	July – September 2020	Completed (December 2020)
	Mesohabitat Mapping and Substrate Characterization Field Data Collection	Summer 2020	September – October 2020	June - August 2021
	Distribute Proposed Flow Test Scenario Framework to Interested Parties for Review	June/July 2020	August 2020	Completed (January 2021)
	Conduct Flow and Water Level Assessment and Hydraulic Model Development	June - October 2020	September – December 2020	June – October 2021
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021	ISR Completed (January 2021) USR December 2021
Water Quality Study	Study Planning and Existing Data Review	February – April 2020	July – August 2020	Completed (August 2020)
	Continuous and Monthly Water Quality Monitoring (Dissolved Oxygen and Temperature)	May – October 2020	July – October 2020	Completed (August – November 2020)
	Supplemental Bypass Reach Continuous Dissolved Oxygen and Temperature Monitoring	May – October 2020	July – October 2020	July – August 2021
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021	ISR Completed (January 2021) USR December 2021

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 Update	January 2021 update
Fish Community Study	Study Planning and Existing Data Review	September 2019 – April 2020	July 2020	Completed (July 2020)
	Fish Community Study	August – October 2020	Late September - Early November 2020	Completed (September – November 2020)
	Roanoke Logperch Adult Surveys (spring sampling conditioned on receipt of waiver from USFWS for sampling within time-of-year restriction period)	May – June 2020, August – October 2020	August – October 2020, May – June 2021	May – June 2021, August – October 2021
	Roanoke Logperch Young-of-Year Surveys	August – October 2020	August – October 2020	August – October 2021
	Roanoke Logperch Larval Surveys	April – June 2020	April – June 2021	April – June 2021
	Desktop Impingement and Entrainment Evaluation and Turbine Blade Strike Analysis	December 2019 – November 2020	July – December 2020	Impingement and Entrainment Evaluation Completed (December 2020) Turbine Blade Strike Analysis (July – December 2021)
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021	ISR Completed (January 2021) USR December 2021
Benthic Aquatic Resources Study	Study Planning and Existing Data Review	November 2019 – February 2020	August – September 2020	Completed (August 2020)
	Benthic Habitat Assessment	March – October 2020	September – October 2020	Completed (September 2020)
	Macroinvertebrate and Crayfish Community Study	March – October 2020	September – October 2020, April – May 2021	Completed (September 2020) April – May 2021
	Mussel Habitat and Community Survey	April – October 2020	August – October 2020	Completed (October 2020)
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021/December 2021	ISR Completed (January 2021) USR December 2021

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 Update	January 2021 update
Wetlands, Riparian, and Littoral Habitat Characterization	Desktop Mapping of Wetland, Riparian, and Littoral Habitats	September 2019 – March 2020	September 2020 – March 2021	January - March 2021
	Field Verification of Preliminary Maps and Identified Wetlands, Riparian, and Littoral Habitat Characterizations	April – July 2020	April – July 2021	April – July 2021
	Distribute Draft Study Report with the USR	December 2020	December 2021	December 2021
Shoreline Stability Assessment Study	Study Planning and Data Review	September 2019 – March 2020	September 2020 – March 2021	January – March 2021
	Shoreline Survey and Determination of Areas Potentially Needing Remediation	April – July 2020	April – July 2021	April – July 2021
	Distribute Draft Study Report with the USR	December 2020	December 2021	December 2021
Recreation Study	Study Planning and Existing Data Review	November 2019 – March 2020	Completed (March 2020)	Completed (March 2020)
	Recreation Facility Inventory and Condition Assessment	November 2019	Completed (November 2019)	Completed (November 2019)
	Convene Meeting with Stakeholders	July – August 2020	September – November 2020	January – April 2021
	Recreation Visitor Use Online Survey	May – October 2020	May 2020 – October 2021	May 2020 – October 2021
	Recreational Use Documentation (2x/month)	May – October 2020	May – October 2021	May – October 2021
	Aesthetic Flow Documentation (Quarterly)	November 2019 – November 2020	November 2019 – November 2020	Completed (November 2020)
	Recreational Flow Release Desktop Evaluation	August 2020 – October 2020	August 2020 – October 2020	Completed (December 2020)
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021/December 2021	ISR Completed (January 2021) USR December 2021

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	July 2020 Update	January 2021 update
Cultural Resources Study	Determination of Area of Potential Effect (APE)	January – June 2020	July – September 2020	Completed (September 2020)
	Background Research and Archival Review	January – June 2020	August 2020 – November 2020	Completed (August - September 2020)
	Phase I Reconnaissance Survey of APE	May – October 2020	April – July 2021	Completed (October 2020)
	Inventory of Traditional Cultural Properties	October 2019 – October 2020	September 2020 – October 2021	January 2021 – October 2021
	Distribute Draft Study Report with the ISR/USR	December 2020	December 2021	ISR Completed (January 2021) USR December 2021
	Historic Properties Management Plan (if necessary)	With the DLA		

2.1 Bypass Reach Flow and Aquatic Habitat Study

2.1.1 Study Status

Appalachian has partially completed the Bypass Reach Flow and Aquatic Habitat Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Bypass Reach Flow and Aquatic Habitat Study is included in Appendix A.

2.1.2 Summary of Study Methods and Results

In accordance with the RSP approved and modified in the Commission's SPD, Appalachian's consultant, HDR Engineering, Inc. (HDR), conducted a Bypass Reach Flow and Aquatic Habitat Study to:

- Delineate and quantify aquatic habitats and substrate types within the bypass reach.
- Identify and characterize locations of habitat management interest located within the bypass reach.
- Develop an understanding of surface water travel times and water surface elevation responses for varying Obermeyer sluice gate openings (i.e., varying flow scenarios) in the bypass reach study area to:
    - Demonstrate the efficacy of the existing bypass reach minimum flow requirement (i.e., 8 cubic feet per second [cfs]) on maintaining suitable habitat for aquatic species.
    - Evaluate potential seasonal minimum flow releases in the bypass reach.

HDR reviewed the hydrologic record for the Project study reach, trash sluice gate operating procedures and design capacity, existing topographic and geologic maps, and available recent and historical aerial imagery. Light detection and ranging data were collected to support development of comprehensive three-dimensional elevation and visual surface layers of the bypass reach. These data were used for desktop mesohabitat mapping of the bypass reach according to substrate size (e.g., sand, gravel, cobble, etc.), cover (e.g., no cover, overhead vegetation, etc.), and mesohabitat types (e.g., pools, riffles, runs, bedrock, shoals). The topographic information was then incorporated as a Geographic Information System (GIS) base layer for future field data collection and hydraulic modeling efforts (to be conducted in 2021).

In 2021, field data will be collected to support development of a two-dimensional (2-D) hydraulic model of the Project's tailwater and bypass reach. This study will use the Innovyze Infoworks Integrated Catchment Model (ICM) software (version 7.0), which is capable of simulating depth and velocities in a 2-D grid pattern over a wide range of flow conditions. Proposed target (i.e., model calibration/validation) flows will be released into the bypass reach for purposes of collecting depth and wetted area data under various bypass flow regimes.

The proposed target flow scenarios are designed to allow 2-D hydraulic model simulations capable of evaluating the full operating range (i.e., 7 cfs to 287 cfs) of the newly installed Obermeyer sluice gate located on the left abutment (looking downstream) of the Niagara dam and spillway.[1]

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[1] In accordance with FERC's September 2, 2020 Order Approving Sluice Gate Replacement, Revised Exhibit F, Supplement to Article 406 Minimum Flow Release Report, and License Articles 404 and 405 Minimum Flow Monitoring Plan, in December 2020 Appalachian completed replacement of the bottom-hinged, leaf type gate and

Field measurements (i.e., bypass reach water surface elevations, depths, and velocities) will be collected under steady flow conditions of approximately 8 cfs (i.e., the existing minimum bypass flow requirement), 20 cfs, 50 cfs, and 115 cfs to support hydraulic model calibration/validation activities. Water level data loggers (pressure transducers that measure water stage changes) will be strategically deployed in the tailwater, bypass, and downstream study reach to record changes in water surface elevation at each of the proposed target flows. The instrumentation will remain in place for several weeks afterwards to collect additional water surface elevation and flow travel time data under higher (than target flow) conditions (i.e., during rainfall runoff events). Data collected at higher flows will provide additional model calibration data which will allow model simulations higher than the Obermeyer gate discharge capacity (287 cfs).

The 2-D hydraulic model will be developed using the topographic mapping data (i.e., digital terrain GIS layer) and target flow calibration data (i.e., water surface elevations, depths, velocities, and flow travel time) and used to evaluate flow patterns and hydraulic connectivity under each flow regime evaluated. In addition, substrate and mesohabitat mapping along with the 2-D model depth and velocity simulation results will be used in combination with aquatic species habitat suitability criteria (HSC) (i.e., using depth, velocity, and habitat preferences) to evaluate potential available habitat under each modeled flow scenario in the study reach. Roanoke Logperch was selected as a standalone target species for this study along with a total of eight species-guild representatives including three shallow-slow, one shallow-fast, two deep-slow, and two deep-fast guilds. Guild representatives were selected from a variety of regionally representative sources, represent a wide range of habitat characteristics, and were selected to represent a wide range of species. Aquatic habitat model results will be used to evaluate potential aquatic habitat availability over a range of simulated flows for Roanoke Logperch and the eight guild representatives (to be determined in consultation with U.S. Fish and Wildlife Service [USFWS] and Virginia Department of Wildlife Resources [VDWR]).

2.1.3 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP, with the exception of the following variances:

- As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the Roanoke River, inoperability of the sluice gate hoist operating system, construction activities associated with installation of the new Obermeyer sluice gate, and temporarily reduced unit generation capability at the Niagara powerhouse, the Bypass Reach Flow and Aquatic Habitat Study fieldwork was postponed to 2021. Therefore, only the desktop habitat mapping results, proposed target flows (for the 2-D ICM model calibration/validation), and HSC information are provided in the preliminary study report (Appendix A).

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hoist operator system at the trash sluice with a bottom-hinged, inflatable Obermeyer (pneumatically actuated) gate. and operating system. Completion of this installation was required to provide flow release control for the flow tests required for this study.

2.2 Water Quality Study

2.2.1 Study Status

Appalachian has partially completed the Water Quality Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Water Quality Study is included in Appendix B.

2.2.2 Summary of Study Methods and Results

In accordance with the RSP approved and modified in the Commission's SPD, HDR conducted a Water Quality Study to:

- Gather baseline water quality data sufficient to determine consistency of existing Project operations with applicable Virginia state water quality standards and designated uses (Virginia Administrative Code Chapter 260).
- Provide data (temperature and dissolved oxygen [DO] concentration) to determine the presence and extent, if any, of temperature or DO stratification in the Niagara impoundment.
- Provide data to support a Virginia Water Protection Permit application (Clean Water Act Section 401 Certification).
- Provide information to support evaluation of whether additional or modified protection, mitigation, and enhancement measures may be appropriate for the protection of water quality at the Project.

HDR performed continuous temperature and DO monitoring, discrete multiparameter water quality sampling, and reservoir and forebay vertical profile data collection at eight locations within the study area. During the initial deployment and subsequent download events, discrete multi-parameter water quality measurements (i.e. spot measurements) of temperature, DO concentration, pH, and specific conductivity were collected at each monitoring location using a Hach Hydrolab® MS5 (Hydrolab). For riverine monitoring locations, Hydrolab water quality data was collected at one location within the water column at a depth similar to the sondes. Profiles were collected at 1-foot intervals using the Hydrolab for the two reservoir monitoring locations to document temperature and DO stratification at the time of the data sonde downloads.

Calibrated Onset® HOBO U26 DO/Temperature Loggers (i.e. sondes) were deployed for continuous in situ measurements. Combined water temperature and DO data loggers were set to record water temperature and DO at 15-minute intervals from July 29 through November 10, 2020. During the continuous monitoring period, the data sondes were downloaded five times (August 12 and 26, September 22-23, October 21, and November 9-10, 2020). At each monitoring location, two data sondes were deployed to provide redundancy. The download schedule was accelerated from monthly to bi-weekly when possible to reduce effects associated with biofouling, which was greater than anticipated at the time of the RSP development.

Water temperatures varied seasonally at continuous and discrete water temperature data collection locations and vertical profile data indicated that while water temperature varied seasonally, there was no thermal stratification at the reservoir monitoring location and no to very weak (i.e., <0.5 ºC) thermal stratification at the forebay monitoring location.

Continuous and discrete DO concentration data indicated that all measurements were greater than the 5.0 mg/l daily average (4.0 mg/l instantaneous minimum) DO standard (9 Virginia Administrative Code 25-260-50) except in the project's forebay and tailrace monitoring locations when instantaneous DO concentrations dropped slightly below the numeric state water quality standard due to a powerhouse outage; each occurrence lasted less than 1.5 hours. Similar to water temperature, there was little (i.e., typically < 1 mg/l) to no difference in DO concentrations between the forebay surface and bottom locations; indicating little to no stratification of DO concentrations throughout the forebay water column. Overall magnitude and trends in DO concentrations were very similar between the forebay, tailrace, and bypass reach monitoring locations.

The vertical profile data at both locations in the reservoir indicated that the pH range varied little (i.e., between 7.6 and 7.85), and there was little to no stratification between the reservoir surface and bottom measurements at both monitoring locations. While Virginia does not have a state standard for specific conductivity, discrete sampling and vertical profile concentrations ranged between 370 – 436 µS/cm which is generally considered suitable for most fish species (USEPA 2012).

Overall, continuous and discrete water quality data collected during the 2020 study period met Virginia Class IV (Roanoke River) and Class VII (Tinker Creek) water quality standards for temperature (<31 ºC), DO (>4.0 mg/l instantaneous minimum; >5.0 mg/l daily average), and pH (range 6.0 – 9.0 for Class IV and 3.7 – 8 for Class VII) at all monitoring locations during the study period. Even with the short-lived events where DO concentration dropped below the state standards, the Project met state water quality criteria throughout the 2020 study period.

Flows in the bypass reach were atypical (i.e., much higher) than the "normal", licensed flow regime. As a result, it is recommended that two continuous temperature and DO data sondes be re-installed in the bypass reach (one at the upstream monitoring location and the other at the downstream monitoring location) during the warmest portion of the summer in 2021 (typically July and August) to record daily fluctuations in temperature and DO concentrations under a more typical bypass flow regime if feasible.

Although there were several data gaps that occurred during the field data collection period that were the result of biofouling, equipment malfunction, and/or equipment theft, these gaps did not affect the overall summary results and conclusions of this study report (Appendix B).

2.2.3 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP, with the exception of the following variances:

- The field season for this study was not able to commence until late July 2020 due to delays associated with travel restrictions and uncertainties related to the ongoing COVID-19 pandemic.
- Due to instrument malfunction, continuous DO and water temperature data were not captured from August 12-26, 2020.
- The forebay profile was not measured during deployment or the first download (August 12, 2020).
- As proposed in the RSP, water quality data downloads were to occur on a monthly basis; however, significant biofouling was observed at the instruments located in the reservoir downstream from Tinker Creek. Data download and instrument maintenance frequency was

modified to a two-week interval; however, the biofouling resulted in several additional time periods where continuous water quality data is not available at this location.

- Discrete (i.e., spot) measurements were not collected at the Tailrace and Bypass Reach locations during the 8/12/2020 download due to instrument malfunction.
- One level logger and two DO sondes were stolen from the reservoir monitoring location downstream from Tinker Creek prior to the October download; these were not replaced since the theft occurred late in the study period and after peak water temperatures had occurred.
- Discrete (i.e., spot) measurements were not collected at the tailrace location during the 10/21/2020 download.

2.3 Fish Community Study

2.3.1 Study Status

Appalachian has partially completed the Fish Community Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Fish Community Study is included in Appendix C.

Due to restrictions on non-essential travel and safety considerations in response to the COVID-19 pandemic, the spring and summer 2020 field sampling activities could not be completed as scheduled but sampling specific to the general fish community survey was completed in fall 2020.

Although the updated study schedule provided by Appalachian in July 2020 included adult Roanoke Logperch sampling efforts, this task was not carried out due to higher than average precipitation in the Roanoke River watershed. Increased rainfall amounts resulted in prolonged high flow events that reduced the number of potential field sampling dates and delayed field sampling efforts due to safety risks and the decreased likelihood of collecting representative samples. Therefore, Roanoke Logperch life stage-specific sampling activities will take place under the revised 2021 field sampling schedule. This will allow sampling for each of the life stage-specific sampling seasons to be performed within a single calendar year.

2.3.2 Summary of Study Methods and Results

In accordance with the RSP approved and modified in the Commission's SPD, Appalachian's consultant and sub-consultant (Edge Engineering and Science, LLC. [EDGE]) conducted a Fish Community Study to:

- Collect a comprehensive baseline of the existing fish community in the Project vicinity.
- Compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution.
- Collect a comprehensive baseline (abundance and distribution) of the Roanoke Logperch population (including larval, young-of-year, and adults) in the vicinity of the Project.
- Confirm flow velocities at the intake structure to facilitate a desktop assessment of entrainment and impingement potential at Niagara.
- Perform a desktop assessment of entrainment and impingement potential at the Niagara intake structure, including an assessment of turbine mortality and survival of fish passage through the turbines or other routes using the USFWS Turbine Blade Strike Analysis Model.

As described above, one objective of the Fish Community Study was not able to be addressed in 2020 and is scheduled to commence and be completed in 2021:

- Collect information regarding the current status (abundance and distribution) of the Roanoke Logperch (including larval, young-of-year, and adults) in the vicinity of the Project for the purpose of establishing a baseline and to potentially support the Commission's cumulative effects analyses.

The Preliminary Fish Community Study consists of two separate studies: 1) the 2020 Fish Community Survey and 2) the Preliminary Fish Impingement and Entrainment Study. These are included as Attachment 1 and Attachment 2 of the Preliminary Fish Community Study Report (Appendix C).

2.3.2.1 2020 Fish Community Survey

General fish community surveys were conducted between September 15 and 16 and October 20 and 21, 2020 during relatively low flow and low-turbidity stream conditions. Sampling was performed by state permitted fish biologists under Virginia Scientific Collecting Permit Nos. 068630 and 068631. Specific sampling dates were based on factors including (but not limited to) weather conditions, water temperatures, river flows and reservoir elevations, and safety of field staff and the public.

Sampling methods were derived from National Rivers and Streams Assessment Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Backpack electrofishing was used to target riffle/run (i.e., wadeable) habitats, two of which were located upstream and five locations downstream of Niagara Dam. Boat electrofishing targeted deeper (i.e., non-wadeable) pool habitats (eight locations) within Niagara impoundment.

A total of 590 fish representing 32 species were collected during the study, the majority (89 percent) of which were taken by backpack electrofishing. Twenty-six (26) species were collected upstream of Niagara Dam while 23 species were collected downstream of the dam. Central Stoneroller (*Campostoma anomalum*; 27.4 percent), Rosefin Shiner (*Lythrurus ardens*; 25.5 percent), and Riverweed Darter (*Etheostoma podostemone*; 8.2 percent) were the most abundant species at riffle/run sites. Redbreast Sunfish (*Lepomis auratus*; 40.0 percent), Golden Redhorse (*Moxostoma erythrurum*; 18.5 percent), and Bluegill (*Lepomis macrochirus*; 16.9 percent) were the most abundant species at pool sites. Central Stoneroller, White Sucker (*Catostomus commersonii*), and Rock Bass (*Ambloplites rupestris*) were the most dominant by weight at riffle/run sites and Golden Redhorse, Redbreast Sunfish, and V-lip Redhorse (*Moxostoma pappillosum*) were the most dominant by weight at pool sites. A single Roanoke Logperch, a federally and state listed endangered species, was collected at the upstream-most survey site, above the confluence of Tinker Creek and the Roanoke River.

The average catch per unit effort (CPUE; individuals per minute) was 6.55 at riffle/run sites with average diversity (H'; Shannon index) of 1.83, and CPUE was 1.44 at pool sites with average diversity of 1.10. The raw fish collection data and representative photos of survey sites and fish collections, as well as a site-specific summary of sampling information, are provided in the Preliminary Fish Community Study Report in Appendix C.

2.3.2.2 Preliminary Impingement and Entrainment Study

HDR has partially completed the Fish Impingement and Entrainment Study in accordance with the RSP and the Commission's SPD, and the preliminary study report is provided as Attachment 2 of

Appendix C. Results from the 2020 Fish Community Study are incorporated into the impingement and entrainment study; therefore, results are subject to change after fish community sampling is completed. Additionally, the assessment of turbine mortality using the USFWS Turbine Blade Strike Analysis Model will be performed in 2021 following the completion of field sampling activities.

Information on the physical and operational characteristics the Project, including trash rack bar spacing, intake velocities and flows, and intake proximity to feeding and rearing habitats was used to make general assessments of impingement and entrainment potential at the Project using a desktop study approach. A species list was developed based on data from recent (Appalachian 2020) and historical (Appalachian 1991) fish community studies (i.e., composition, abundance, listed or protected status, recreational significance), as well as known occurrence records from the VDWR for the Roanoke River at the time of the historical fish community study.

With consideration of site-specific facility characteristics and fishery information, detailed entrainment data from 33 sites included in the EPRI (1997) entrainment database were applied in this analysis. Entrainment data were standardized to the number of fish/hour of unit capacity based on the site-specific hydraulic capacity of the sampled units and the number of hours sampling occurred during each study from the database, and then used to calculate fish entrainment rates (fish/hour) at maximum design turbine discharge at the Project (684 cfs).

Using intake opening structure dimensions of 40-ft wide and 15.4-ft high[2], the calculated approach velocity in front of the intake is approximately 1.1 fps (i.e., 40 ft x 15.4 ft / 684 cfs). This approach velocity is similar to those presented in the historical entrainment report (Appalachian 1991). Burst swim speeds for target or representative species were compared to the estimated intake velocity to evaluate whether fish may be susceptible to intake flows at the Project. Fish swim burst speeds obtained from literature indicate that all target species and life stages evaluated, with the exception of eggs, larvae, and juvenile Spottail Shiner, would be able to avoid entrainment at the Project given that estimated swim burst speeds are greater than approach velocities at the intake. Although most species were considered of entrainable size (i.e., smaller than the 3.625-inch clear-spacing width of the trash rack), it is likely fish can avoid the intake if of juvenile or adult size.

According to the EPRI (1997) database, fish measuring less than six inches in length were the majority (88 percent) of entrained fish, and fish less than eight inches exhibit the highest entrainment rates throughout the year. Catfishes, Rock Bass, suckers and redhorses, *Lepomis* sunfishes, and Black Crappie have the highest entrainment rates of the target species and groups. Peak months of entrainment for these species and species groups varied. Smallmouth and Largemouth bass, species often sought after by anglers, have some of the lowest entrainment rates of the target species and groups. Entrainment rates were highest from April to October, with peaks in April, July, and October. Peaking months may correspond to spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events. Susceptibility to entrainment is variable depending on species and time period, however most target species and species groups have low entrainment potential for most of the year.

While the greatest opportunity for fish mortality through a facility lies in potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005);

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[2] The top of the normal reservoir operating band is 884.4 ft NGVD. At this reservoir level, the depth in front of the intake structure is approximately 13.9 ft. The trash racks are angled at a 15 degree slope from top to bottom, therefore wetted height of the trash racks is approximately 15.4 ft.

however, the historical study (Appalachian 1991) determined that these factors are minimal at the Project. Since no significant changes have occurred at the facility that would change these parameters since the last relicensing, injuries and mortalities caused by factors other than turbine strikes are expected to be negligible.

In summary, the findings of this study concur with the historical entrainment study completed for the prior relicensing in that effects to the fish community in the Project vicinity are expected to be minimal. Most fish would not be excluded by the intake trash racks, however velocities in front of the intake are comparable to normal flow conditions of the Roanoke River and would therefore likely be navigable by most juvenile and adult fish in the area. Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project. Susceptibility to entrainment is variable depending on species and time period, however most target species and species groups have low entrainment potential for most of the year.

2.3.3 Variances from FERC-Approved Study Plan

The Fish Community Study was conducted in full accordance with the Commission's SPD. The Fish Impingement and Entrainment Study was conducted in full accordance with the methods described in the RSP with the following exceptions:

- Per the Project RSP and Commission's SPD, intake velocities were to be measured using an ADCP along the upstream face of the angled trash racks to determine the approximate approach velocity immediately upstream of the intake structure. During the 2020 field season, a combination of high flow events and inoperable turbine-generator units at the Project prevented field data collection efforts. As a result, approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the two generating units. Using this approach, the calculated velocity in front of the intake is approximately 1.1 fps, which is similar to the intake velocities presented in the historical entrainment report (Appalachian 1991). Further, a desktop evaluation using Roanoke River morphometrics and flow data from the nearest upstream gage (USGS 02055000 Roanoke River at Roanoke, Virginia) suggests that the velocity of the river in the vicinity of the Project is comparable to that estimated in front of the intake. Given this information, and since the design and the general operation of the facility have not changed since the prior license application, the calculated approach velocity is representative of actual conditions at the Niagara intake structure and is used to support evaluations of impingement and entrainment at Niagara.
- In accordance with the RSP, the Turbine Blade Strike Analysis will be completed using the USFWS's Turbine Blade Strike Analysis Model following completion of the Fish Community Study field sampling. The RSP listed this report as being included with the ISR at the end of the 2020 field season; however, this effort will be completed at the end of the 2021 field season, when the remaining fish sampling activities have been completed. The evaluation will be performed using the most recent version available of the Turbine Blade Strike Analysis Model, mean and standard deviation of fish lengths based on fish data collected during the 2020-2021 Fish Community Study, and site-specific inputs for required model parameters, as summarized in Attachment 2 of Appendix C.

2.4 Benthic Aquatic Resources Study

2.4.1 Study Status

Appalachian has partially completed the study activities for the Benthic Aquatic Resources Study in accordance with the RSP and the Commission's SPD. The technical report including available preliminary results of the Benthic Aquatic Resources Study is included in Appendix D.

Due to delays related to weather and the COVID-19 pandemic, the spring 2020 sampling effort was rescheduled for the spring 2021 index period (March 1 May 31) and will be completed at the same sites sampled during the fall index period (September 1 – November 30). The preliminary technical report includes study information based on fall 2020 sampling activities for the Benthic Aquatic Resources Study (Appendix D).

2.4.2 Summary of Study Methods and Results

In accordance with the RSP approved in the Commission's SPD, EDGE conducted an Aquatic Resources Study to:

- Quantify the amount of benthic habitat available for macroinvertebrates, crayfish, and mussels within the bypass reach;
- Collect a baseline of existing macroinvertebrate and crayfish communities in the vicinity of the Project using two temporally independent sampling efforts (fall 2020 index period and spring 2021 index period); and
- Identify potential habitat and characterize mussel communities within the Project area.

A Benthic Aquatic Resources Study was performed to document a comprehensive representation of the Project area and to correlate results with previous sampling efforts (Appalachian 1991) for comparison. Macroinvertebrate and crayfish sampling efforts employed a variety of methods to target representative habitat at 10 sites throughout the Project area. Mussel sampling targeted representative habitat at 13 sites throughout the Project area. Additional information and results are described below.

2.4.2.1 Macroinvertebrate and Crayfish Survey

Macroinvertebrate and crayfish surveys were performed using sampling methods derived from the National Rivers and Streams Assessment Field Operations Manual and Virginia Department of Environmental Quality (VDEQ) Biological Monitoring Program Quality Assurance Project Plan and included quantitative and qualitative sampling methods that target different habitats (USEPA 2019; VDEQ 2008). Quantitative sampling methods targeted riffle/run habitats and qualitative sampling methods targeted available microhabitats in pools habitats. Sampling was performed by an EDGE state and federally permitted astacologist under Virginia Scientific Collecting Permit No. 068630. All macroinvertebrate sites were sampled between September 15 and 16 and October 5, 2020, during the fall sample index period defined by VDEQ (September 1 – November 30) (VDEQ 2008).

2.4.2.1.1 Quantitative Sampling

Benthic macroinvertebrate and crayfish sampling were completed at five riffle/run sites along 100-meter transects. Macroinvertebrate sampling was conducted holding the D-frame net on the bottom of the stream perpendicular to flow and kicking substrate to agitate and dislodge organisms, thus allowing dislodged organisms to flow into the net. A single quantitative sample consisted of a composite of six kick sets, each disturbing approximately 0.33 meters^2 above the dip net for a duration of 30-90 seconds and totaled an area comprising 2.0 meters^2. For quality assurance measures, replicate sampling was conducted at one quantitative site within close proximity (not in the same locations as the first set of samples) of the initial sampling area.

To assess the crayfish community, additional kick samples and seining efforts were performed following benthic macroinvertebrate sampling to ensure all crayfish habitat had been covered. Additionally, crayfish collected during backpack electrofishing efforts (completed as part of fall 2020 field efforts) were processed and added to crayfish data for inclusion as a qualitative data point at analogous sites.

2.4.2.1.2 Qualitative Sampling

Benthic macroinvertebrate and crayfish were also sampled at five qualitative sites (i.e., multi-habitat) along 100-meter transects following guidelines defined by USEPA (2019) and VDEQ (2008). Sampling was conducted by performing 20 jabs with a D-frame net into suitable, stable habitats (snags, vegetation, banks, and substrate) 20 times. A single jab consists of forcefully thrusting the net into a microhabitat for a linear distance of 1.0 meter, followed by 2-3 sweeps of the same area to collect dislodged organisms for 20-90 seconds per jab, sweep, or kick. Different types of habitat were sampled in rough proportion to their frequency within the reach. Sampling effort was proportionally allocated (20 jabs/sweeps/kicks) to shore-zone and bottom-zone, 20-90 seconds per jab, sweep, or kick.

2.4.2.1.3 Results

The taxonomic results of macroinvertebrate collections are not yet available; however, on-site observations of macroinvertebrates indicate the potential for variability in abundance and community structure throughout the Project area. Five species of crayfish were collected and identified in the field during survey efforts at 8 of the 10 sites sampled: the Appalachian Brook Crayfish (*Cambarus bartoni bartoni*), Atlantic Slope Crayfish (*Cambarus longulus*), Ozark Crayfish (*Faxonius ozarkae*), Virile Crayfish (*Faxonius virilis*), and the Red Swamp Crayfish (*Procambarus clarkii*). The Appalachian Brook Crayfish and Atlantic Slope Crayfish are native to the Roanoke River while the Ozark Crayfish, Virile Crayfish, and Red Swamp Crayfish are considered invasive species in the state of Virginia. Representative site and crayfish photos are provided in the study report in Appendix D. Site-specific information is provided below.

2.4.2.2 Mussel Survey

Mussel surveys were performed October 6-8, 2020, following methods defined in the RSP, derived from the Draft Freshwater Mussel Guidelines for Virginia (USFWS and VDGIF 2018), and performed by EDGE’s state permitted malacologist and a commercial dive team under Virginia Scientific Collecting Permit No. 068630. Mussel surveys were carried out using habitat dependent methods (e.g., water depth, substrate, stream flow) and included snorkeling, viewscope, and/or Surface Supplied Air. Sampling dates were chosen within approved survey windows and occurred during relatively low flow and high visibility.

2.4.2.2.1 Transect Surveys

Sampling for freshwater mussels involved surveying along eight transects (from 30 to 75 meters in length) placed every 500 meters in the reservoir above Niagara Dam and the free-flowing reach near the upstream extent of the Project area. Divers searched transects using Surface Supplied Air methods at an approximate rate of one minute per square meter in heterogeneous substrates.

2.4.2.2.2 Abbreviated Surveys

Sampling for freshwater mussels involved surveying five abbreviated sites outside the impounded area. Abbreviated mussel surveys were completed throughout the assigned survey reach using viewscopes, snorkeling, and Surface Supplied Air methods. Surveyors targeted habitat(s) suitable for the occurrence of freshwater mussels and searched those areas at an approximate rate of one minute per square meter in heterogeneous substrates.

2.4.2.2.3 Results

Unionids were mostly absent throughout all 13 survey reaches. Eight transect surveys in the Niagara reservoir, totaling 430 meters^2 of search effort, resulted in the collection of zero live or deadshell specimens. Abbreviated surveys at five locations, with a cumulative search effort of 1,335 minutes, resulted in the collection of four live unionids representing one species, Eastern Elliptio (*Elliptio complanata*). The Eastern Elliptio is native to the Roanoke River system and a common species in Atlantic Slope mussel assemblages. Additionally, a single Notched Rainbow (*Villosa constricta*) was observed as weathered deadshell material during quantitative macroinvertebrate and crayfish surveys near the Tinker Creek site. No live mussels or deadshell were collected downstream of Niagara Dam. The invasive Asiatic Clam (*Corbicula fluminea*) was present in relatively even densities throughout the mainstem Roanoke River (above and below Niagara Dam) with the higher densities occurring where suitable mollusk habitat was present. The highest density of Asiatic Clams in the Project area was noted in Tinker Creek. They were also noted at the mouth of Wolf Creek but did not persist beyond the confluence with the Roanoke River. Representative site and mussel photos are provided in the study report in Appendix D.

2.4.3 Variances from FERC-Approved Study Plan

The Benthic Aquatic Resources Study was conducted in full accordance with the methods described in the RSP with the following exceptions:

- Restrictions on non-essential travel and safety considerations for field staff prohibited spring 2020 field efforts, therefore, spring macroinvertebrate and crayfish sampling will take place in 2021.

2.5 Wetlands, Riparian, and Littoral Habitat Characterization Study

2.5.1 Study Status

The Wetlands, Riparian, and Littoral Habitat Characterization Study has been postponed until 2021. The technical report including the results of the Wetlands, Riparian, and Littoral Habitat Characterization will be included in the USR.

2.6 Shoreline Stability Assessment Study

2.6.1 Study Status

The Shoreline Stability Assessment Study Report has been postponed until 2021. The technical report including the results of the Shoreline Stability Assessment Study will be included in the USR.

2.7 Recreation Study

2.7.1 Study Status

Appalachian has partially completed the Recreation Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Recreation Study is included in Appendix E.

The current study status is as follows:

- Recreation Facility Inventory and Condition Assessment – Completed in January 2020
- Existing and Future Recreational Opportunities - Postponed until Q1 2021.
- Recreation Visitor Use Online Survey- Preliminary data provided. Survey has been extended through October 2021.
- Recreational Use Documentation - Postponed until May 2021.
- Aesthetic Flow Documentation - Completed (except one more visit to capture bypass reach minimum flow conditions in 2021).
- Recreational Flow Release Desktop Evaluation – Completed in November 2020.

2.7.2 Summary of Study Methods and Results

2.7.2.1 Recreation Facility Inventory and Conditions Assessment

Appalachian's sub-consultant, Young Energy Services (YES), provided an analysis of the Recreation Facility Inventory and Condition Assessment of the four facilities (Attachment 1 of Appendix E). YES staff conducted the field inventory for Tinker Creek Canoe Launch (Non-Project facility) on October 18, 2019. The Project Canoe and Portage Trail (Project facility) was assessed on October 24, 2019. The Roanoke River Trail (Non-Project facility) and Rutrough Road Canoe and Kayak Ramp (Non-Project facility) assessment took place on October 28, 2019. Additionally, a qualitative assessment of the condition of the recreation facilities was performed using a Recreation Facility Inventory and Condition Assessment Form.

YES observed several common themes among the recreation facilities and concluded that, overall, the facilities are in good condition. Common themes included:

- Each facility is well maintained with no trash or vandalism observed during the assessment.
- In general, signage is adequate and in good shape at the facilities, except for the Project-related Canoe Portage Trail, where some improvements could be made.

- ADA designated parking spots are provided only at the Tinker Creek Canoe Launch.
- Toilet facilities are not provided at any of the facilities.

2.7.2.2 Recreation Visitor Use Online Survey

Appalachian's consultant, HDR, developed an online survey as described in the RSP. The online survey was administered through the Project's relicensing website and offered respondents the opportunity to provide survey responses electronically. The online survey results included in this Study Report include responses from April 2020 through October 2020. The online survey is presently proposed to continue through October 2021.

Appalachian posted signs including a brief description of the purpose and intent of the survey and website address on Appalachian-owned and/or operated facilities (Canoe Portage Trail and Tinker Creek Canoe Launch). Roanoke County posted a sign at the Rutrough Road Canoe/Kayak Ramp and at two kiosks within the Explore Project, a nearby park maintained by Roanoke County. Additionally, notice of the survey continues to be posted on the Project's relicensing website. HDR provided an update and website address to local outfitters and regional organizations so they would have the opportunity to distribute notice of the survey to their members or clients. Appalachian notified relicensing participants the online survey was available through the second quarterly ILP study progress report. These outreach methods allowed respondents to complete a survey on-site, or later upon returning home from their visit, or without visiting the Project if the link was identified through other (electronic) communications.

The Recreation Visitor Use Online Survey provided a method for existing and potential recreation visitors to the Study Area to respond and provide feedback on recreation opportunities [Project and Non-Project facilities] at the Project. From April 21, 2020 to October 31, 2020, Appalachian received 120 responses to the online survey. Eighty-six percent of the responses primarily pertained to three recreation facilities: Niagara Canoe Portage Trail (owned by Appalachian) Roanoke River Trail/Overlook (owned by NPS), and Rutrough Road Canoe/Kayak Ramp (owned by Roanoke County), indicating these sites were the most frequently utilized by online survey respondents. Canoe/kayaking and fishing were the most popular activities at the Project documented in the online survey. Visitors rated each recreational visit at the Project for its accessibility, parking, crowding, safety, condition, availability, and overall experience. The sliding scale rating system indicated that visitors generally found the individual metrics and overall experience "acceptable." The only metric that was not rated highest in the acceptable category was the Available Facilities metric, which was rated neutral.

Several comments included requests or recommendations for flow releases, which was analyzed as part of this study. There were also comments including requests for trash removal and the construction of a waterpark and play waves. The top two suggestions for improvement included better and more public access and improvements to portages.

Facility-specific summaries and verbatim user comments from the online survey are included in Appendix E, Attachment 2.

2.7.2.3 Aesthetic Flow Documentation

To characterize and capture the appearance of the dam and bypass reach under a range of flows,[3] YES collected photo and video documentation from three key observation points (KOPs): 1) the NPS Roanoke River Outlook adjacent to the Blue Ridge parking lot, 2) a bench midway down the stairs to the bypass, and 3) the bank fishing area located at the end of the trail steps at the Roanoke River. The selection of the KOPs was based on professional judgment of YES staff who are familiar with the Project and nearby recreation resources, as well as areas that could be practically and safely accessed for this data collection.

YES took photos and videos at these three KOPs on ten different occasions to gather comparable data for all four seasons under a range of flow conditions (including periods of spill over the spillway crest). As a result of the photograph and video documentation, YES found that in leaf-off months (approximately October to April), aesthetically pleasing views of the spillway, dam, and bypass reach are available from the Roanoke River Trail. In leaf-on months (approximately May to September) when recreation typically increases, the spillway is not easily viewed from KOP 2 due to vegetation. The bypass can be seen year-round from KOP 1 and 3. Overall, the optimal time for viewing the Project spillway and bypass reach appears to be late October and early November when leaves are changing colors and falling. The fall colors, along with the open views created by the leaf-fall, create optimal aesthetic conditions.

In high flow conditions, the spillway may be aesthetically appealing, but the high flows can cause turbidity in the bypass and cover the unique geological features, making the bypass less aesthetically pleasing. Generally, aesthetically pleasing views occur under low to mid flows ranging from the estimated 50 cfs passed through the trash sluice gate at the spillway during periods of no generation at the powerhouse to approximately 200 cfs over the Project spillway. The aesthetic view of 8 cfs (licensed minimum flow requirement when the powerhouse is generating) through the sluice gate was not recorded in 2020 but is not expected to provide a better or worse aesthetic view of the Project than the estimated 24 cfs shown above. YES plans to collect an additional aesthetic flow observation of the bypass reach from the three KOPs during a period of approximately 8 cfs bypass reach flow conditions in 2021 to confirm this assumption and address specific objectives of the Recreation Study.

From the observations made in the field by YES, flows of 50 to 200 cfs resulted in similar acoustics. Sound from flows through the bypass are more pronounced above 200 cfs, but do not necessarily contribute to a more pleasant experience to those observing flows from the Roanoke River Trail.

In general, existing Project operations provide an appropriate aesthetic experience. Appendix E, Attachment 3 provides a photolog of views from the KOPs over the course of the study period.

2.7.2.4 Recreation Flow Release Desktop Evaluation

The objective of the Recreational Flow Release Desktop Evaluation is to evaluate the potential for controlled flow releases from the Project to support short-term enhancement of downstream flow conditions for recreational boating (i.e., primarily canoeing, kayaking, and other paddling activities). To address stakeholders' interests while recognizing Project constraints related to enhancement of

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[3] Article 403 of the current license requires a minimum flow of 8.0 cfs into the bypass reach, which is provided via the trash sluice gate. The trash sluice gate hoist operator system was not operational in 2020; as a result, bypass reach flows during 2020 were higher than the license requirement. The gate has been repaired and a new gate and operating system installed, which is expected to be operational by early 2021.

downstream flow conditions, HDR conducted a desktop evaluation to assess the potential for Project operations to support short-term enhancement of flow conditions for downstream boating.

Due to the relatively narrow (i.e., 1-foot) authorized reservoir operating band, the Project normally operates in a run-of-river mode whereby Project inflows are released downstream either via the powerhouse or bypass reach. In an effort to provide short-term flow releases for recreational purposes, powerhouse generation could be reduced to either Unit 1 (maximum capacity of 379 cfs) or Unit 2 (maximum capacity of 305 cfs). For example, operating Unit 2 (only) at maximum capacity would result in a run-time of 2 hours and 12 minutes using the volume of water contained in the 1-ft operating band and an additional 1 hour and 21 minutes including the freeboard volume (for a total of 3 hours and 33 minutes).

On a monthly average basis, there appears to be enough Project inflow to support operation of at least one unit year-round. However, during drier/drought years, there are periods when Project inflows are too low to operate a unit. During these periods, Project flow releases would be made via the trash sluice gate into the bypass reach to maintain reservoir levels and provide the required minimum flow.

The potential for the short-term enhancement of downstream flow conditions to support recreation activities would be most advantageous to paddlers during the typically lower flow late-summer/early-fall months (i.e., July through October). The distance between the Project's portage put-in and the downstream Explore Park/Rutrough Point canoe/kayak access area is approximately three river miles. Paddlers using this stretch of river may benefit the most from a potential short-term recreation flow release, as a flow pulse between 1 hour and approximately 3.5 hours could be maintained depending on the number of units generating and the available reservoir storage volume. This run-time would likely allow paddlers enough time to navigate this stretch of river. Attempting to enhance flows below the Explore Park/Rutrough Point access area would not provide much benefit as the headwaters of Smith Mountain Lake extend up to this area and would significantly dampen the effect. Any short-term operational modification to provide flow enhancement downstream of the Project would be subject to sufficient inflow, availability of Project facilities, and availability of operating personnel. Appalachian also notes that operating the reservoir with more fluctuation than is typical (i.e., utilizing the full authorized operating band) to provide what would amount to a very minor "bump" in downstream flow may have unintended effects on reservoir littoral habitat.

2.7.3 Variances from FERC-Approved Study Plan

The preliminary Recreation Study has been and will continued to be conducted in accordance with the Commission's SPD. The schedule in Appalachian's July 27, 2020 updated ILP study schedule revised the Recreation Study tasks until late 2020 or 2021. The only task that was scheduled for 2020 (as of the July 27, 2020 schedule update) but not completed is the stakeholders meeting. Due to restrictions on gathering, Appalachian has tentatively rescheduled this meeting to quarter 1 of 2021. No other changes to the schedule or variances from the study plan are anticipated.

2.8 Cultural Resources Study

2.8.1 Study Status

Appalachian has partially completed the Cultural Resources Study in accordance with the RSP and the Commission's SPD. The technical report including the preliminary results of the Cultural Resources Study is included in Appendix F (Privileged).

In accordance with the RSP approved in the Commission's SPD, Appalachian began tasks associated with the Cultural Resources Survey in the late summer of 2020. Tasks initiated and/or completed to date include Consultation for the APE Determination (Task 1), Background Research and Archival Review of the Study Area (Task 2), and a Phase I Reconnaissance Survey of the Area of Potential Effects (APE) (Task 3). An Inventory of Traditional Cultural Properties (Task 4) and consulting with agencies to determine if a Historic Properties Management Plan is necessary for the Project (Task 5) will take place during the second study season in 2021.

The Preliminary Cultural Resources Survey Report and Attachment 1 thereto contain the locations of referenced sites and as such are being filed with FERC as Privileged.

2.8.2 Summary of Study Methods and Results

The goal of the Cultural Resources Study is to collect additional information regarding cultural resources within the Project APE to assist in identifying Project effects on archeological and historic properties and developing appropriate management measures.

Concurrent with the January 28, 2019, PAD and NOI, Appalachian requested designation as the Commission's non-federal representative for carrying out informal consultation pursuant to Section 106. The Commission granted Appalachian's request by notice dated March 26, 2019. Pursuant to 36 CFR §800.4(a)(1), in a letter dated September 1, 2020, Appalachian consulted with the Advisory Council on Historic Preservation, the U.S. National Park Service, Bureau of Indian Affairs, Virginia Department of Historic Resources/State Historic Preservation Office (VDHR/SHPO), the Cherokee Nation, the Catawba Indian Nation, the Delaware Nation, the Monacan Indian Nation, the Pamunkey Indian Tribe, the Eastern Band of Cherokee Indians, and the Archaeological Society of Virginia, and requested concurrence for determining the APE for the Project defined as all lands necessary for Project operations (Appendix F, Attachment 1). Responses from these stakeholders are included in Appendix F, Attachment 2.

In August 2020, Terracon Consultants, Inc. (Terracon) (Appalachian's sub-consultant) reviewed the Virginia Cultural Resource Information System to identify previously recorded cultural resources within a 0.5-mile radius of the Study Area. On September 10, 2020, Terracon staff traveled to the Virginia Department of Historic Resources (VDHR) office in Richmond, VA to gather additional information. The results of Terracon's research are presented in Appendix F (Privileged). Terracon recommended that none of the resources identified, either within the APE and those within a 0.5-mile radius, will be affected by continued operation of the Project.

On October 13 and 14, 2020 Terracon conducted an archaeological assessment of the Project APE, including areas along Tinker Creek (Appendix F, Attachment 1). Most areas were accessed by canoe except the areas immediately surrounding the dam, which were accessed by vehicle. Archaeological investigations found that areas within the APE along Tinker Creek and the Roanoke River west of Tinker Creek have a low potential for containing archaeological resources.

The Niagara powerhouse and dam (080-0095) were re-evaluated as historic resources. Much of the footprint of the original 1906 facility remains, including the length and general dimensions of the dam and the powerhouse. Within this footprint, however, many of the original components have been removed or modified. The most significant is the replacement of the original power canal (which failed in 1987) with the current steel penstocks in 1988. Within the powerhouse, the substructure was altered in 1954 to support the replacement of Unit 1 and the original Unit 2 was replaced in 1991. In January 1991, following a survey of the Project by Berger (1991), the SHPO determined that the Project was ineligible for the National Register of Historic Places (NRHP). Despite the importance of this facility to the history of Roanoke region, and considering the extensive alterations that have been made from the 1950s to the present, the current cultural resources survey reinforces the recommendation that the Niagara powerhouse and dam are ineligible for the NRHP.

Terracon recommended that areas along the Roanoke River east of Tinker Creek may have the potential to yield deeply buried archaeological remains, however, the results of a pending geomorphological assessment are needed to confirm this; the geomorphological assessment is scheduled for 2021.

Additionally, based on the initial background research and site investigations, Terracon concluded that no historic properties are currently being adversely affected by the Project. If new construction were to occur in the areas outlined in the Study Report, then additional archaeological investigations may be warranted and consultation with the SHPO would be necessary.

2.8.3 Variances from FERC-Approved Study Plan

The Cultural Resources Study has been and will continue to be conducted in conformance with the Commission’s SPD. The schedule in Appalachian’s July 27, 2020 updated ILP study schedule revised the Cultural Resources Study until 2021. Appalachian was able to adjust the schedule and begin the first three tasks outlined in the Cultural Resources Revised Study Plan during the first field season and expects to complete the rest of the study during the 2021 field study season.

3 Upcoming ILP Milestones and Study Reporting

Table 3-1 presents upcoming ILP milestones.

Table 3-1. Upcoming Major ILP Milestones

Date	Milestone
January 21, 2020	Appalachian Hosts ISR Meeting (18 CFR §5.15(c)(2))
February 5, 2021	Appalachian File ISR Meeting Summary (18 CFR §5.15(c)(3))
March 7, 2021	Stakeholders File Disagreements with ISR Meeting Summary (18 CFR §5.15(c)(3)) (if necessary)
April 6, 2021	Appalachian File Response to ISR Meeting Summary Disagreements (18 CFR §5.15(c)(5)) (if necessary)
May 6, 2021	FERC Provide Determination on Disputes (18 CFR §5.15(c)(6)) (if necessary)
Spring – Fall 2021	Appalachian Conduct Second Year of Studies
October 1, 2021	Appalachian File Draft License Application (DLA) (18 CFR §5.16(a))
December 5, 2021	Appalachian File USR (18 CFR §5.15(f))
December 20, 2021	Appalachian Host USR Meeting (18 CFR §5.15(f))
December 30, 2021	Stakeholders File Comments on DLA (18 CFR §5.16(e))
January 4, 2022	Appalachian File USR Meeting Summary (18 CFR §5.15(f))
February 3, 2022	Stakeholders File Disagreements with USR Meeting Summary (18 CFR §5.15(f)(4)) (if necessary)
February 28, 2022	Appalachian File Final License Application (18 CFR §5.17)
March 5, 2022	Appalachian File Response to USR Meeting Summary Disagreements (18 CFR §5.15(f)(5)) (if necessary)

4 Notice of Intent to File Draft License Application

As required by 18 CFR § 5.16(c), Appalachian hereby advises the Commission of its intent to file a Draft License Application, which will include the contents of a license application, rather than a Preliminary Licensing Proposal. The draft license application will be filed no later than October 1, 2021.

5 References

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Attachment 1

Attachment 1 – FERC Correspondence

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FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, DC 20426
December 6, 2019

OFFICE OF ENERGY PROJECTS

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

VIA FERC Service

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

Reference: Study Plan Determination for the Niagara Hydroelectric Project

Dear Mr. Magalski:

Pursuant to 18 C.F.R. § 5.13(c) of the Commission's regulations, this letter contains the study plan determination for the Niagara Hydroelectric Project (Niagara Project) located on the Roanoke River in Roanoke County, Virginia. The determination is based on the study criteria set forth in section 5.9(b) of the Commission's regulations, applicable law, Commission policy and practice, and the record of information.

Background

On July 9, 2019, Appalachian Power Company (Appalachian) filed its Proposed Study Plan (PSP) for eight studies covering water quality, aquatic habitat and fishery resources, terrestrial resources, recreation resources, and cultural resources in support of its intent to relicense the project.

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

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

Study Plan Determination

Appalachian's RSP is approved with the staff-recommended modifications discussed in Appendix B. As indicated in Appendix A, of the eight studies proposed by Appalachian, four are approved with staff-recommended modifications and four are approved as filed by Appalachian. This determination also addresses three additional studies requested by stakeholders, not adopted by Appalachian, and not required by this determination (see Appendix A). In Appendix B, we explain the specific modifications to the study plan and the bases for modifying, adopting, or not adopting requested studies. Although Commission staff considered all study plan criteria in section 5.9 of the Commission's regulations, staff only reference the specific study criteria that are particularly relevant to the determination.

Studies for which no issues were raised in comments on the RSP are not discussed in this determination. Unless otherwise indicated, all components of the approved studies not modified in this determination must be completed as described in Appalachian's RSP. Pursuant to section 5.15(c)(1) of the Commission's regulations, the initial study report for all studies in the approved study plan must be filed by December 5, 2020.

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

If you have any questions, please contact Allyson Conner at allyson.conner@ferc.gov or (202) 502-6082.

Sincerely,

Terry L. Turpin
Director
Office of Energy Projects

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

APPENDIX A

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

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

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

APPENDIX B

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

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

I. Required Studies

Flow and Bypass Reach Aquatic Habitat Study

Applicant's Proposed Study

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

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

Flow Release

Comments on the Study

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

Discussion and Staff Recommendation

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

Velocity and Water Quality Measurements

Comments on the Study

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

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

Discussion and Staff Recommendation

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

Species of Interest

Comments on the Study

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

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

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

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

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

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

Discussion and Staff Recommendation

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

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

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

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

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

Water Quality Study

Applicant's Proposed Study

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

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

Length of Study

Comments on the Study

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

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

Discussion and Staff Recommendation

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

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

Deployment Depths of Data Sondes in the Forebay

Comments on the Study

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

Discussion and Staff Recommendation

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

Continuous Water Quality Monitoring Site Locations

Comments on the Study

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

Discussion and Staff Recommendation

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

Fish Community Study

Applicant's Proposed Study

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

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

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

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

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

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

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

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

Roanoke Logperch Adult and YOY sampling

Comments on the Study

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

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

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

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

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

Discussion and Staff Recommendation

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

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

Roanoke Logperch Larvae Sampling

Comments on the Study

As noted above, Appalachian expresses some concern that Roanoke logperch larvae can be confidently identified to the species level due to potential confusion with a similar species, the chainback darter. However, in comments on the RSP, Dr. Angermeier notes that the Roanoke logperch is more abundant than the chainback darter in the Roanoke River, and chainback darter larvae are present in the river earlier in the spring, so the number of misclassifications is likely to be less than what was found by Buckwalter et al. (In review).

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

Discussion and Staff Recommendation

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

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

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

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

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

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

Benthic Aquatic Resources Study

Applicant's Proposed Study

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

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

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

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

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

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

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

Mussel Survey Methodology

Comments on the Study

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

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

Discussion and Staff Recommendation

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

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

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

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

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

II. Studies Requested but Not Adopted by Appalachian

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

Study Request

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

Discussion and Staff Recommendation

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

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

Fish Protection and Upstream and Downstream Passage Studies

Study Request

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

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

Discussion and Staff Recommendation

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

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

Study Request

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

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

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

Discussion and Staff Recommendation

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

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

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

July 27, 2020

VIA ELECTRONIC FILING

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

Subject: **Niagara Hydroelectric Project (FERC No. 2466-034)**
First Quarterly Study Progress Report, Updated ILP Study Schedule, and Request for Extension of Time to File Initial Study Report

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Applicant), a unit of American Electric Power (AEP) is the Licensee, owner, and operator of the run-of-river 2.4 megawatt (MW) Niagara Hydroelectric Project (Project No. 2466) (Project or Niagara Project), located on the Roanoke River in Roanoke County, Virginia. The Project is currently undergoing relicensing following the Federal Energy Regulatory Commission's (FERC's or Commission's) Integrated Licensing Process (ILP).

The purposes of this filing are to (1) inform FERC and Project stakeholders of revised timeframes for conducting certain field activities to be performed pursuant to the approved ILP Study Plan for the Project and (2) request Commission approval of a modification to the approved ILP Process Plan and Schedule that would extend the filing deadline for the Initial Study Report (ISR) for the Project from December 5, 2020 to January 11, 2021. As further explained below, these modifications are required in light of ongoing and presently anticipated resource and schedule challenges associated with the ongoing Novel Coronavirus Disease (COVID-19) pandemic and are not expected to impact Appalachian's ability to timely file an application for a new license by the statutory deadline (February 29, 2024).

This filing also serves as Appalachian's First Quarterly Study Progress Report for the Project. This progress report describes the activities performed since this Study Plan Determination (SPD), as well as ILP activities generally expected to be conducted in quarter 3 (Q3) of 2020.

Background

In accordance with 18 CFR §5.11 of the Commission's regulations, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD). The RSP, as subsequently approved by the FERC, establishes Appalachian's proposed schedule to complete desktop and field activities and develop reports for the following studies. A proposed study schedule is included in the RSP for each of the studies listed below:

1. Flow and Bypass Reach Aquatic Habitat Study;
2. Water Quality Study;
3. Fish Community Study;
4. Benthic Aquatic Resources Study
5. Wetlands, Riparian, and Littoral Habitat Characterization Study;
6. Shoreline Stability Assessment Study;
7. Recreation Study; and
8. Cultural Resources Study.

Updated Study Schedule and Study Progress

Appalachian's intent, at the time of filing the RSP, was to complete ILP study activities in the first ILP study season (2020) to the greatest extent possible. The study schedules were based on an expectation of commencing field work by early April and developing draft study reports and the ISR by early December 2020.

Appalachian commenced the Recreation Study in November 2019 and began capturing aesthetic flow documentation at that time. The Recreation Facility Inventory and Condition Assessment was completed in the fall of 2019. Additionally, Appalachian initiated the recreation visitor use online survey on April 27, 2020 and distributed notification of the availability of the online survey to interested agencies. Signs prompting visitors to complete the survey were installed at associated recreation facilities (Tinker Creek Canoe Launch, the Niagara Portage Put-In, and the Rutrough Road Canoe/Kayak Ramp) in June. Appalachian notes the National Park Service did not grant permission for installation of a similar sign at the Roanoke River Trail on National Park Service property.

Due to prevailing restrictions on non-essential travel and safety considerations for staff who would be traveling for and performing fieldwork, Appalachian and Appalachian's consultants have not been able to commence fieldwork for the other studies (i.e., studies requiring intensive periods of fieldwork in the spring) as originally proposed in the RSP. Appalachian and Appalachian's consultants continue to monitor evolving conditions and presently anticipate commencing field study activities concurrent with this filing. As a result, conduct of several season-sensitive spring field studies will have to be deferred until the second (2021) study season, and the study period for the water quality study will be shortened (though notably is still expected to include the majority of the targeted low inflow and high temperature season). Other studies that would potentially have commenced in the spring or early summer are expected to be shifted in the mid- to late summer or fall seasons. On a resource allocation basis, Appalachian does not expect to be able to complete all of the required ILP study activities within the remaining study season. As such, Appalachian proposes to also shift the timing conducting studies that are more baseline condition-characterization in nature to 2021.

A detailed schedule is attached (Attachment 1), which shows the schedule proposed in the RSP alongside the revised proposed schedule.

Appalachian shared an earlier version of this table with the primary resource agencies (U.S. Fish and Wildlife Service, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, and the Virginia Department of Environmental Quality) and conducted a conference call on June 29, 2020 to review the revised study schedule and solicit agency feedback and comments. Participants in this meeting concurred with Appalachian's proposed schedule revisions, and minor revisions to the schedule were made based on comments received during this meeting, as documented in the meeting summary included in Attachment 2.

Request for Extension of Time to File the ISR

Because the study delays forced by COVID-19 conditions are expected to lead to significant field study activities continuing through the fall of 2020, it will not be feasible to develop draft study reports and a comprehensive ISR by the December 5, 2020 deadline if significant field study activities continue through the fall of 2020. Appalachian believes that a comprehensive ISR, inclusive of draft study reports where possible, will be to the benefit of the ILP process for this Project, as well as to Project stakeholders. As such, Appalachian is requesting that the deadline to file the ISR be extended to January 11, 2020. Appalachian does not propose and is not requesting any subsequent adjustment of the USR deadline (December 5, 2021).

Appalachian notified the agencies listed above of Appalachian's intention to file a request for extension of time to file the ISR (and the subsequent shift of the ISR meeting and comment deadline into early 2021) during the June 29, 2020 conference call. As indicated in the attached meeting summary, participants in this meeting did not express any opposition to or concerns with this request.

Appalachian notes the extraordinary circumstances that have shifted the ILP study schedule for the Project and believes this request is consistent with recent guidance from the Commission and Commission staff regarding potential impacts of COVID-19 on non-statutory deadlines and required notifications to and approvals by FERC. Appalachian thanks the Commission staff for their consideration of this request and hopes that this filing finds Commission staff and Project stakeholders in good health.

If there are any questions regarding the RSP, please do not hesitate to contact me at (614) 716-2240 or by email jmmagalski@aep.com.

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation

Attachments (2)

cc: Distribution List

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Federal Agencies

Mr. John Eddins
Archaeologist/Program Analyst
Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, DC 20001-2637
jeddins@achp.gov

Blue Ridge National Heritage Area
195 Hemphill Knob Road
Asheville, NC 28803

Park Headquarters
Blue Ridge Parkway
199 Hemphill Knob Road
Asheville, NC 28803-8686

Ms. Kimberly Bose
Secretary
Federal Energy Regulatory Commission
888 1st St NE
Washington, DC 20426

FEMA Region 3
615 Chestnut Street
One Independence Mall, Sixth Floor
Philadelphia, PA 19106-4404

George Washington and Jefferson National Forest
5162 Valleypointe Parkway
Roanoke, VA 24019

Mr. John Bullard
Regional Administrator
NOAA Fisheries Service
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive
Gloucester, MA 01930-2276

Mr. John A. Bricker
State Conservationist
US Department of Agriculture
Natural Resources Conservation Service
1606 Santa Rosa Road, Suite 209
Richmond, VA 23229-5014

Mr. Harold Peterson
Bureau of Indian Affairs
US Department of the Interior
545 Marriott Dr, Suite 700
Nashville, TN 37214
Harold.Peterson@bia.gov

Office of the Solicitor
US Department of the Interior
1849 C Street, NW
Washington, DC 20240

Ms. Lindy Nelson
Regional Environmental Officer, Office of Environmental Policy & Compliance
US Department of the Interior, Philadelphia Region
Custom House, Room 244
200 Chestnut Street
Philadelphia, PA 19106

Ms. Barbara Rudnick
NEPA Team Leader - Region 3
US Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. Martin Miller
Chief, Endangered Species - Northeast Region (Region 5)
US Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035

Ms. Cindy Schulz
Field Supervisor, Virginia Field Office
US Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Mr. John McCloskey
US Fish and Wildlife Service
John_mcCloskey@fws.gov

Mr. Richard C. McCorkle
Fish and Wildlife Biologist, Pennsylvania Field Office
US Fish and Wildlife Service
110 Radnor Road, Suite 101
State College, PA 16801
richard_mccorkle@fws.gov

Ms. Elizabeth Merz
US Forest Service
3714 Highway 16
Marion, VA 24354

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. Mark Bennett
Center Director of VA and WV Water Science Center
US Geological Survey
John W. Powell Building
12201 Sunrise Valley Drive
Reston, VA 20192
mrbennet@usgs.gov

Hon. Ben Cline
US Congressman, 6th District
US House of Representatives
10 Franklin Road SE, Suite 510
Roanoke, VA 24011

Mr. Michael Reynolds
Acting Director, Headquarters
US National Park Service
1849 C Street, NW
Washington, DC 20240

Ms. Catherine Turton
Architectural Historian, Northeast Region
US National Park Service
US Custom House, 3rd Floor
200 Chestnut Street
Philadelphia, PA 19106

Hon. Tim Kaine
US Senate
231 Russell Senate Office Building
Washington, DC 20510

Hon. Mark Warner
US Senate
703 Hart Senate Office Building
Washington, DC 20510

Mr. Matthew Lee
US Environmental Protection Agency
lee.matthew@epa.gov

State Agencies

Dr. Elizabeth Moore
President
Archaeological Society of Virginia
PO Box 70395
Richmond, VA 23255

Blue Ridge Soil and Water Conservation District
1297 State Street
Rocky Mount, VA 24151

Mr. Jess Jones
Freshwater Mollusk Conservation Center
Virginia Tech
1B Plantation Road
Blacksburg, VA 24061

Mr. Ralph Northam
Governor
Office of the Governor
PO Box 1475
Richmond, VA 23218

Mr. Paul Angermeier
Assistant Unit Leader
Virginia Cooperative Fish and Wildlife Research Unit
Department of Fisheries and Wildlife Conservation - Virginia Tech
106 Cheatham Hall
Blacksburg, VA 24061
biota@vt.edu

Mr. Benjamin Hermerding
Secretary of the Commonwealth
Virginia Council on Indians
PO Box 2454
Richmond, VA 23218
benjamin.hermerding@governor.virginia.gov

Ms. Robbie Rhur
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
Robbie.Rhur@dcr.virginia.gov

Ms. Rene Hypes
Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
rene.hypes@dcr.virginia.gov

Mr. Clyde Cristman
Division Director
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Ms. Lynn Crump
FERC
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
lynn.crump@dcr.virginia.gov

Mr. Tyler Meader
Locality Liasion - Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
nhreview@dcr.virginia.gov

Mr. Matthew Link
Water Withdrawal Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
matthew.link@deq.virginia.gov

Mr. Andrew Hammond
Water Withdrawal Permitting & Compliance Manager
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23218
andrew.hammond@deq.virginia.gov

Mr. Tony Cario
Water Withdrawal Permit Writer, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
anthony.cario@deq.virginia.gov

Mr. Scott Kudlas
Director, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
scott.kudlas@deq.virginia.gov

Mr. Brian McGurk
Water Withdrawl Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
Brian.McGurk@deq.virginia.gov

Blue Ridge Regional Office
Virginia Department of Environmental Quality
3019 Peters Creek Road
Roanoke, VA 24019

Mr. Chris Sullivan
Senior Area Forester
Virginia Department of Forestry
900 Natural Resources Drive
Charlottesville, VA 22903

Mr. Scott Smith
Region 2 Fisheries Manager
Virginia Department of Game and Inland Fisheries
1132 Thomas Jefferson Road
Forest, VA 24551
scott.smith@dgif.virginia.gov

Ms. Julie Langan
Director and State Historic Preservation Officer
Virginia Department of Historic Resources
2801 Kensington Avenue
Richmond, VA 23221

Mr. Tim Pace
Chairman
Virginia Roanoke River Basin Advisory Committee
PO Box 1105
Richmond, VA 23218

Local Governments

Ms. Anita McMillan
Town of Vinton
amcmillan@vintonVA.gov

Mr. Christopher Whitlow
Interim County Administrator
Franklin County Administration
1255 Franklin Street
Rocky Mount, VA 24151

Mr. Sherman P. Lea, Sr.
Mayor
City of Roanoke
Noel C. Taylor Municipal Building
215 Church Avenue
Roanoke, VA 24011

Niagara Hydroelectric Project (FERC No. 2466) Distribution List

Mr. Richard Caywood
Assistant County Administrator
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
rcaywood@roanokecountyva.gov

Mr. David Weir
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
dweir@roanokecountva.gov

Mr. David Henderson
Engineering
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
dhenderson@roanokecountyva.gov

Mr. Phil North
Hollins Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Mr. David Radford
Windsor Hills Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Ms. Paula Shoffner
Executive Director
Tri-County Lakes Administrative Commission
400 Scruggs Road #200
Moneta, VA 24121
paulas@sml.us.com

Mr. Doug Blount
Director
Roanoke County Parks, Recreation and Tourism
1206 Kessler Mill Road
Salem, VA 24153
dblount@roanokecountyva.gov

Ms. Lindsay Webb
Parks Planning and Development Manager
County of Roanoke
1206 Kessler Mill Road
Salem, VA 24153
LWEBB@roanokecountyva.gov

Mr. Joey Hiner
Town of Vinton
311 S. Pollard St.
Vinton, VA 24179
jhiner@vintonVA.gov

Mr. Bo Herndon
Town of Vinton
312 S. Pollard St.
Vinton, VA 24180
wherndon@vintonVA.gov

Mr. Kenny Sledd
Town of Vinton
313 S. Pollard St.
Vinton, VA 24181
ksledd@vintonVA.gov

Western Virginia Water Authority
601 South Jefferson Street
Roanoke, VA 24011

Tribes

Chief Bill Harris
Catawba Indian Nation
996 Avenue of the Nations
Rock Hill, SC 29730

Deborah Dotson
President
Delaware Nation
P.O. Box 825
Anadarko, OK 73005

Chief Dean Branham
Monacan Indian Nation
PO Box 1136
Madison Heights, VA 24572

Chief Robert Gray
Pamunkey Indian Tribe
1059 Pocahontas Trail
King William, VA 23086

Non-Governmental

American Canoe Association
503 Sophia Street, Suite 100
Fredericksburg, VA 22401

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. Kevin Richard Colburn
National Stewardship Director
American Whitewater
PO Box 1540
Cullowhee, NC 28779
kevin@americanwhitewater.org

Headquarters
Appalachian Trail Conservancy
416 Campbell Ave SW #101
Roanoke, VA 24016-3627

Blue Ridge Land Conservancy
722 1st Street SW, Suite L
Roanoke, VA 24016

Blue Ridge Parkway Foundation
717 South Marshall Street, Suite 105 B
Winston-Salem, NC 27101

Ms. Audrey Pearson
Executive Director
Friends of the Blue Ridge Parkway
PO Box 20986
Roanoke, VA 24018
audrey_pearson@friendsbrp.org

Friends of the Rivers of Virginia
257 Dancing Tree Lane
Hollins, VA 24019

Mr. Bill Tanger
Chairman
Friends of the Roanoke
PO Box 1750
Roanoke, VA 24008
bill.tanger@verizon.net

Ms. Juanita Callis
Director
Friends of the Roanoke
PO Box 1750
Roanoke, VA 24008-1750

Mr. Mike Pucci
President
Roanoke River Basin Association
150 Slayton Avenue
Danville, VA 24540
Roanoke River Blueway
313 Luck Avenue SW
Roanoke, VA 24016
roanokeriverblueway@gmail.com

Ms. Amanda McGee
Regional Planner II
Roanoke Valley - Alleghany Regional
Commission
P.O. Box 2569
Roanoke, VA 24010
amcgee@rvarc.org

Ms. Liz Belcher
Greenway Coordinator
Roanoke Valley Greenway
1206 Kessler Mill Road
Salem, VA 24153
liz.belcher@greenways.org

Mr. Steve Moyer
Trout Unlimited
1777 N. Kent Street, Suite 100
Arlington, VA 22209

Upper Roanoke River Roundtable
PO Box 8221
Roanoke, VA 24014

Lorie Smith
Smith Mountain Lake Association
400 Scruggs Road #2100
Moneta, VA 24121
TheOffice@SMLAssociation.org

ATTACHMENT 1

ILP STUDY SCHEDULE UPDATE

Table 1. Proposed Changes to the 2020-2021 Study Plan Schedule for the Niagara Project (FERC No. 2466)

Proposed Changes to the 2020-2021 Study Plan Schedule for the Niagara Project (FERC No. 2466)			
Study	**Activities**	**Approved Timeframe for Completion (RSP and SPD)**	**Proposed Timeframe for Completion (July 2020 update)**
Flow and Bypass Reach Aquatic Habitat Study	Topographic Mapping and Photogrammetry Data Collection	Fall 2019	Completed (January 2020)
	Desktop Habitat Assessment	Spring 2020	July – September 2020
	Mesohabitat Mapping and Substrate Characterization Field Data Collection	Summer 2020	September – October 2020*
	Distribute Proposed Flow Test Scenario Framework to Interested Parties for Review	June/July 2020	August 2020
	Conduct Flow and Water Level Assessment and Hydraulic Model Development	June - October 2020	September – December 2020*
	Distribute Draft Study Report with the ISR	December 2020	January 2021
Water Quality Study	Study Planning and Existing Data Review	February – April 2020	July – August 2020
	Continuous and Monthly Water Quality Monitoring (Dissolved Oxygen and Temperature)	May – October 2020	July – October 2020
	Distribute Draft Study Report with the ISR	December 2020	January 2021
Fish Community Study	Study Planning and Existing Data Review	September 2019 – April 2020	July 2020
	Fish Community Study	August – October 2020	Late September - Early November 2020
	Roanoke Logperch Adult Surveys (*spring sampling conditioned on receipt of waiver from USFWS for sampling within time-of-year restriction period*)	May – June 2020, August – October 2020	August – October 2020, May – June 2021
	Roanoke Logperch Young-of-Year Surveys	August – October 2020	August – October 2020
	Roanoke Logperch Larval Surveys	April – June 2020	April – June 2021
	Desktop Impingement and Entrainment Evaluation	December 2019 – November 2020	July – December 2020
	Distribute Draft Study Report with the ISR	December 2020	January 2021

* Schedule for completion of fieldwork requiring minimum flow conditions in bypass reach is conditioned on replacement of the sluice gate as presently scheduled and planned by AEP for September 2020 (prior FERC approval required). Scheduled fieldwork that cannot be completed in the fall of 2020 due to this or any other conditions would be rescheduled for 2021 (as soon as possible in the 2021 field season, given required inflow and operating conditions).

Proposed Changes to the 2020-2021 Study Plan Schedule for the Niagara Project (FERC No. 2466)

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	Proposed Timeframe for Completion (July 2020 update)
Benthic Aquatic Resources Study	Study Planning and Existing Data Review	November 2019 – February 2020	August – September 2020
	Benthic Habitat Assessment	March – October 2020	September – October 2020
	Macroinvertebrate and Crayfish Community Study	March – October 2020	September – October 2020, April – May 2021
	Mussel Habitat and Community Survey	April – October 2020	August – October 2020
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021/December 2021
Wetlands, Riparian, and Littoral Habitat Characterization	Desktop Mapping of Wetland, Riparian, and Littoral Habitats	September 2019 – March 2020	September 2020 – March 2021
	Field Verification of Preliminary Maps and Identified Wetlands, Riparian, and Littoral Habitat Characterizations	April – July 2020	April – July 2021
	Distribute Draft Study Report with the USR	December 2020	December 2021
Shoreline Stability Assessment Study	Study Planning and Data Review	September 2019 – March 2020	September 2020 – March 2021
	Shoreline Survey and Determination of Areas Potentially Needing Remediation	April – July 2020	April – July 2021
	Distribute Draft Study Report with the USR	December 2020	December 2021

Proposed Changes to the 2020-2021 Study Plan Schedule for the Niagara Project (FERC No. 2466)

Study	Activities	Approved Timeframe for Completion (RSP and SPD)	Proposed Timeframe for Completion (July 2020 update)
Recreation Study	Study Planning and Existing Data Review	November 2019 – March 2020	Completed
	Recreation Facility Inventory and Condition Assessment	November 2019	Completed
	Convene Meeting with Stakeholders	July – August 2020	September – November 2020
	Recreation Visitor Use Online Survey	May – October 2020	May 2020 – October 2021
	Recreational Use Documentation (2x/month)	May – October 2020	May – October 2021
	Aesthetic Flow Documentation (Quarterly)	November 2019 – November 2020	November 2019 – November 2020
	Recreational Flow Release Desktop Evaluation	August 2020 – October 2020	August 2020 – October 2020
	Distribute Draft Study Report with the ISR/USR	December 2020	January 2021/December 2021
Cultural Resources Study	Determination of Area of Potential Effect (APE)	January – June 2020	July – September 2020
	Background Research and Archival Review	January – June 2020	August 2020 – November 2020
	Phase I Reconnaissance Survey of APE	May – October 2020	April – July 2021
	Inventory of Traditional Cultural Properties	October 2019 – October 2020	September 2020 – October 2021
	Distribute Draft Study Report with the ISR/USR	December 2020	December 2021
	Historic Properties Management Plan (if necessary)	With the DLA or Preliminary Licensing Proposal	

ATTACHMENT 2

JUNE 29, 2020 MEETING SUMMARY

From: Elizabeth B Parcell <ebparcell@aep.com>
Sent: Friday, July 17, 2020 3:54 PM
To: Yayac, Maggie; Kulpa, Sarah; Jonathan M Magalski
Subject: FW: Niagara Project Relicensing Study Schedule Update Meeting Notes
Attachments: [EXTERNAL] Re: Niagara Project Relicensing Study Schedule Update Meeting Notes

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From: Elizabeth B Parcell
Sent: Friday, July 17, 2020 3:37 PM
To: 'McCorkle, Richard' <richard_mccorkle@fws.gov>; 'McCloskey, John' <john_mccloskey@fws.gov>; Brian McGurk (Brian.McGurk@deq.virginia.gov) <Brian.McGurk@deq.virginia.gov>; 'scott.smith@dgif.virginia.gov' <scott.smith@dgif.virginia.gov>
Cc: Yayac, Maggie <Maggie.Yayac@hdrinc.com>; 'Kulpa, Sarah' <Sarah.Kulpa@hdrinc.com>; Jonathan M Magalski (jmmagalski@aep.com) <jmmagalski@aep.com>
Subject: Niagara Project Relicensing Study Schedule Update Meeting Notes

Good afternoon,

Attached please find a draft summary of our discussion from a couple weeks ago regarding the updated ILP study schedules and request to FERC for extension of the deadline to file the ISR. We plan to include a copy of this summary in the upcoming FERC filing. Please provide any comments or questions on the attached summary as soon as you can get to it, or no later than the end of next week.

Thanks and happy Friday! Have a great weekend.

Liz

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY
ELIZABETH B PARCELL | **PROCESS SUPV**
EBPARCELL@AEP.COM | D:540.985.2441 | C:540.529.4191
40 FRANKLIN ROAD SW, ROANOKE, VA 24011

Meeting Summary

Project:	Niagara Hydroelectric Project (FERC No. 2466)
Subject:	ILP Study Schedule Update
Date:	Monday, June 29, 2020
Location:	WebEx (10:00am-11:00am)
Attendees:	Scott Smith (VDGIF) Rick McCorkle (USFWS) John McCloskey (USFWS) Brian McGurk (VDEQ) Jon Magalski (AEP) Liz Parcell (AEP) Sarah Kulpa (HDR) Maggie Yayac (HDR)

Introduction

Liz (AEP) thanked everyone for being available to discuss the Niagara Project and explained that the purpose of the meeting would be to discuss the changes to the ILP study schedule due to COVID-19 travel restrictions and related concerns. Liz noted that a revised schedule was provided in the meeting invite.

Study Schedule Update

- Sarah (HDR) explained that AEP is currently planning on initiating field studies in July and expects to continue field work through the fall, potentially into November if needed. Time-sensitive spring studies that were not able to be completed due to travel restrictions have been re-scheduled for the spring of 2021. AEP is aiming to collect field data this year in support of the bypass reach, aquatic resources, and water quality studies, where doing so is compatible with the remaining study season, and studies that are more baseline characterization in nature are being postponed to 2021. This will allow AEP and their consultants to appropriate allocate resources to priority studies.
- AEP plans on filing the revised schedule with FERC and will also be requesting an extension of time to file the Initial Study Report (from December 6, 2020 to January 11, 2021) and to conduct the Initial Study Report meeting. Sarah noted that this schedule change will not affect the schedule for filing of the Updated Study Report in 2021 or the overall licensing schedule. The extension is being requested to provide more time for AEP and their consultants to develop preliminary or draft study reports for filing with the ISR, following the completion of field activities this fall.
- AEP hopes to file the study schedule update and request for extension of time to file the ISR as soon as possible and is seeking agency feedback on the revised schedule and the request during this call.

- Sarah provided a high level overview of the revised schedule for ILP study activities, as described in the table distributed with the meeting invite and that will be filed with FERC.

Flow and Bypass Reach Aquatic Habitat Study

- LiDAR data and orthoimagery have been captured at the Niagara Project and HDR will be using this information to begin building the hydraulic model to support the Flow and Bypass Reach Aquatic Habitat Study (i.e. identify level logger placement, flow test scenarios, etc.). Additionally, the flow test scenario will be developed and sent to agencies for review and comment in August. Flow tests are scheduled to take place in October as long as the sluice gate replacement construction is complete by that time.

Sluice Gate Replacement/ Draft Non-Capacity Amendment

- The existing sluice gate operating system (hoist) is presently not operational, so the gate is being maintained in an open position to pass a minimum flow of 50 cfs at all times. Minimum flow (i.e., 8 cfs) conditions and the ability to control the release through the sluice gate are required to complete fieldwork for the Flow and Bypass Reach Aquatic Habitat Study. This will be achieved through replacement of the existing bottom-hinged leaf-type gate with a pneumatic Obermeyer gate in the existing sluice structure. This maintenance activity is the subject of the draft non-capacity amendment application that AEP distributed to agencies for review in May.
- Construction cannot begin on the replacement sluice gate until FERC has approved the non-capacity amendment. If the sluice gate replacement is not completed as scheduled this fall, fieldwork for the Flow and Bypass Reach Aquatic Habitat Study will be postponed until 2021 (as soon as feasible given Project inflow conditions).
- Sarah noted that to date AEP had received VDEQ and VDGIF’s comments on the draft application. USFWS and VDEQ briefly discussed previous intent to perform internal modeling with respect to potential flow releases for the relicensing study, however VDEQ noted that was no longer planned. Liz forwarded to USFWS (Rick and John) a copy of VDEQ’s comments on the draft application for reference.
- Rick asked about the capacity of the new Obermeyer gate and if it would be able to provide an appropriate range of minimum flows that may be tested or recommended through the relicensing.
    - Sarah noted that the Obermeyer gate is quite versatile and will be able to release the full range of the existing sluice gate, though likely in a more precise manner, particularly at the low end of flow releases. As shown in the combined minimum flow release plan and report included in the draft non-capacity amendment application, the capacity of the gate goes up to about 300 cfs under the normal reservoir range.
    - Action Item: USFWS will provide comments regarding the replacement of the gate within the week. (Note comments were provided by email July 2, 2020.)

- John (USFWS) explained that the threatened and endangered species portion of the Service's review would be best completed by AEP proceeding through the Virginia Field Office's online review process. Action Item: John to send the link for the online project review process. (Note link was provided after the call).
    - John explained that this process expedites projects that result in determinations of no effect or not likely to adversely affect listed species.
    - Sarah stated that AEP will initiate the online review process and may file the non-capacity amendment with FERC while this process and any response required from USFWS is pending.
- Scott (VDGIF) and Brian (VDEQ) recommended building more flexibility into the schedule for the Bypass Reach Study due to potential for delay of the fieldwork due to installation of the new gate. Action Item: HDR/AEP to update the revised schedule and/or include footnote regarding timing of studies conditioned on sluice gate replacement.

Water Quality Study

- Sarah reviewed the Revised Study Plan (RSP) requirements of the Water Quality Study for the Project (continuous and monthly monitoring at 7 locations).
- Sarah explained that under the updated study schedule water quality monitoring is expected to begin in late July and would proceed through October. HDR and AEP believe this will still sufficiently capture the low flow and high temperature period of the year.
- Discussion of whether the abbreviated monitoring period will be sufficient to complete the Water Quality Study. Scott noted that if would depend on the outcome of the data as to whether or not the shortened period would be representative and useful. Brian asked if the initial year was not sufficient would it be reasonable to do additional field data collection next year. Jon (AEP) noted that the second study season is available through the ILP and that the need for additional data collection would be evaluated and discussed in the ISR and during the ISR Meeting.
- The group concurred it is worthwhile to collect as much data as feasible for the remaining field season.

Fish Community Study

- Sarah explained that the Fish Community Study would still be conducted sometime in August or September (into October if needed). The schedule has not changed. Generally, agencies are interested in the cooler water temperatures and would appreciate AEP targeting a fall study.
- AEP plans on conducting the fall adult Roanoke logperch surveys within the same general timeframe as originally approved in the RSP. However, the time-sensitive spring/early summer adult Roanoke logperch survey would be pushed into next year.

- The young-of-year Roanoke logperch survey is proposed to be completed in the same timeframe as approved in the RSP (August-October 2020). USFWS and VDGIF agreed that minimum (i.e. 8 cfs) flow conditions are not required to complete this survey and that higher bypass reach flows may be more appropriate for this survey. Therefore the gate replacement is not a critical path activity for the aquatic surveys scheduled for this fall.
- The larval Roanoke logperch survey has been rescheduled for next spring.
- HDR plans on providing 2020 results in a preliminary study report that would also include a preliminary desktop impingement and entrainment study. The final Fish Community study report would be prepared at the end of 2021 as part of the Updated Study Report.
- Brief discussion in response to question raised by John (USFWS) about how the larval study results would be integrated into the desktop impingement and entrainment study. Methods for evaluating the results of the larval study have not been determined, as this is not a common licensing study. HDR and AEP do not expect to use USFWS's blade strike model or the larger methodology proposed for the desktop impingement and entrainment study to evaluate larval entrainment.
- Also in support of the desktop impingement and entrainment study, intake velocity measurements are scheduled for completion in 2020.

Benthic Aquatic Resources Study

- The Macroinvertebrate and Crayfish Study will proceed with the fall sampling this year, and the spring survey sampling season is being shifted to 2021.
- The mussel habitat and community survey window has been tightened up (still within the original timeframe proposed in the RSP), scheduled for completion in August – October 2020.

Wetland, Riparian, and Littoral Habitat, Shoreline Stability and Cultural Studies

- Desktop and fieldwork rescheduled for spring-summer 2021.

Recreation Study

- AEP began the online survey data collection in late April 2020 and it will likely extend through the 2021 recreation season.
- In-person observations will be postponed until 2021 to avoid close contact with recreation users and adhere to social distancing guidelines.
- Discussion of how this is likely an irregular recreation usage year (potentially a combination of higher and lower recreation use levels) due to the COVID-19.
- Desktop activities including the recreation flow release assessment are still expected to be completed this year for preliminary reporting in the ISR.
- AEP has an ongoing aesthetic flow documentation task that will wrap up in November.

Other

- AEP plans on submitting an update to FERC shortly and would like to mention that they’ve consulted with the agencies and that there was verbal agreement that there was no opposition.
- The agencies all agreed that they are in agreement with the schedule adjustments and AEP’s request for extension of time to file the ISR.

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
August 10, 2020

OFFICE OF ENERGY PROJECTS

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

VIA Electronic Mail

Jonathan Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation
1 Riverside Plaza
Columbus, OH 43215
jmmagalski@aep.com

Subject: Revised Process Plan and Schedule for the Niagara Hydroelectric Project No. 2466

Dear Mr. Magalski:

On July 9, 2019, the Commission issued a process plan and schedule under the Integrated Licensing Process (ILP) for Appalachian Power Company's (Appalachian) Niagara Hydroelectric Project No. 2466 (Niagara Project). The process plan and schedule set pre-filing milestones and deadlines for, among other things, filing study reports, requesting modifications to the approved study plan, filing a preliminary licensing proposal (or draft license application), and filing the final license application.

On November 6, 2019, Appalachian filed a revised study plan (RSP) that included eight proposed studies in support of its intent to relicense the project. On December 6, 2019, the Commission issued a study plan determination for the project approving Appalachian's RSP with staff-recommended modifications.

On July 27, 2020, Appalachian filed its first quarterly study progress report, an updated ILP study schedule, and a request for an extension of time to file the initial study report (ISR) to account for the effects of the Coronavirus pandemic. Appalachian states that current restrictions on non-essential travel and safety considerations for its staff, who would be travelling for and performing the fieldwork, have prevented several of the studies from taking place in the spring and summer of 2020, as originally scheduled in the RSP. Appalachian anticipates commencing fieldwork for a number of studies in the fall of 2020; however, multiple season-sensitive studies must be delayed until the spring of 2021.[1] On June 29, 2020, Appalachian consulted the U.S. Fish and Wildlife Service, Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, and the Virginia Department of Environmental Quality via conference call to discuss potential changes to the study schedule. All participants concurred with Appalachian's proposed schedule revisions.

Specifically, Appalachian requests that the Commission revise the process plan and schedule to allow Appalachian to file the ISR on January 11, 2021. Appalachian states that it would not be feasible to complete the fieldwork, study reports, and ISR by the current December 5, 2020 deadline. Appalachian states that a deadline extension would provide sufficient time to conduct fieldwork during the fall of 2020, to develop the associated draft study reports, and to finalize a comprehensive ISR. The process plan and schedule for the second study season in 2021 would remain unchanged.

To allow Appalachian additional time to complete the first season's field studies, develop the draft study reports, and complete the ISR, the request to extend the due date for filing the ISR to January 11, 2021 is granted. The revised process plan and schedule for the Niagara Project is attached.

If you have any questions, please contact Allyson Conner at (202) 502-6082 or allyson.conner@ferc.gov.

Sincerely,

Vince Yearick
Director
Division of Hydropower Licensing

Attachment: Revised Process Plan and Schedule

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[1] *See* Attachment 1, ILP Study Schedule Update, of Appalachian's request filed on July 27, 2020.

ATTACHMENT 1
NIAGARA PROJECT REVISED PROCESS PLAN AND SCHEDULE

Shaded milestones are unnecessary if there are no study disputes. If the due date falls on a weekend or holiday, the due date is the following business day. Early filings or issuances will not result in changes to these deadlines.

Responsible Party	Pre-Filing Milestone	Date	FERC Regulation
Appalachian	First Study Season	Spring - Fall 2020	5.15(a)
Appalachian	File Initial Study Report	1/11/2021	5.15(c)(1)
All Stakeholders	Initial Study Report Meeting	1/26/2021	5.15(c)(2)
Appalachian	File Initial Study Report Meeting Summary	2/10/2021	5.15(c)(3)
All Stakeholders	File Disagreements/Requests to Amend Study Plan	3/12/2021	5.15(c)(4)
All Stakeholders	File Responses to Disagreements/Amendment Requests	4/11/2021	5.15(c)(5)
FERC	Issue Director's Determination on Disagreements/Amendments	5/11/2021	5.15(c)(6)
Appalachian	Second Study Season	Spring - Fall 2021	5.15(a)
Appalachian	File Preliminary Licensing Proposal (or Draft License Application)	10/1/2021	5.16(a)-(c)
All Stakeholders	File Comments on Preliminary Licensing Proposal (or Draft License Application)	12/30/2021	5.16(e)
Appalachian	File Updated Study Report	12/5/2021	5.15(f)
All Stakeholders	Updated Study Report Meeting	12/20/2021	5.15(f)
Appalachian	File Updated Study Report Meeting Summary	1/4/2022	5.15(f)
Appalachian	File Final License Application	2/28/2022	5.17
All Stakeholders	File Disagreements/Requests to Amend Study Plan	2/3/2022	5.15(f)

Responsible Party	**Pre-Filing Milestone**	**Date**	**FERC Regulation**
Appalachian	Issue Public Notice of Final License Application Filing	3/14/2022	5.17(d)(2)
All Stakeholders	File Responses to Disagreements/Amendment Requests	3/5/2022	5.15(f)
FERC	Issue Director's Determination on Disagreements/Amendments	4/4/2022	5.15(f)

Yayac, Maggie

Subject: FW: Niagara Hydroelectric Project (VA) -- Filing of ILP Study Progress Report
Attachments: Niagara Second Quarterly Progress Report.pdf

From: Kulpa, Sarah <Sarah.Kulpa@hdrinc.com>
Sent: Tuesday, October 27, 2020 5:29 PM
To: ACHP - John Eddins <jeddins@achp.gov>; County of Roanoke - David Henderson <dhenderson@roanokecountyva.gov>; County of Roanoke - David Weir <dweir@roanokecountyva.gov>; County of Roanoke - Lindsay Webb <LWEBB@roanokecountyva.gov>; County of Roanoke - Richard Caywood <rcaywood@roanokecountyva.gov>; Friends of the Blue Ridge Parkway - Audrey Pearson <audrey_pearson@friendsbrp.org>; Friends of the Roanoke - Bill Tanger <bill.tanger@verizon.net>; Harold Peterson <harold.peterson@bia.gov>; Kevin Colburn - American Whitewater (kevin@americanwhitewater.org) <kevin@americanwhitewater.org>; Roanoke County Parks - Doug Blount <dblount@roanokecountyva.gov>; Roanoke River Blueway <roanokeriverblueway@gmail.com>; Roanoke Valley Alleghany Regional Commission - Amanda McGee <amcgee@rvarc.org>; Roanoke Valley Greenway - Liz Blecher <liz.belcher@greenways.org>; Smith Mountain Lake Assn - Lorie Smith <TheOffice@SMLAssociation.org>; Town of Vinton - Anita McMillan <amcmillan@vintonVA.gov>; Town of Vinton - Bo Herndon <wherndon@vintonVA.gov>; Town of Vinton - Joey Hiner <jhiner@vintonVA.gov>; Town of Vinton - Kenny Sledd <ksledd@vintonVA.gov>; Tri-County Lakes Administrative Commission - Paula Shoffner <paulas@sml.us.com>; UADEQ - Brian McGurk <Brian.McGurk@deq.virginia.gov>; USEPA - Matthew Lee <lee.matthew@epa.gov>; USFWS <richard_mccorkle@fws.gov>; USFWS - John McCloskey <John_mcCloskey@fws.gov>; USGS - Mark Bennett <mrbennet@USGS.gov>; VA Cooperative Fish and Wildlife Research Unit - Paul Angermeier <biota@vt.edu>; VADCR - Lynn Crump <lynn.crump@dcr.virginia.gov>; VADCR - Natural Heritage <nhreview@dcr.virginia.gov>; VADCR - Robbie Ruhr <Robbie.Rhur@dcr.virginia.gov>; VADEQ - Andrew Hammond <andrew.hammond@deq.virginia.gov>; VADEQ - Anthony Cario <anthony.cario@deq.virginia.gov>; VADEQ - Matthew Link <matthew.link@deq.virginia.gov>; VADEQ - Scott Kudlas <scott.kudlas@deq.virginia.gov>; Virginia Council on Indians - Emma Williams <emma.williams@governor.virginia.gov>; Virginia Department of Conservation and Recreation - Rene Hypes <rene.hypes@dcr.virginia.gov>; Virginia Department of Game and Inland Fisheries - Scott Smith <scott.smith@dgif.virginia.gov>
Cc: Yayac, Maggie <Maggie.Yayac@hdrinc.com>; 'ebparcell@aep.com' <ebparcell@aep.com>; 'jmmagalski@aep.com' <jmmagalski@aep.com>
Subject: Niagara Hydroelectric Project (VA) -- Filing of ILP Study Progress Report

Niagara Hydroelectric Project Stakeholders:

Appalachian Power Company (Appalachian), a unit of American Electric Power (AEP), is the licensee, owner and operator of the Niagara Hydroelectric Project (FERC No. 2466) (Project) located on the Roanoke River in Roanoke County, Virginia. The Project is operated under a license issued by the Federal Energy Regulatory Commission (FERC). The existing FERC license for the Project expires on February 29, 2024. Appalachian is pursuing a new license for the continued operation of the Project in accordance with FERC's Integrated Licensing Process (ILP).

Pursuant to the ILP, Appalachian filed the second ILP Study Progress Report with the Commission today. We are notifying stakeholders and distributing an electronic copy of this submittal (attached). The filing can also be viewed online at FERC's eLibrary at and will be added to the Project's public relicensing website (http://www.aephydro.com/HydroPlant/Niagara) in the coming days.

Thank you for your continued attention to this Project and for your understanding as we navigated a challenging field season. Should you have any questions regarding this filing, please contact Jon Magalski with AEP at (614) 716-2240 or jmmagalski@aep.com.

Thank you,

Sarah Kulpa

Project Manager

HDR
440 S. Church Street, Suite 900
Charlotte, NC 28202-2075
D 704.248.3620 **M** 315.415.8703
sarah.kulpa@hdrinc.com

hdrinc.com/follow-us

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

October 27, 2020

VIA ELECTRONIC FILING

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

Subject: **Niagara Hydroelectric Project (FERC No. 2466-034)**
Second Quarterly Study Progress Report

Dear Secretary Bose:

Appalachian Power Company (Appalachian or Applicant), a unit of American Electric Power (AEP) is the Licensee, owner, and operator of the run-of-river 2.4 megawatt (MW) Niagara Hydroelectric Project (Project No. 2466) (Project or Niagara Project), located on the Roanoke River in Roanoke County, Virginia. The Project is currently undergoing relicensing following the Federal Energy Regulatory Commission's (FERC's or Commission's) Integrated Licensing Process (ILP).

On July 27, 2020, Appalachian filed with FERC the First Quarterly Study Progress Report, an Updated ILP Study Schedule, and a Request for Extension of Time to file the Initial Study Report. On August 10, 2020, FERC approved this request. As established by the Updated ILP Study Schedule filed on July 27, the Roanoke Logperch Larval Study (a component of the Fish Community Study) and the Wetland, Riparian, and Littoral Habitat Characterization and Shoreline Stability Assessment Studies are scheduled for 2021.

As proposed in Appalachian's November 6, 2019 Revised Study Plan (RSP) and approved in the Commission's December 6, 2019 Study Plan Determination (SPD), Appalachian hereby files the Second Quarterly Study Progress Report for the Project. This progress report describes the activities performed since the First Quarterly Study Progress Report and in quarter 3 (Q3) of 2020, as well as ILP activities generally expected to be conducted in quarter 4 (Q4) of 2020. Unless otherwise described, all relicensing studies are being conducted in conformance with the approved RSP and the Commission's SPD.

General Updates

- As authorized by FERC order dated September 2, 2020, Appalachian is in the process of replacing the existing bottom-hinged, leaf type gate and hoist system in the Project's sluice structure with a bottom-hinged, inflatable Obermeyer (pneumatically actuated) gate and operating system. The existing gate hoist system has been inoperable in 2020 and was maintained in an open position to provide a flow of at least 50 cfs (the required minimum flow for periods when the powerhouse is not generating) at all times. The gate replacement project was originally scheduled for completion in September 2020. The gate replacement project has encountered construction delays associated with the dewatering method for the sluice gate structure and is currently scheduled for completion by mid-November 2020.
- The Q3 field sampling efforts were impacted by periodic heavy storm events which resulted in prevailing high base flow conditions in the Roanoke River watershed. This was further influenced by Hurricane Sally. The study-specific protocols for sampling fish, mussels, and benthic macroinvertebrate communities (referenced in the RSP) provide guidance on establishing the appropriate target flow scenarios to support sampling efforts in a way that is safe and that will result in quality, representative data. The timing and frequency of the storm events resulted in high flow scenarios delaying field crews. Schedule deviations for the individual studies are discussed below in the study specific Q3 progress updates.
- In Q4 2020, data from the on-going field work and studies will be analyzed and summarized in support of the Initial Study Report (ISR) to be filed with FERC on January 11, 2021.

Flow and Bypass Reach Aquatic Habitat Study

- Desktop aquatic habitat/substrate mapping is complete.
- Hydraulic model development progress:
    - Preliminary terrain mesh has been developed.
    - Habitat Suitability Index curves and information for the guilds have been compiled for future incorporation into the model.
- Field verification of desktop aquatic habitat/substrate mapping, bypass reach test flows, and particle size distribution assessments will be conducted after the sluice gate replacement project is complete as these activities require controlled flows in the bypass reach (via the sluice gate). The sluice gate replacement project is currently scheduled to be completed in Q4 2020, however, higher inflows typically occur over the winter and early

spring months which will likely result in postponement of field activities associated with this study until early-summer 2021. Model development is then expected to be completed in Q3 2021.

- Appalachian plans to consult with the applicable agencies at the ISR meeting to review proposed test flow scenarios that will be used to support model calibration and validation activities.

Water Quality Study

- Water quality instruments (i.e., dissolved oxygen [DO] and water temperature sondes) and level loggers were deployed at the locations identified in the RSP the week of July 27, 2020.
- Data from these instruments were subsequently downloaded on four separate occasions, generally every two to three weeks. Due to instrument malfunction, data was not captured from August 12-26, 2020.
- As proposed in the RSP, water quality data downloads were to occur on a monthly basis; however, significant biofouling was observed at the instruments located in the reservoir downstream from Tinker Creek. Data download and instrument maintenance frequency was modified to a two-week interval; however, the biofouling has resulted in several additional time periods where continuous water quality data is not available at this location.
- During instrument downloads, instantaneous water quality measurements were collected using a handheld multi-parameter data sonde (i.e., hydrolab). The instantaneous water quality data will be used to corroborate and/or adjust data collected by the continuous water quality data sondes.
- Water quality data collection as described in the RSP is scheduled to continue through the end of October 2020, at which time data from the instruments will be downloaded and the instruments will be demobilized from the Project.

Fish Community Study

- Field data collection for the general fish community study was initiated in September 2020 with all but three sites being completed before sampling was interrupted due to increasing precipitation in the watershed. The fish community study sampling was completed the week of October 19, 2020 after flows returned to targeted levels and allowed for safe collection of representative samples.
- The adult and young-of-year Roanoke Logperch sampling effort was postponed to September 2020 as established by the updated ILP study schedule. This field data

collection was further delayed due to high stream flows resulting in unsafe sampling conditions. In addition to safety concerns, these higher level base flows resulted in unfavorable habitat conditions. As such, the Roanoke Logperch sampling effort for adult and young-of-year will be rescheduled to 2021. With this change in schedule, each of the life stage-specific sampling efforts for Roanoke Logperch will be performed in 2021, thus providing a data set that is representative of a full Roanoke Logperch reproduction and recruitment in 2021.

- Data compilation is underway for the desktop impingement and entrainment evaluation. Weather and flow conditions and powerhouse operating conditions have delayed the confirmation of the intake velocities originally scheduled for completion in Q3 2020. An attempt will be made to measure intake velocities in Q4 2020 (November), if conditions allow; if the measurement cannot be taken within the remaining field season the measurements will be rescheduled to as soon as practical in 2021. Intake velocities will be analyzed and support the final impingement and entrainment evaluation.
- Appalachian will initiate the Blade Strike Analysis using the most recent version of the model provided by USFWS and will also incorporate available historical information. The analysis and preliminary reporting will be performed in Q4 based on available information. A tentative list of species to be used in the analysis will be noted in the ISR and will include historical data and results of the fish community study in 2020. The final results and report will be developed in 2021 once all site-specific data is gathered, processed, and verified.

Benthic Aquatic Resources Study

- Field data collection for the macroinvertebrate and crayfish community study began in September 2020 but was interrupted due to increasing precipitation and stream flows. Once stream flows returned to a more acceptable range (allowing for safe in stream work and collection of representative samples), sampling was reinitiated and sampling at the remaining macroinvertebrate and crayfish community study sites were completed on October 5, 2020.
- Field data collection for the mussel community study was completed for all proposed sites between October 6 and October 9, 2020. The majority of the Project exhibited limited mussel habitat as the surveyed habitats consist predominantly of boulder and bedrock substrates. The survey efforts collected a total of 4 Eastern elliptio (*Elliptio complanata*); two were collected in Tinker Creek, and two were collected at the most upstream site near the wastewater treatment plant on the Roanoke River. No other live or relic mussel specimens were observed during the survey efforts.

Recreation Study

- The Recreation Visitor Use Online Survey is on-going and will continue into Q4 2020.
    - From April to September 2020 there have been 118 visitors at recreation sites within the Niagara Project area who completed this survey, with a decrease in response rates over the past few months. Canoeing/kayaking has been documented as the primary activity.
- On September 5, 2020, pictures and videos were captured of the spillway and bypass reach to support the Aesthetic Flow Documentation. A final aesthetic site visit is scheduled to be conducted in Q4 2020, under minimum flow (i.e., 8 cfs in the bypass reach) conditions, if feasible.
- Due to travel and in-person meeting restrictions this fall and winter, Appalachian plans to convene with stakeholders to discuss existing and future recreational opportunities in Q1 2021.

Cultural Resources Study

- Consultation letters requesting concurrence from the Virginia State Historic Preservation Officer (SHPO), Advisory Council on Historic Preservation, Indian Tribes, and other parties to determine and document the Area of Potential Effects (APE) for Project relicensing were transmitted via email and mail on September 1, 2020 with responses requested with 30 days of receipt. To date, Appalachian has received responses from the Virginia SHPO, Catawba Indian Nation, Monacan Indian Nation and Pamunkey Indian Tribe who concurred with the definition of the APE. The Virginia SHPO additionally commented they would like additional features within the APE to be evaluated as part of this study.
- The Archeological Phase I Reconnaissance Survey (field effort) of the APE was substantively completed the week of October 12, 2020.

If there are any questions regarding this progress report, please do not hesitate to contact me at (614) 716-2240 or via email at jmmagalski@aep.com

Sincerely,

Jonathan M. Magalski
Environmental Specialist Consultant
American Electric Power Services Corporation

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Federal Agencies

Mr. John Eddins
Archaeologist/Program Analyst
Advisory Council on Historic Preservation
401 F Street NW, Suite 308
Washington, DC 20001-2637
jeddins@achp.gov

Blue Ridge National Heritage Area
195 Hemphill Knob Road
Asheville, NC 28803

Park Headquarters
Blue Ridge Parkway
199 Hemphill Knob Road
Asheville, NC 28803-8686

Ms. Kimberly Bose
Secretary
Federal Energy Regulatory Commission
888 1st St NE
Washington, DC 20426

FEMA Region 3
615 Chestnut Street
One Independence Mall, Sixth Floor
Philadelphia, PA 19106-4404

George Washington and Jefferson National Forest
5162 Valleypointe Parkway
Roanoke, VA 24019

Mr. John Bullard
Regional Administrator
NOAA Fisheries Service
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive
Gloucester, MA 01930-2276

Mr. John A. Bricker
State Conservationist
US Department of Agriculture
Natural Resources Conservation Service
1606 Santa Rosa Road, Suite 209
Richmond, VA 23229-5014

Mr. Harold Peterson
Bureau of Indian Affairs
US Department of the Interior
545 Marriott Dr, Suite 700
Nashville, TN 37214
Harold.Peterson@bia.gov

Office of the Solicitor
US Department of the Interior
1849 C Street, NW
Washington, DC 20240

Ms. Lindy Nelson
Regional Environmental Officer, Office of Environmental Policy & Compliance
US Department of the Interior
Philadelphia Region
Custom House, Room 244
200 Chestnut Street
Philadelphia, PA 19106

Mr. Matthew Lee
US Environmental Protection Agency
lee.matthew@epa.gov

Ms. Barbara Rudnick
NEPA Team Leader - Region 3
US Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Mr. John McCloskey
US Fish and Wildlife Service
John_mcCloskey@fws.gov

Mr. Richard C. McCorkle
Fish and Wildlife Biologist
Pennsylvania Field Office
US Fish and Wildlife Service
110 Radnor Road, Suite 101
State College, PA 16801
richard_mccorkle@fws.gov

Mr. Martin Miller
Chief, Endangered Species
Northeast Region (Region 5)
US Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035

Ms. Cindy Schulz
Field Supervisor, Virginia Field Office
US Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Ms. Elizabeth Merz
US Forest Service
3714 Highway 16
Marion, VA 24354

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. Mark Bennett
Center Director
VA and WV Water Science Center
US Geological Survey
John W. Powell Building
12201 Sunrise Valley Drive
Reston, VA 20192
mrbennet@usgs.gov

Hon. Ben Cline
US Congressman, 6th District
US House of Representatives
10 Franklin Road SE, Suite 510
Roanoke, VA 24011

Mr. Michael Reynolds
Acting Director, Headquarters
US National Park Service
1849 C Street, NW
Washington, DC 20240

Ms. Catherine Turton
Architectural Historian, Northeast Region
US National Park Service
US Custom House, 3rd Floor
200 Chestnut Street
Philadelphia, PA 19106

Hon. Tim Kaine
US Senate
231 Russell Senate Office Building
Washington, DC 20510

Hon. Mark Warner
US Senate
703 Hart Senate Office Building
Washington, DC 20510

State Agencies

Dr. Elizabeth Moore
President
Archaeological Society of Virginia
PO Box 70395
Richmond, VA 23255

Blue Ridge Soil and Water Conservation District
1297 State Street
Rocky Mount, VA 24151

Mr. Jess Jones
Freshwater Mollusk Conservation Center
Virginia Tech
1B Plantation Road
Blacksburg, VA 24061

Mr. Ralph Northam
Governor
Office of the Governor
PO Box 1475
Richmond, VA 23218

Mr. Paul Angermeier
Assistant Unit Leader
Virginia Cooperative Fish and Wildlife Research Unit
Department of Fisheries and Wildlife Conservation - Virginia Tech
106 Cheatham Hall
Blacksburg, VA 24061
biota@vt.edu

Mr. Benjamin Hermerding
Secretary of the Commonwealth
Virginia Council on Indians
PO Box 2454
Richmond, VA 23218
benjamin.hermerding@governor.virginia.gov

Mr. Clyde Cristman
Division Director
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219

Ms. Lynn Crump
FERC
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
lynn.crump@dcr.virginia.gov

Ms. Rene Hypes
Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
rene.hypes@dcr.virginia.gov

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. Tyler Meader
Locality Liasion - Division of Natural Heritage
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
nhreview@dcr.virginia.gov

Ms. Robbie Rhur
Virginia Department of Conservation and Recreation
600 East Main Street, 24th Floor
Richmond, VA 23219
Robbie.Rhur@dcr.virginia.gov

Mr. Tony Cario
Water Withdrawal Permit Writer, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
anthony.cario@deq.virginia.gov

Mr. Andrew Hammond
Water Withdrawal Permitting & Compliance Manager
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23218
andrew.hammond@deq.virginia.gov

Mr. Scott Kudlas
Director, Office of Water Supply
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
scott.kudlas@deq.virginia.gov

Mr. Matthew Link
Water Withdrawal Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
matthew.link@deq.virginia.gov

Mr. Brian McGurk
Water Withdrawl Permit Writer
Virginia Department of Environmental Quality
PO Box 1105
Richmond, VA 23218
Brian.McGurk@deq.virginia.gov

Blue Ridge Regional Office
Virginia Department of Environmental Quality
3019 Peters Creek Road
Roanoke, VA 24019

Mr. Chris Sullivan
Senior Area Forester
Virginia Department of Forestry
900 Natural Resources Drive
Charlottesville, VA 22903

Mr. Scott Smith
Region 2 Fisheries Manager
Virginia Department of Game and Inland Fisheries
1132 Thomas Jefferson Road
Forest, VA 24551
scott.smith@dgif.virginia.gov

Ms. Julie Langan
Director and State Historic Preservation Officer
Virginia Department of Historic Resources
2801 Kensington Avenue
Richmond, VA 23221

Local Governments

Mr. Christopher Whitlow
Interim County Administrator
Franklin County Administration
1255 Franklin Street
Rocky Mount, VA 24151

Ms. Anita McMillan
Town of Vinton
amcmillan@vintonVA.gov

Mr. Sherman P. Lea, Sr.
Mayor
City of Roanoke
Noel C. Taylor Municipal Building
215 Church Avenue
Roanoke, VA 24011

Mr. Richard Caywood
Assistant County Administrator
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
rcaywood@roanokecountyva.gov

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Mr. David Henderson
Engineering
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
dhenderson@roanokecountyva.gov

Ms. Lindsay Webb
Parks Planning and Development Manager
County of Roanoke
1206 Kessler Mill Road
Salem, VA 24153
LWEBB@roanokecountyva.gov

Mr. David Weir
County of Roanoke
PO Box 29800
5204 Bernard Drive
Roanoke, VA 24018
dweir@roanokecountva.gov

Mr. Phil North
Hollins Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Mr. Doug Blount
Director
Roanoke County Parks, Recreation and Tourism
1206 Kessler Mill Road
Salem, VA 24153
dblount@roanokecountyva.gov

Mr. Bo Herndon
Town of Vinton
312 S. Pollard St.
Vinton, VA 24180
wherndon@vintonVA.gov

Mr. Joey Hiner
Town of Vinton
311 S. Pollard St.
Vinton, VA 24179
jhiner@vintonVA.gov

Mr. Kenny Sledd
Town of Vinton
313 S. Pollard St.
Vinton, VA 24181
ksledd@vintonVA.gov

Ms. Paula Shoffner
Executive Director
Tri-County Lakes Administrative Commission
400 Scruggs Road #200
Moneta, VA 24121
paulas@sml.us.com

Western Virginia Water Authority
601 South Jefferson Street
Roanoke, VA 24011

Mr. David Radford
Windsor Hills Magisterial District
5204 Bernard Drive, 4th floor
Roanoke, VA 24014

Tribes

Chief Bill Harris
Catawba Indian Nation
996 Avenue of the Nations
Rock Hill, SC 29730

Deborah Dotson
President
Delaware Nation
P.O. Box 825
Anadarko, OK 73005

Chief Dean Branham
Monacan Indian Nation
PO Box 1136
Madison Heights, VA 24572

Chief Robert Gray
Pamunkey Indian Tribe
1059 Pocahontas Trail
King William, VA 23086

Non-Governmental

American Canoe Association
503 Sophia Street, Suite 100
Fredericksburg, VA 22401

Mr. Kevin Richard Colburn
National Stewardship Director
American Whitewater
PO Box 1540
Cullowhee, NC 28779
kevin@americanwhitewater.org

Niagara Hydroelectric Project (FERC No. 2466)
Distribution List

Headquarters
Appalachian Trail Conservancy
416 Campbell Ave SW #101
Roanoke, VA 24016-3627

Blue Ridge Land Conservancy
27 Church Ave SW
Roanoke, VA 24011-2001

Blue Ridge Parkway Foundation
717 South Marshall Street, Suite 105 B
Winston-Salem, NC 27101

Ms. Audrey Pearson
Executive Director
Friends of the Blue Ridge Parkway
PO Box 20986
Roanoke, VA 24018
audrey_pearson@friendsbrp.org

Friends of the Rivers of Virginia
257 Dancing Tree Lane
Hollins, VA 24019

Ms. Juanita Callis
Director
Friends of the Roanoke
PO Box 1750
Roanoke, VA 24008-1750

Mr. Bill Tanger
Chairman
Friends of the Roanoke
PO Box 1750
Roanoke, VA 24008
bill.tanger@verizon.net

Mr. Mike Pucci
President
Roanoke River Basin Association
150 Slayton Avenue
Danville, VA 24540

Roanoke River Blueway
313 Luck Avenue SW
Roanoke, VA 24016
roanokeriverblueway@gmail.com

Ms. Amanda McGee
Regional Planner II
Roanoke Valley - Alleghany Regional Commission
P.O. Box 2569
Roanoke, VA 24010
amcgee@rvarc.org

Ms. Liz Belcher
Greenway Coordinator
Roanoke Valley Greenway
1206 Kessler Mill Road
Salem, VA 24153
liz.belcher@greenways.org

Lorie Smith
Smith Mountain Lake Association
400 Scruggs Road #2100
Moneta, VA 24121
TheOffice@SMLAssociation.org

Mr. Steve Moyer
Trout Unlimited
1777 N. Kent Street, Suite 100
Arlington, VA 22209

Upper Roanoke River Roundtable
PO Box 8221
Roanoke, VA 24014

Attachment 2

Attachment 2 – ISR Meeting Agenda

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Initial Study Report Meeting Agenda

Project: Niagara Hydroelectric Project

Subject: Initial Study Report Meeting

Date: Thursday, January 21, 2021

Location: WebEx

The Initial Study Report (ISR) meeting is scheduled for January 21, 2021 from 10 a.m. to 3 p.m. (approximately). The ISR meeting topics are currently scheduled for the following times:

Topic	Schedule
Welcome and Introduction	10:00 AM – 10:15 AM
Fish Community Study	10:15 AM – 11:15 AM
Benthic Aquatic Resources Study	11:15 AM – 11:45 AM
Bypass Reach Flow and Aquatic Habitat Study	11:45 AM – 12:30 PM
Lunch Break	12:30 PM – 1:00 PM
Water Quality Study	1:00 PM – 1:30 PM
Recreation Study	1:30 PM – 2:30 PM
Afternoon Break	2:30 PM – 2:35 PM
Cultural Resources Study	2:35 PM – 2:50 PM
Discussion, Questions and Next Steps	2:50 PM – 3:00 PM

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

Appendix A

Appendix A – Preliminary Bypass Reach Flow and Aquatic Habitat Study Report

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Preliminary Bypass Reach Flow and Aquatic Habitat Study Report

Niagara Hydroelectric Project (FERC No. 2466)

January 11, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

Tables

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Acronyms and Abbreviations

1-D	one-dimensional
2-D	two-dimensional
3-D	three-dimensional
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
cfs	cubic feet per second
FERC or Commission	Federal Energy Regulatory Commission
ft	feet/foot
GIS	Geographic Information System
HSC	Habitat Suitability Criteria
HSI	Habitat Suitability Index
POR	period of record
NGVD	National Geodetic Vertical Datum of 1929
ICM	Integrated Catchment Model
ILP	Integrated Licensing Process
LiDAR	Light detection and ranging
Project	Niagara Hydroelectric Project
RSP	Revised Study Plan
SPD	Study Plan Determination
ISR	Initial Study Report
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources
WUA	weighted useable area

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD).

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Bypass Reach Flow and Aquatic Habitat Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The objectives of this study are to conduct a flow and habitat assessment for the Project's tailwater and bypass reach using a combination of desktop, field survey, and hydraulic modeling methodologies with the following goals:

- Delineate and quantify aquatic habitats and substrate types within the bypass reach.
- Identify and characterize locations of habitat management interest located within the bypass reach.
- Develop an understanding of surface water travel times and water surface elevation responses for varying Obermeyer sluice gate openings (i.e., varying flow scenarios) in the bypass reach study area to:
    - Demonstrate the efficacy of the existing bypass reach minimum flow requirement (i.e., 8 cubic feet per second [cfs]) on maintaining suitable habitat for aquatic species.
    - Evaluate potential seasonal minimum flow releases in the bypass reach.

3 Study Area

The study area for the Flow and Bypass Reach Aquatic Habitat Study includes the tailwater, bypass reach, and river reach downstream of the Niagara powerhouse to the Blue Ridge Parkway Bridge Figure 3-1.

Figure 3-1. Bypass Reach Flow and Aquatic Habitat Study Area

4 Background and Existing Information

The Niagara bypass reach is approximately 1,500 feet (ft) long, consisting primarily of exposed bedrock and rock outcroppings. License Article 403 established an 8-cfs minimum flow requirement for the bypass reach, but flows can be higher depending on Project inflows and/or spillway sluice gate operations. Under normal operating conditions, the Project uses available flows for powerhouse generation, maintaining the elevation of the Niagara reservoir between elevations of 884.4 and 883.4 ft NGVD[1].

Under Article 403 of the current license, Appalachian is also required to maintain 50 cfs minimum flow release or inflow, whichever is less, downstream of the Project powerhouse. When inflow to the Project exceeds the powerhouse discharge capacity (684 cfs), the excess flows are passed over and through the spillway.

Monthly flow data from the U.S. Geological Survey (USGS) 02056000 Roanoke River at Niagara, VA flow gaging station is provided in Table 4-1. This gage is located immediately downstream of the Project and reports daily average flow data starting in October 1926 through present, providing a 95-year period of record (POR). Monthly mean flow data, along with the 25th and 75th percentile flow data[2] is provided from January 1991 through December 2020 (a 30-year POR[3]) to put recent historic river flows in perspective with the Niagara maximum hydraulic capacity and current minimum downstream flow release requirements.

Based on mean monthly streamflow data, the average flow for this 30-year hydrologic period is 571 cfs. The driest year was 1999 with an average flow of 275 cfs, and the wettest year was 2019 with an average flow of 704 cfs. Table 4-2 provides the percentage of days each month (during the 30-year POR) when Project inflows exceed the powerhouse discharge capacity and excess flows are routed to the bypass reach.

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[1] All elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD).

[2] A percentile is a value on a scale of one hundred that indicates the percent of a distribution that is equal to or below it. A flow percentile greater than 75 is considered to be wetter than normal; a flow percentile between 25 and 75 is considered normal; and a flow percentile less than 25 is considered to be drier than normal.

[3] The January 1991 – December 2020 POR is reflective of current land use and water use practices and uses more modern data collection and recording methods compared to the 1926 – 1990 POR. The more recent POR also contains a number of dry and wet periods that are sufficient for purposes of evaluating flow regimes relevant to the bypass reach flow and aquatic habitat study goals and objectives.

Table 4-1. USGS 02056000 Roanoke River at Niagara, VA Monthly Flow Statistics, 1991 - 2020

Month	USGS 02056000 Roanoke River at Niagara, VA		
	25th Percentile Flow (cfs)	Mean Monthly Flow (cfs)	75th Percentile Flow (cfs)
Annual	287.1	571.3	761.7
Jan	324.2	671.7	1,013
Feb	341.6	829.2	1,136
Mar	511.6	886.8	1,124
Apr	514.4	826.3	1,128
May	366.5	734.1	903.9
Jun	269.8	588.7	832.9
Jul	224.2	371.6	375.7
Aug	179.2	280.9	326.9
Sep	169.9	384.0	444.1
Oct	160.8	333.0	371.5
Nov	180.6	387.2	655.2
Dec	203.1	562.2	829.5

Table 4-2. Percentage of Days with Spillage > 8 cfs to the Bypass Reach at Niagara

Facility	Niagara Powerhouse Capacity 684 cfs		
Time Period	1991-2020	1999 (dry year)	2019 (wet year)
Annual	24.6	6.3	64.1
Jan	29.5	9.7	61.3
Feb	33.3	0.0	60.7
Mar	46.8	22.6	38.7
Apr	39.9	6.7	10.0
May	28.4	0.0	6.5
Jun	18.3	0.0	46.7
Jul	11.5	9.7	77.4
Aug	12.3	3.2	67.7
Sep	16.6	13.3	100.0
Oct	13.0	0.0	100.0
Nov	20.3	0.0	100.0
Dec	26.1	9.7	100.0

5 Methodology

The U.S. Fish and Wildlife Service (USFWS) and the Virginia Department of Wildlife Resources ([VDWR] formerly the Virginia Department of Game and Inland Fisheries [VDGIF]) requested an instream flow study with the goal of determining the minimum flow, or range of flows to the bypass required to support habitat for a suite of species inhabiting the Roanoke River, including the Roanoke Logperch (*Percina rex)*.

Appalachian's goal in selecting a process for evaluating flows at the Project is to develop a technical basis for systematically evaluating and balancing the needs and priorities of the various flow-related resources. Therefore, the goal of this study is to characterize changes in habitat quantity over a range of flows and operational scenarios. There are several types or combinations of methodologies that could be used to meet the study objectives, ranging from very quantitative to relatively qualitative data. Appalachian believes that the approach used for this study (i.e., development of a 2-dimensional [2-D] flow and habitat model) provides the requested information at an appropriate level of effort. This approach also allows for an assessment of potential Project protection, mitigation, and enhancement measures for the benefit of the range of resources in the bypass reach.

5.1 Literature Review and Desktop Assessment

A literature review of available information was performed to support the study goals, methodologies, and planning of field portions of the study. This task included a review of the hydrologic record for the Project reach, existing sluice gate operating procedures maintained by Appalachian, existing topographic and geologic maps, and available recent and historical aerial imagery.

Several pieces of information were considered in the field study planning process. First, a desktop analysis of mesohabitat (i.e., pools, riffles, runs, bedrock, shoals) mapping of the bypass reach was completed using high-resolution aerial imagery and topographic contour data. Second, species of interest were determined based on preliminary stakeholder consultation and an evaluation of management objectives (e.g., determine potential habitat availability under different flow regimes using guild curves to represent fish species that are or may be present in the bypass reach, including an evaluation specific to Roanoke Logperch). The life history characteristics and habitat preferences of selected species, as well distribution of mesohabitat types, were considered in the selection of target flows and locations for field data collection. Desktop mesohabitat mapping results are included in Section 6.3.

5.2 Topography Mapping and Photogrammetry Data Collection

Light detection and ranging (LiDAR) data were collected to support development of comprehensive three-dimensional (3-D) elevation and visual surface layers of the bypass reach. These data were used for desktop mesohabitat mapping as well as to produce a topographic map of the bypass reach. The topographic information was then incorporated as a base layer for subsequent field data collection and hydraulic modeling efforts.

5.3 Desktop Mesohabitat Mapping

Using the high-resolution photogrammetry data (see Section 5.2), polygons were drawn in Geographic Information System (GIS) software to encompass the bypass study sites according to substrate size (e.g., sand, gravel, cobble, etc.), cover (e.g., no cover, overhead vegetation, etc.), and mesohabitat types (Table 5-1). Mesohabitats were delineated based on typical stream and river morphological, longitudinal sequences (i.e., riffle, run, pool, glide) (Wildland Hydrology 1996) and aerial signatures denoting flow and turbulence at leakage, low-flow, or moderate-flow conditions.

Table 5-1. Desktop Mesohabitat Delineation Codes Used for the Niagara Flow and Aquatic Habitat Study

Substrate-Cover Classifications		
Code	**Cover**	**Substrate**
01	No Cover	and silt or terrestrial vegetation
02	No Cover	and sand
03	No Cover	and gravel
04	No Cover	and cobble
05	No Cover	and small boulder
06	No Cover	and boulder
07	No Cover	and mud or flat bedrock[1] (unsuitable as cover)
08	Overhead vegetation	and terrestrial vegetation
09	Overhead vegetation	and gravel
10	Overhead vegetation	and cobble
11	Overhead vegetation	and small boulder, angled bedrock[3], or woody debris
12	Instream cover	and cobble
13	Instream cover	and small boulder, angled bedrock[3], or woody debris
14	Proximal[2]	and cobble
15	Proximal[2]	and small boulder, angled bedrock[3], or woody debris
16	Instream or proximal[2]	and gravel
17	Overhead, instream, or proximal[2]	and silt or sand
18	Aquatic vegetation	and aquatic macrophytes

Mesohabitat Classifications	
Code	**Mesohabitat Type**
00	Upland[4]
01	Pool
02	Riffle
03	Run
04	Glide
05	Shoal
06	Backwater

[1] Flat bedrock consists of bedrock that is smooth, with or without crater-like divots, or otherwise unsuitable as instream cover.

[2] ”Proximal” is defined as within 4 ft of suitable cover.

[3] Angled bedrock is angular, jutting or semi-vertical, slab-like bedrock. Angled bedrock was categorized as instream cover, regardless of presence of overhead vegetation.

[4.] Upland areas are areas that are inundated during spill events.

5.4 Field Data Collection

5.4.1 Flow and Water Level Assessment

In this task, field data will be collected to support development of a two-dimensional (2-D) hydraulic model (described under Task 4 of the RSP) of the Project’s tailwater and bypass reach. Proposed target (i.e., model calibration/validation) flows will be released into the bypass reach for purposes of collecting depth and wetted area data under various bypass flow regimes.

The proposed target flow scenarios are designed to allow 2-D hydraulic model simulations capable of evaluating the full operating range of the [soon-to-be] newly installed Obermeyer sluice gate located on the left abutment (looking downstream) of the Niagara dam and spillway (Figure 3-1). The Obermeyer gate is 6 ft wide and the discharge rating curve under various forebay and gate invert elevations is provided on Figure 5-1.

The Obermeyer gate will be capable of providing flow releases of approximately 7 cfs to 287 cfs under the authorized reservoir operating range of 883.4 ft to 884.4 ft, respectively (see Figure 5-1). There are also three 3-ft by 4-ft openings in the dam approximately 15 ft below the crest of the dam. The openings are sealed with wooden “mud gates” on the upstream face of the dam and steel plates on the downstream face of the dam. To relieve pressure from leakage around the edges of the wooden mud gates, two sluice pipes (each equipped with a valve) are installed in each opening. The valves are normally kept in the open position, providing a combined leakage flow of approximately 1.0 cfs to the bypass reach.

Therefore, target flows that will allow a model simulation range from 8 cfs (the minimum Obermeyer gate discharge capacity plus mud gate leakage; and also the minimum bypass flow requirement) up to 287 cfs (the maximum Obermeyer gate discharge capacity under normal operating conditions) will be assessed.

The four target flows proposed in Table 5-2 will allow model simulations that cover the Obermeyer gate discharge capacity range from 8 cfs up to 287 cfs. Field measurements (i.e., bypass reach water surface elevations, depths, and velocities) collected under steady flow conditions of approximately 8 cfs, 20 cfs, 50 cfs, and 115 cfs will be used to support hydraulic model calibration/validation activities. Assuming the forebay elevation is at the midpoint of the normal operating band, the target test flows are well within the normal gate operating range (see Figure 5-1The approximate gate invert elevation for each proposed target flow is provided in Table 5-2.

Prior to the target flow field data collection event, water level data loggers (pressure transducers that measure water stage changes) will be strategically deployed in the tailwater, bypass, and downstream study reach to record changes in water surface elevation at each of the target flows. The instrumentation will remain in place for several weeks afterwards to collect additional water surface elevation and flow travel time data under higher (than target flow) conditions (i.e., during rainfall runoff events). Data collected at higher flows will provide additional model calibration data which will allow model simulations higher than the Obermeyer gate discharge capacity.

Work for this task will be carried out in 2021.

Table 5-2. Niagara Bypass Reach Flow and Aquatic Habitat Study – Proposed Target Flow Scenarios

Niagara Hydroelectric Project				
Open Spillway Crest: 885 ft				
Reservoir Operating Range: 883.4 - 884.4 ft; assume starting Pool Elevation is 883.9 ft				
Volume of Water in Reservoir Operating Range: 56.5 acre-ft				
Obermeyer Gate Dimensions: 6 ft wide; Max & Min Gate Elevations, 885.33 ft / 878.40 ft				
Obermeyer Gate Capacity: 7 - 287 cfs within Reservoir Operating Range				
Powerhouse Discharge Capacity: 684 cfs				
Powerhouse Minimum Discharge Capacity: 100 cfs (either unit operating)				
Obermeyer Gate				
Approximate Gate Invert Elevation* (ft)	Proposed Target Flows (cfs)	Flow Test Duration (hrs)	Volume (acre-ft)	Model Simulation Range (cfs)
883.39	8	8	5	8
882.94	20	8	13	↓
882.11	50	8	33	
880.74	115	8	76	
				287

Notes: *Assume starting point is midpoint of normal operating range with adequate inflow to maintain pond levels during flow tests. All elevations are referenced to NGVD 29. Mean monthly flows are from USGS 02056000 Roanoke River at Niagara, Virginia flow gaging station, which is immediately downstream from the Niagara tailwater and bypass reach confluence.

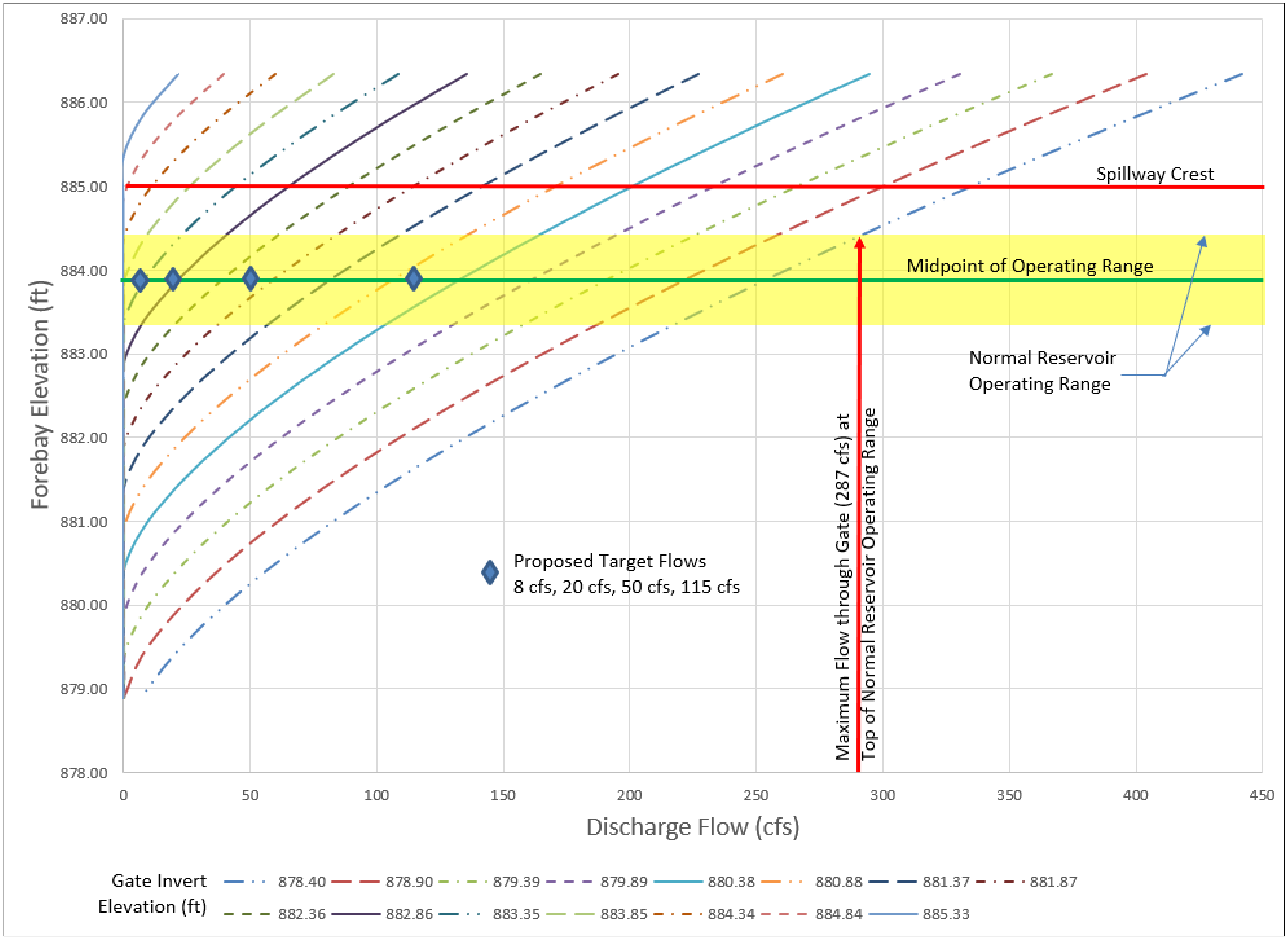

Figure 5-1. Niagara Obermeyer Sluice Gate Rating Curve

5.4.2 Substrate Characterization and Mapping

In addition to substrate mapping in the Niagara bypass reach, a Wolman pebble count (Wolman 1954) will be performed along one to two transects before and after each controlled flow release. This data will be used to characterize the existing surface substrate grain size distribution in the bypass reach and determine if the test flows evaluated have sufficient velocity to mobilize substrate particles in the bypass reach. The Wentworth grain size classification scale (Wentworth 1922) will be used to assign size classes to the substrate as recommended by USFWS. Substrate particle sizes will be plotted by size class and frequency to determine particle size distribution within the bypass reach.

Work for this task will be carried out in 2021.

5.5 Hydraulic Model Development

5.5.1 General Model Description

Development of a 2-D hydraulic model will be carried out as part of the Bypass Reach Flow and Aquatic Habitat Study. A 2-D model incorporates detailed terrain data obtained by topographic mapping technologies and provides options for building one-dimensional (1-D) and 2-D geometries. It also utilizes a 1-D/2-D model development approach which optimizes the simulation of observed hydraulic behavior for specific project requirements. This study will use the Innovyze Infoworks Integrated Catchment Model (ICM) software (version 7.0), which is capable of simulating depth and velocities in a 2-D grid pattern over a wide range of flow conditions.

The advantages of implementing a 2-D model provides more stable results over a wider range of flows than a 1-D model, thus reducing troubleshooting during model development; however, simulation speed is generally slower. The ICM software performs 2-D unsteady flow hydraulic calculations based on conservation of mass and momentum to dynamically route the spillway release flood wave downstream and uses a finite-volume solution algorithm to allow for 2-D cells to be wet or dry and handle a sudden rush of water, subcritical, supercritical, and mixed-flow regimes. For instance, a spillway release is a highly dynamic flood wave that rises and falls quickly; therefore, the 2-D unsteady flow calculation must use the full momentum form of the St. Venant equations (the full momentum equation accounts for the change in velocity both spatially and temporally).

The model geometry is defined by digital terrain model elevation values, user inputs based on Project drawings and survey information, and Manning's roughness coefficient inputs (used to establish terrain roughness) and calculates the flood wave hydrograph resulting from a spillway release based on input gate operation parameters. The ICM model is also capable of simulating reservoir inflow and rate of reservoir rise, dynamic gate operations scenarios, release travel times, and rates of rise at locations within and downstream of the bypass reach.

5.5.2 Niagara Bypass Reach ICM Model Development

The morphology of the approximately 1,500-foot-long Niagara bypass reach extending from the dam to the vicinity of the powerhouse tailwater is variable and includes deep and shallow pools, runs, shoals, steep cascades, and side channels with large boulders. This channel variability impacts flow travel times differently at varying flows and is most accurately represented by a 2-D model.

Work for this task will be carried out in 2021 and results of the modeling effort for the Niagara bypass reach will be included in a standalone Niagara bypass reach ICM model development report, which will be included as an attachment to the updated Bypass Reach Flow and Aquatic Habitat study report.

5.6 Aquatic Habitat Evaluation

Activities described above (i.e., literature review and desktop assessment, topographic mapping and photogrammetry, field data collection, and hydraulic model development) will be used to develop a flow and aquatic habitat assessment of the Niagara tailwater and bypass reach. Specifically, for each flow scenario evaluated, incremental changes in depth and wetted area will be determined. The water level logger data in combination with the 2-D model results will be used to determine rate of rise and fall of water elevation (i.e., water depth) in the tailwater and bypass reach and evaluate flow patterns and hydraulic connectivity under each flow regime evaluated. In addition, substrate and mesohabitat mapping along with the 2-D model depth and velocity simulation results will be used in combination with aquatic species habitat suitability criteria (HSC) (i.e., using depth, velocity, and habitat preferences) to evaluate potential available habitat under each modeled flow scenario in the study reach.

Work for this task will be carried out in 2021.

5.6.1 Target Species and Habitat Suitability Criteria

Roanoke Logperch was selected as a standalone target species for this study along with a total of eight species-guild representatives including three shallow-slow, one shallow-fast, two deep-slow, and two deep-fast guilds. Guild representatives were selected from a variety of regionally representative sources, represent a wide range of habitat characteristics, and were selected to represent a wide range of species. In some cases, general non-species-specific criteria were used. In other cases specific species were used to represent a guild category; these include Redbreast Sunfish (*Lepomis auritus*), Silver Redhorse (*Moxostoma anisurum*), and Shorthead Redhorse (*Moxostoma macrolepidotum*) (Table 5-3).

5.6.1.1 Target Species

The Roanoke Logperch is endemic to the Roanoke River basin within North Carolina and Virginia and the Chowan River basin in Virginia. The distribution in the upper Roanoke system extends roughly 1.8 miles downstream of the Niagara Dam upstream into the North Fork Roanoke River and to the South Fork Roanoke River (USFWS 1992). The species predominantly occurs in those portions of the drainage within the Piedmont and Ridge and Valley physiographic provinces. Populations are vulnerable due to limited range and low densities. The Roanoke Logperch is not typically found in reservoirs or other lentic environments.

The Roanoke Logperch is a large darter and can reach a length of about 6 inches. According to USFWS (1992), depending on the different phases of its life history and season, most riverine habitat types are used by this species at some point. During the reproductive period, males are primarily associated with shallow riffles, while spawning females are common in deep runs over gravel and small cobble. Young and juveniles usually occur in slow runs and pools with clean bottoms. Winter habitat of all phases is believed to be under boulders in deep pools (USFWS 1992). Logperch in the Roanoke River have been found primarily in runs, select deep, fast habitats with exposed, silt-free gravel substrate, occasionally in riffles, and rarely in pools. Logperch have been found at a variety of depths and velocities, but consistently in silt-free, loosely embedded substrate (Rosenberger and Angermeier 2003).

5.6.1.2 Guild Species

Redbreast sunfish

As a representative of the deep/slow guild, the Redbreast Sunfish, is a member of the Centrarchidae family. The Redbreast Sunfish is native along the Atlantic slope of the Appalachians from southern Canada to Florida west to the Apalachicola River (Lee et al. 1980). Like most sunfishes, they are opportunistic insectivores that also feed on small fishes as they obtain larger sizes (Levine et al. 1986; Wallace 1984). Superficially, the Redbreast Sunfish resembles most other sunfish, particularly the Bluegill (*Lepomis macrochirus*). However, unlike Bluegill, the Redbreast Sunfish lacks a black blotch on the dorsal fin and has shorter gill rakers. Redbreast Sunfish can be distinguished from all other sunfish, except the Bluegill, by black on the opercular flap that extends to the posterior margin. Adults range from 60-155 millimeter total length (Lee et. al. 1980).

More than any other sunfish, the Redbreast Sunfish dwells almost entirely in lotic environments (Lee et al. 1980; Stauffer et al. 1995). Gravel spawning nests are constructed from spring through summer when water temperatures reach 23° C (Levine et al. 1986; Stauffer et al. 1995).

Redhorse

Representing both shallow/slow (i.e., young of year) and deep/fast (i.e., adults) guilds, Catostomidae are members of the genus *Moxostoma*, the redhorses. Specifically, Silver Redhorse (*M. anisurum*) and Shorthead Redhorse (*M. macrolepidotum*) habitat suitability information is included in the guild habitat modeling.

The redhorses are indigenous to the Atlantic slope of the Appalachians, the Mississippi River Drainage, and the Great Lakes Basin. All the redhorses possess subterminal mouths used to forage the streambed for benthic macroinvertebrates. Like other catostomids, they are drab olive bronze dorsally and fade to white ventrally. They possess complete, well developed lateral lines and develop tubercles during breeding. These fish can attain lengths up to 600 millimeters standard length (Lee et al. 1980; Stauffer et al. 1995).

The redhorse can inhabit both lentic and lotic environments, but they prefer medium to large streams and rivers with clear water and assorted rock substrates. While they are usually associated with deep pools and backwaters, they spawn in spring and early summer on coarse gravel (Lee et al. 1980; Stauffer et al. 1995).

5.6.1.3 Habitat Suitability Criteria

HSC define the range of microhabitat variables that are suitable for a particular species and life stage of interest. Variables typically defined with HSC include depth, velocity, instream cover, and bottom substrate. Habitat Suitability Indices (HSI) are the numerical indices that represent the capacity of a given habitat to support a selected fish species (USFWS 1981). HSI values range from 0.0 to 1.0, indicating habitat conditions that are unsuitable to optimal, respectively. HSC provide the biological criteria input to the ICM 2-D model, which combines the physical habitat data and the habitat suitability criteria into a site-wide habitat suitability index (i.e., weighted usable area or WUA) over a range of simulation flows. WUA is defined as the sum of stream surface area within a nodal area model domain or stream reach, weighted by multiplying area by habitat suitability variables (most often velocity, depth, and substrate or cover), which range from 0.0 to 1.0 each.

HSI for target species and life stages were obtained from three previous instream flow investigations: (1) Sutton Hydroelectric Project, Elk River, WV (HDR 2010); (2) Smith Mountain Hydroelectric Project, Roanoke River, Va (TRPA & Berger 2007); and (3) Claytor Hydroelectric Project, New River, Va (TRPA & Berger 2008) (Table 5-3). These three recent studies represent the best available sources for regionally applicable species information due to their close proximity to the study location, the similarity in river condition and species community modeled, and the collaborative HSC review process that each underwent.

HSI were developed for Roanoke Logperch from data presented in Rosenberger and Angermeier (2003). Frequency of occurrence was measured for each HSC for Roanoke Logperch young-of-year, subadult, and adult life stages. Using the frequency of occurrence for HSC as well as available habitat, a measure of habitat preference was calculated (Ensign and Angermeier 1994). Habitat preference values were then scaled to a 0 to 1 index by dividing each preference value by the highest value for that variable (Ensign and Angermeier 1994). HSI developed for Roanoke Logperch are presented in Table 5-4.

Velocity, depth, and substrate HSI curves for shallow and fast water guilds are shown on Figure 5-2 through Figure 5-5. HSC data tables are included in Attachment 1. Habitat maps will be developed based on these criteria and will be included as an attachment to the updated Bypass Reach Flow and Aquatic Habitat Study report in 2021.

Table 5-3. Target Species Habitat and Suitability Criteria Source and Code Table

Species or Guild	Life Stage/ Category	Representative	Source Study	HSC Code
Roanoke Logperch	Adult	--	Rosenberger and Angermeier 2003	RLPA
	Subadult	--	Rosenberger and Angermeier 2003	RLPSA
	Young-of-Year	--	Rosenberger and Angermeier 2003	RLPYOY
Shallow-Slow Guild	Fine substrate no cover	Redbreast sunfish spawning	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFS
	All substrate with aquatic vegetation	Silver redhorse Young of Year	Sutton Hydroelectric Project, Elk River, WV	SRHAV
	Coarse substrate	Generic shallow-slow guild	Sutton Hydroelectric Project, Elk River, WV	SHSLO
Shallow-Fast Guild	Moderate velocity with coarse substrate	Generic shallow-fast guild	Claytor Hydroelectric Project New River, VA	SHFST
Deep-Slow Guild	Cover	Redbreast sunfish Adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFA
	No cover	Generic deep-slow guild	Sutton Hydroelectric Project, Elk River, WV	DSLON

Species or Guild	Life Stage/ Category	Representative	Source Study	HSC Code
Deep-Fast Guild	Slightly weighted for fine substrate, Cover	Silver redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SRHAD
	Coarse-mixed substrate	Shorthead redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SHRHA

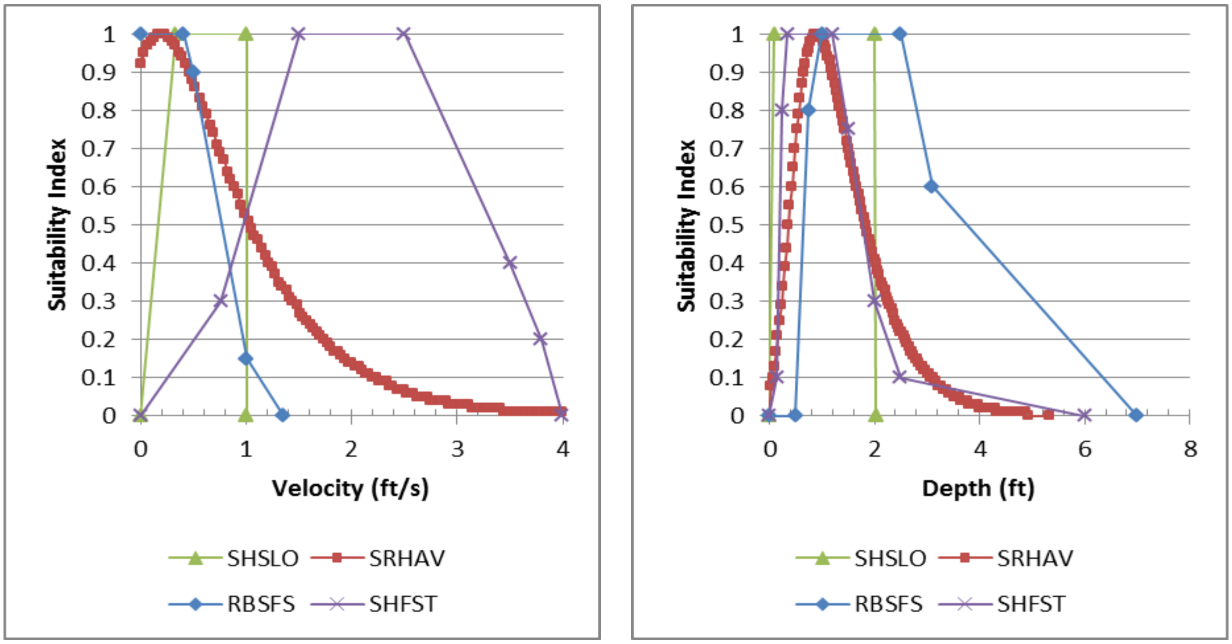

Figure 5-2. Velocity HSC (left) and Depth HSC (right) for Shallow Water Guilds

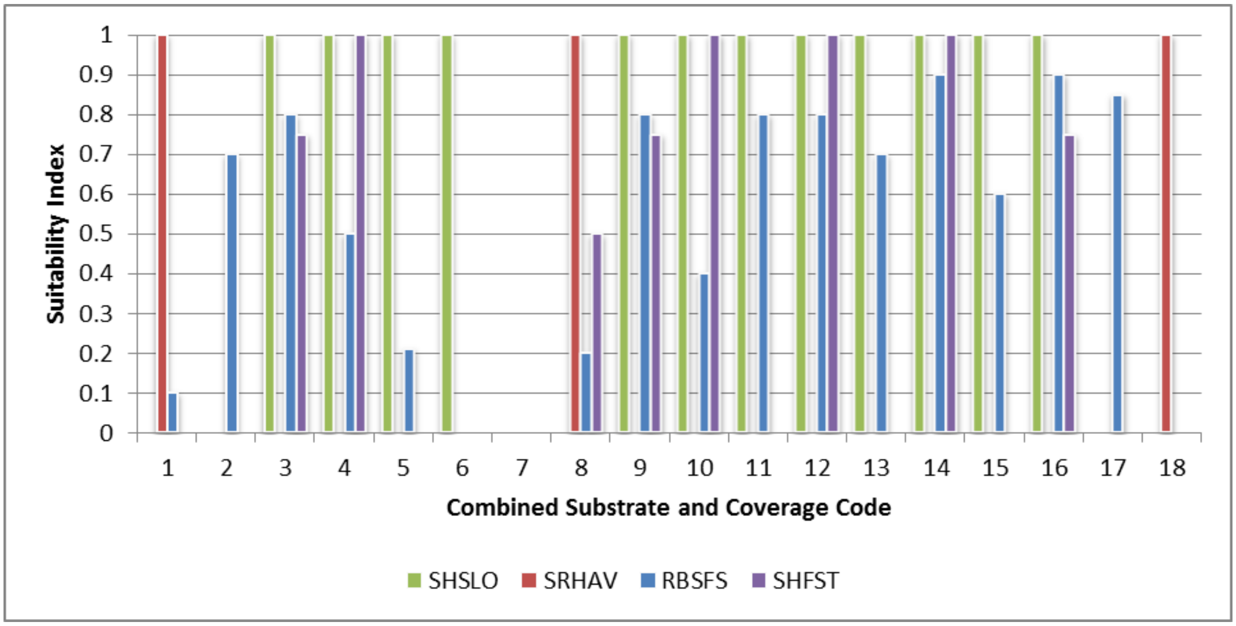

Figure 5-3. Substrate HSC for Shallow Water Guilds

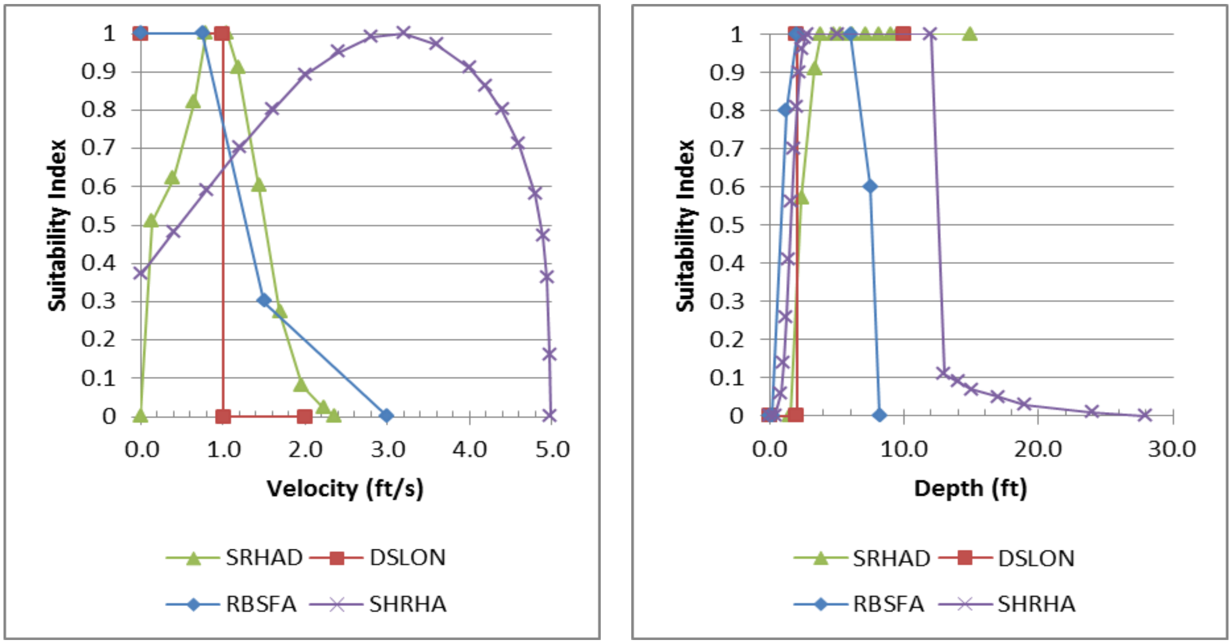

Figure 5-4. Velocity HSC (left) and Depth HSC (right) for Deep Water Guilds

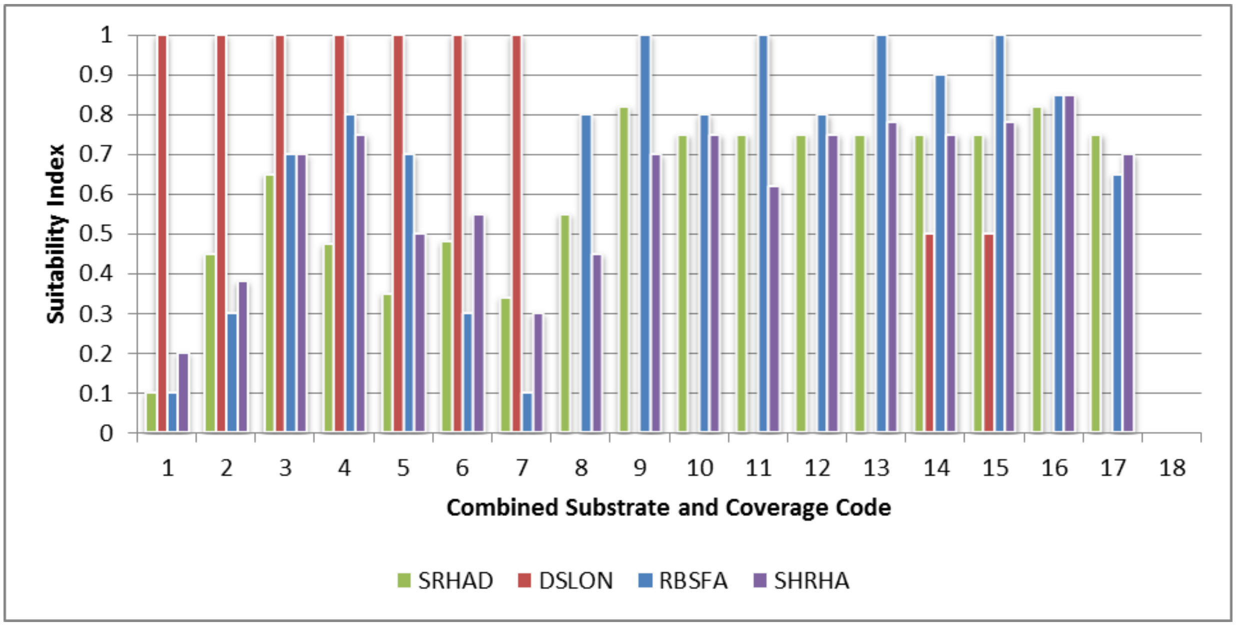

Figure 5-5. Substrate HSC for Deep Water Guilds

Table 5-4. Habitat Suitability Indices Developed for Roanoke Logperch based on Rosenberger and Angermeier (2003)

Habitat Suitability Criteria	Habitat Suitability Index		
Mean Velocity (m/s)	**Adult**	**Subadult**	**YOY**
0	0.00	0.00	0.26
0.01-0.04	0.03	0.00	1.00
0.04-0.1	0.26	1.00	0.08
0.11-0.4	0.70	0.17	0.00
>0.41	1.00	0.24	0.00
Depth (cm)	**Adult**	**Subadult**	**YOY**
0-15	0.00	0.00	0.06
16-30	0.10	0.68	1.00
31-50	0.91	1.00	0.00
>51	1.00	0.25	0.00
Substrate (rank)[1]	**Adult**	**Subadult**	**YOY**
<3	0.03	0.00	0.00
4-6	1.00	1.00	1.00
7	0.10	0.66	0.00
8-9	0.25	0.10	0.00

[1] Rankings based on a 9-category Wentworth scale as defined in Lahey and Angermeier (2007): 0-3=organic matter, clay, and silt; 4-6=sand, small gravel, large gravel; 7=cobble; 8-9=boulder and bedrock.

Note: YOY = young-of-year

6 Study Results

6.1 Literature Review and Desktop Assessment Results

The literature review included several key reports and documents, which are included in the references section, as well as USGS and Project flow data as described in Section 5. The results of the desktop mesohabitat mapping of the bypass reach, which was completed using high-resolution aerial imagery and topographic contour data, are included in Section 6.3. The 2-D hydraulic model results and the aquatic habitat evaluation results including the life history characteristics and habitat preferences of selected species, as well distribution of mesohabitat types, will be included in the final study report.

6.2 Topography Mapping and Photogrammetry Data Collection Results

LiDAR data were used to support development of the desktop mesohabitat mapping (see Figure 6-1) and will be used to support development of comprehensive 3-D elevation and visual surface layers for the bypass reach. Maps of the digital terrain model and mesohabitat modeling results will be included in the final study report.

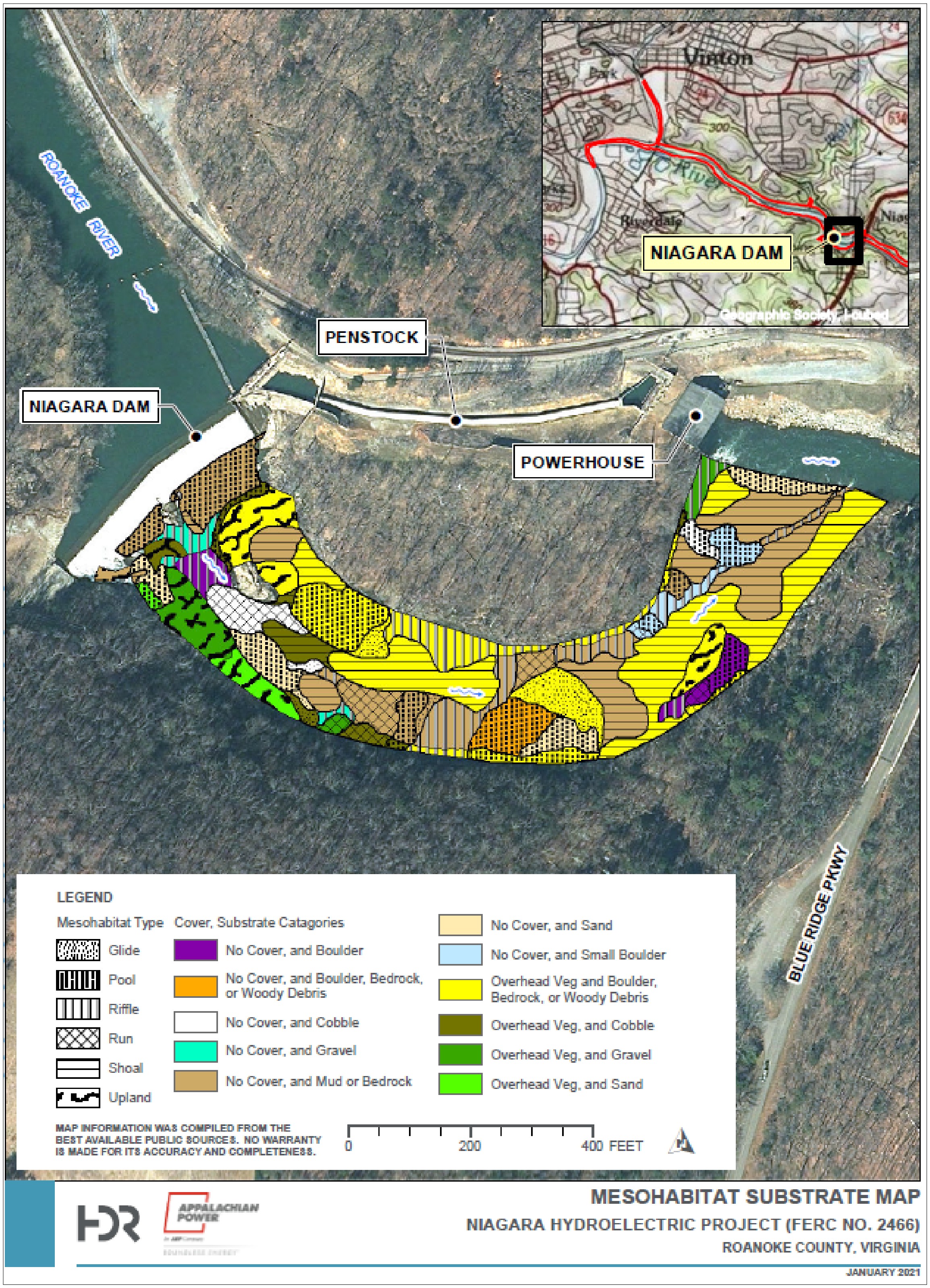

Figure 6-1. Bypass Reach Desktop Habitat Delineation at Niagara Hydroelectric Project

6.3 Desktop Mesohabitat Mapping Results

The habitat mapping codes described in Section 5.3 were used to delineate the Niagara bypass reach. Habitat types will be verified and/or updated in GIS as necessary based on field observations performed in 2021. Substrate-cover and mesohabitat classifications will be reviewed by a senior scientist and polygons will be processed using quality control procedures to ensure data integrity throughout the aquatic habitat modeling process.

The total area evaluated for the Niagara bypass reach was 6.79 acres. Approximately half of the bypass contained cover is in the form of overhead vegetation (Table 6-1). The majority of substrate in the bypass consisted of boulder, bedrock, or woody debris (75.1 percent). Much of the bypass was categorized as shoal habitat (37.0 percent), however pools and riffles were also prevalent (24.8 and 14.8 percent, respectively). Approximately 11.3 percent of the bypass was characterized as “upland”, which includes areas that are exposed during low flows but may be inundated during spillage events.

Table 6-1. Summary of Aquatic Habitat Characteristics

Habitat Characteristics	Area (ac.)	Percent
Cover		
Overhead Vegetation	3.45	50.9
No Cover	3.34	49.1
Substrate		
Boulder, Bedrock, or Woody Debris	5.10	75.1
Sand	0.55	8.1
Cobble	0.54	7.9
Gravel	0.42	6.1
Small Boulder	0.19	2.8
Mesohabitat		
Shoal	2.51	37.0
Pool	1.68	24.8
Riffle	1.00	14.8
Upland	0.77	11.3
Run	0.49	7.2
Glide	0.34	4.9

6.4 Field Data Collection Results

Work for this task will be carried out in 2021.

6.4.1 Flow and Water Level Assessment Results

Work for this task will be carried out in 2021.

6.4.2 Particle Size Distribution Results

Work for this task will be carried out in 2021.

6.5 Hydraulic Model Development

Work for this task will be carried out in 2021.

6.6 Aquatic Habitat Evaluation Results

Work for this task will be carried out in 2021.

7 Summary and Discussion

7.1 Delineate and Quantify Aquatic Habitats and Substrate Types

Work for this task will be carried out in 2021.

7.2 Surface Water Travel Times and Water Surface Elevation Responses

Work for this task will be carried out in 2021.

7.3 Identify and Characterize Locations of Habitat Management Interest

Work for this task will be carried out in 2021.

7.4 Efficacy of Existing Bypass Reach Minimum Flow Requirement

Work for this task will be carried out in 2021.

7.5 Evaluate the Impacts of Seasonal Minimum Flows

Work for this task will be carried out in 2021.

8 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP with the exception of the following variance:

- As a result of the delay to the start of the 2020 field season, higher than normal seasonal flow conditions in the Roanoke River, inoperability of the trash sluice gate hoist operating system, construction activities associated with installation of the new Obermeyer trash sluice gate, and temporarily reduced unit generation capability at the Niagara powerhouse, the Bypass Reach Flow and Aquatic Habitat Study fieldwork was postponed to 2021. Therefore, only the desktop habitat mapping results, proposed target flows (for the 2-D ICM model calibration/validation), and HSC information is provided in this preliminary study report.

9 Germane Correspondence and Consultation

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the ISR to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021. These delays pushed the start of the 2020 field season into late July 2020. FERC letters of correspondence are included in Attachment 1 of the ISR.

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Attachment 1

Attachment 1 – Habitat Suitability Criteria Tables

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Table 1. Shallow Guild HSC Table

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
RBSFS	0.0	0.00	1.00	0.0	0.00	0.00	1	0.1
	0.4	0.12	1.00	0.5	0.15	0.00	2	0.7
	0.5	0.15	0.90	0.8	0.23	0.80	3	0.8
	1.0	0.31	0.15	1.0	0.31	1.00	4	0.5
	1.3	0.41	0.00	2.5	0.76	1.00	5	0.21
	--	--	--	3.1	0.95	0.60	6	0
	--	--	--	7.0	2.13	0.00	7	0
	--	--	--	--	--	--	8	0.2
	--	--	--	--	--	--	9	0.8
	--	--	--	--	--	--	10	0.4
	--	--	--	--	--	--	11	0.8
	--	--	--	--	--	--	12	0.8
	--	--	--	--	--	--	13	0.7
	--	--	--	--	--	--	14	0.9
	--	--	--	--	--	--	15	0.6
	--	--	--	--	--	--	16	0.9
	--	--	--	--	--	--	17	0.85
	--	--	--	--	--	--	18	0
SRHAV	0.0	0.00	0.92	0.0	0.00	0.00	1	1
	0.0	0.01	0.95	0.0	0.01	0.08	2	0
	0.1	0.02	0.97	0.1	0.02	0.10	3	0
	0.1	0.03	0.98	0.1	0.03	0.13	4	0
	0.1	0.04	0.99	0.1	0.04	0.17	5	0
	0.2	0.05	1.00	0.2	0.05	0.21	6	0
	0.2	0.06	1	0.2	0.06	0.25	7	0
	0.2	0.07	1	0.2	0.07	0.29	8	1
	0.3	0.08	0.99	0.3	0.08	0.34	9	0
	0.3	0.09	0.98	0.3	0.09	0.39	10	0
SRHAV	0.3	0.10	0.97	0.3	0.10	0.44	11	0
	0.4	0.11	0.95	0.4	0.11	0.5	12	0
	0.4	0.12	0.94	0.4	0.12	0.55	13	0
	0.4	0.13	0.92	0.4	0.13	0.6	14	0
	0.5	0.14	0.9	0.5	0.14	0.65	15	0
	0.5	0.15	0.88	0.5	0.15	0.7	16	0
	0.5	0.16	0.86	0.5	0.16	0.75	17	0
	0.6	0.17	0.83	0.6	0.17	0.79	18	1
	0.6	0.18	0.81	0.6	0.18	0.83	--	--
	0.6	0.19	0.79	0.6	0.19	0.87	--	--
	0.7	0.20	0.76	0.7	0.20	0.90	--	--
	0.7	0.21	0.74	0.7	0.21	0.92	--	--
	0.7	0.22	0.71	0.7	0.22	0.95	--	--
	0.8	0.23	0.69	0.8	0.23	0.96	--	--
	0.8	0.24	0.67	0.8	0.24	0.98	--	--
	0.8	0.25	0.64	0.8	0.25	0.99	--	--
	0.8	0.26	0.62	0.8	0.26	1	--	--
	0.9	0.27	0.6	0.9	0.27	1	--	--
	0.9	0.28	0.58	0.9	0.28	1	--	--
	1.0	0.29	0.55	1.0	0.29	1	--	--
	1.0	0.30	0.53	1.0	0.30	0.99	--	--
	1.0	0.31	0.51	1.0	0.31	0.98	--	--
	1.0	0.32	0.49	1.0	0.32	0.97	--	--
	1.1	0.33	0.47	1.1	0.33	0.96	--	--
	1.1	0.34	0.46	1.1	0.34	0.94	--	--
	1.2	0.35	0.44	1.2	0.35	0.93	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	1.2	0.36	0.42	1.2	0.36	0.91	--	--
	1.2	0.37	0.4	1.2	0.37	0.89	--	--
	1.3	0.38	0.39	1.3	0.38	0.87	--	--
	1.3	0.39	0.37	1.3	0.39	0.85	--	--
	1.3	0.40	0.35	1.3	0.40	0.83	--	--
	1.3	0.41	0.34	1.3	0.41	0.81	--	--
	1.4	0.42	0.33	1.4	0.42	0.79	--	--
	1.4	0.43	0.31	1.4	0.43	0.77	--	--
	1.4	0.44	0.3	1.4	0.44	0.75	--	--
	1.5	0.45	0.29	1.5	0.45	0.72	--	--
	1.5	0.46	0.27	1.5	0.46	0.7	--	--
	1.5	0.47	0.26	1.5	0.47	0.68	--	--
	1.6	0.48	0.25	1.6	0.48	0.66	--	--
	1.6	0.49	0.24	1.6	0.49	0.64	--	--
	1.6	0.50	0.23	1.6	0.50	0.62	--	--
	1.7	0.51	0.22	1.7	0.51	0.6	--	--
	1.7	0.52	0.21	1.7	0.52	0.58	--	--
	1.7	0.53	0.2	1.7	0.53	0.56	--	--
	1.8	0.54	0.19	1.8	0.54	0.54	--	--
	1.8	0.55	0.18	1.8	0.55	0.52	--	--
	1.8	0.56	0.17	1.8	0.56	0.5	--	--
	1.9	0.57	0.17	1.9	0.57	0.48	--	--
	1.9	0.58	0.16	1.9	0.58	0.46	--	--
	1.9	0.59	0.15	1.9	0.59	0.45	--	--
	2.0	0.60	0.14	2.0	0.60	0.43	--	--
	2.0	0.61	0.14	2.0	0.61	0.41	--	--
	2.0	0.62	0.13	2.0	0.62	0.4	--	--
	2.1	0.63	0.13	2.1	0.63	0.38	--	--
SRHAV	2.1	0.64	0.12	2.1	0.64	0.37	--	--
	2.1	0.65	0.11	2.1	0.65	0.35	--	--
	2.2	0.66	0.11	2.2	0.66	0.34	--	--
	2.2	0.67	0.1	2.2	0.67	0.33	--	--
	2.2	0.68	0.1	2.2	0.68	0.31	--	--
	2.3	0.69	0.09	2.3	0.69	0.3	--	--
	2.3	0.70	0.09	2.3	0.70	0.29	--	--
	2.3	0.71	0.09	2.3	0.71	0.28	--	--
	2.4	0.72	0.08	2.4	0.72	0.27	--	--
	2.4	0.73	0.08	2.4	0.73	0.25	--	--
	2.4	0.74	0.07	2.4	0.74	0.24	--	--
	2.5	0.75	0.07	2.5	0.75	0.23	--	--
	2.5	0.76	0.07	2.5	0.76	0.22	--	--
	2.5	0.77	0.06	2.5	0.77	0.22	--	--
	2.6	0.78	0.06	2.6	0.78	0.21	--	--
	2.6	0.79	0.06	2.6	0.79	0.2	--	--
	2.6	0.80	0.05	2.6	0.80	0.19	--	--
	2.7	0.81	0.05	2.7	0.81	0.18	--	--
	2.7	0.82	0.05	2.7	0.82	0.17	--	--
	2.7	0.83	0.05	2.7	0.83	0.17	--	--
	2.7	0.84	0.04	2.7	0.84	0.16	--	--
	2.8	0.85	0.04	2.8	0.85	0.15	--	--
	2.8	0.86	0.04	2.8	0.86	0.15	--	--
	2.9	0.87	0.04	2.9	0.87	0.14	--	--
	2.9	0.88	0.04	2.9	0.88	0.13	--	--
	2.9	0.89	0.03	2.9	0.89	0.13	--	--
	2.9	0.90	0.03	2.9	0.90	0.12	--	--
	3.0	0.91	0.03	3.0	0.91	0.12	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	3.0	0.92	0.03	3.0	0.92	0.11	--	--
	3.1	0.93	0.03	3.1	0.93	0.11	--	--
	3.1	0.94	0.03	3.1	0.94	0.1	--	--
	3.1	0.95	0.03	3.1	0.95	0.1	--	--
	3.1	0.96	0.02	3.1	0.96	0.09	--	--
	3.2	0.97	0.02	3.2	0.97	0.09	--	--
	3.2	0.98	0.02	3.2	0.98	0.08	--	--
	3.3	0.99	0.02	3.3	0.99	0.08	--	--
	3.3	1.00	0.02	3.3	1.00	0.08	--	--
	3.3	1.01	0.02	3.3	1.01	0.07	--	--
	3.3	1.02	0.02	3.3	1.02	0.07	--	--
	3.4	1.03	0.02	3.4	1.03	0.07	--	--
	3.4	1.04	0.02	3.4	1.04	0.06	--	--
	3.4	1.05	0.01	3.4	1.05	0.06	--	--
	3.5	1.06	0.01	3.5	1.06	0.06	--	--
	3.5	1.07	0.01	3.5	1.07	0.05	--	--
	3.5	1.08	0.01	3.5	1.08	0.05	--	--
	3.6	1.09	0.01	3.6	1.09	0.05	--	--
	3.6	1.10	0.01	3.6	1.10	0.05	--	--
	3.6	1.11	0.01	3.6	1.11	0.04	--	--
	3.7	1.12	0.01	3.7	1.12	0.04	--	--
	3.7	1.13	0.01	3.7	1.13	0.04	--	--
	3.7	1.14	0.01	3.7	1.14	0.04	--	--
	3.8	1.15	0.01	3.8	1.15	0.04	--	--
	3.8	1.16	0.01	3.8	1.16	0.03	--	--
	3.8	1.17	0.01	3.8	1.17	0.03	--	--
SRHAV	3.9	1.18	0.01	3.9	1.18	0.03	--	--
	3.9	1.19	0.01	3.9	1.19	0.03	--	--
	3.9	1.20	0.01	3.9	1.20	0.03	--	--
	4.0	1.21	0.01	4.0	1.21	0.03	--	--
	4.0	1.22	0.01	4.0	1.22	0.02	--	--
	4.0	1.23	0.01	4.0	1.23	0.02	--	--
	4.1	1.24	0	4.1	1.24	0.02	--	--
	--	--	--	4.1	1.25	0.02	--	--
	--	--	--	4.1	1.26	0.02	--	--
	--	--	--	4.2	1.27	0.02	--	--
	--	--	--	4.2	1.28	0.02	--	--
	--	--	--	4.2	1.29	0.02	--	--
	--	--	--	4.3	1.30	0.02	--	--
	--	--	--	4.3	1.31	0.02	--	--
	--	--	--	4.3	1.32	0.01	--	--
	--	--	--	4.4	1.33	0.01	--	--
	--	--	--	4.4	1.34	0.01	--	--
	--	--	--	4.4	1.34	0.01	--	--
	--	--	--	4.5	1.36	0.01	--	--
	--	--	--	4.5	1.37	0.01	--	--
	--	--	--	4.5	1.38	0.01	--	--
	--	--	--	4.6	1.39	0.01	--	--
	--	--	--	4.6	1.40	0.01	--	--
	--	--	--	4.6	1.41	0.01	--	--
	--	--	--	4.7	1.42	0.01	--	--
	--	--	--	4.7	1.43	0.01	--	--
	--	--	--	4.7	1.44	0.01	--	--
	--	--	--	4.8	1.45	0.01	--	--

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	--	--	--	4.8	1.46	0.01	--	--
	--	--	--	4.8	1.47	0.01	--	--
	--	--	--	4.8	1.48	0.01	--	--
	--	--	--	4.9	1.49	0.01	--	--
	--	--	--	4.9	1.50	0	--	--
	--	--	--	5.3	1.63	0	--	--
SHSLO	0.00	0.00	0	0.00	0.00	0	1	0
	0.33	0.10	1	0.10	0.03	1	2	0
	1.00	0.31	1	2.00	0.61	1	3	1
	1.00	0.31	0	2.03	0.62	0	4	1
	--	--	--	--	--	--	5	1
	--	--	--	--	--	--	6	1
	--	--	--	--	--	--	7	0
	--	--	--	--	--	--	8	0
	--	--	--	--	--	--	9	1
	--	--	--	--	--	--	10	1
	--	--	--	--	--	--	11	1
	--	--	--	--	--	--	12	1
	--	--	--	--	--	--	13	1
	--	--	--	--	--	--	14	1
	--	--	--	--	--	--	15	1
	--	--	--	--	--	--	16	1
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0
SHFST	0.00	0.00	0	0.00	0.00	0	1	0
	0.76	0.23	0.3	0.15	0.05	0.1	2	0
	1.50	0.46	1	0.25	0.08	0.8	3	0.75
	2.50	0.76	1	0.35	0.11	1	4	1
	3.50	1.07	0.4	1.20	0.37	1	5	0
	3.80	1.16	0.2	1.50	0.46	0.75	6	0
	4.00	1.22	0	2.00	0.61	0.3	7	0
	--	--	--	2.50	0.76	0.1	8	0.5
	--	--	--	6.00	1.83	0	9	0.75
	--	--	--	--	--	--	10	1
	--	--	--	--	--	--	11	0
	--	--	--	--	--	--	12	1
	--	--	--	--	--	--	13	0
	--	--	--	--	--	--	14	1
	--	--	--	--	--	--	15	0
	--	--	--	--	--	--	16	0.75
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0

Table 2. Deep Guild HSC Table

Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
RBSFA	0.0	0.00	1.00	0.0	0.00	0.00	1	0.1
	0.8	0.23	1.00	0.2	0.06	0.00	2	0.3
	1.5	0.46	0.30	1.2	0.37	0.80	3	0.7
	3.0	0.91	0.00	2.0	0.61	1.00	4	0.8
	--	--	--	6.0	1.83	1.00	5	0.7
	--	--	--	7.5	2.29	0.60	6	0.3
	--	--	--	8.2	2.50	0.00	7	0.1
	--	--	--	--	--	--	8	0.8
	--	--	--	--	--	--	9	1
	--	--	--	--	--	--	10	0.8
	--	--	--	--	--	--	11	1
	--	--	--	--	--	--	12	0.8
	--	--	--	--	--	--	13	1
	--	--	--	--	--	--	14	0.9
	--	--	--	--	--	--	15	1
	--	--	--	--	--	--	16	0.85
	--	--	--	--	--	--	17	0.65
	--	--	--	--	--	--	18	0
DSLON	0.0	0.00	1.00	0.0	0.00	0.00	1	1
	1.0	0.31	1.00	2.0	0.61	0.00	2	1
	1.0	0.31	0.00	2.0	0.61	1.00	3	1
	2.0	0.61	0.00	10.0	3.05	1.00	4	1
	--	--	--	--	--	--	5	1
	--	--	--	--	--	--	6	1
	--	--	--	--	--	--	7	1
	--	--	--	--	--	--	8	0
	--	--	--	--	--	--	9	0
	--	--	--	--	--	--	10	0
	--	--	--	--	--	--	11	0
	--	--	--	--	--	--	12	0
DSLON	--	--	--	--	--	--	13	0
	--	--	--	--	--	--	14	0.5
	--	--	--	--	--	--	15	0.5
	--	--	--	--	--	--	16	0
	--	--	--	--	--	--	17	0
	--	--	--	--	--	--	18	0
SRHAD	0.0	0.00	0.00	0.0	0.00	0.00	1	0.1
	0.1	0.04	0.51	1.5	0.46	0.00	2	0.45
	0.4	0.12	0.62	2.4	0.73	0.57	3	0.65
	0.6	0.20	0.82	3.3	1.02	0.91	4	0.475
	0.8	0.24	1.00	3.8	1.16	1.00	5	0.35
	1.0	0.32	1.00	4.8	1.45	1.00	6	0.48
	1.2	0.36	0.91	5.2	1.59	1.00	7	0.34
	1.4	0.44	0.6	6.2	1.88	1	8	0.55
	1.7	0.52	0.27	7.1	2.18	1	9	0.82
	2.0	0.60	0.08	8.1	2.47	1	10	0.75
	2.2	0.68	0.02	9.0	2.76	1	11	0.75
	2.4	0.719	0	9.5	2.90	1	12	0.75
	--	--	--	15.0	4.56	1	13	0.75
	--	--	--	--	--	--	14	0.75
	--	--	--	--	--	--	15	0.75
	--	--	--	--	--	--	16	0.82
	--	--	--	--	--	--	17	0.75
	--	--	--	--	--	--	18	0
SHRHA	0.0	0.00	0.37	0.0	0.00	0.00	1	0.2
	0.4	0.12	0.48	0.4	0.12	0.00	2	0.38

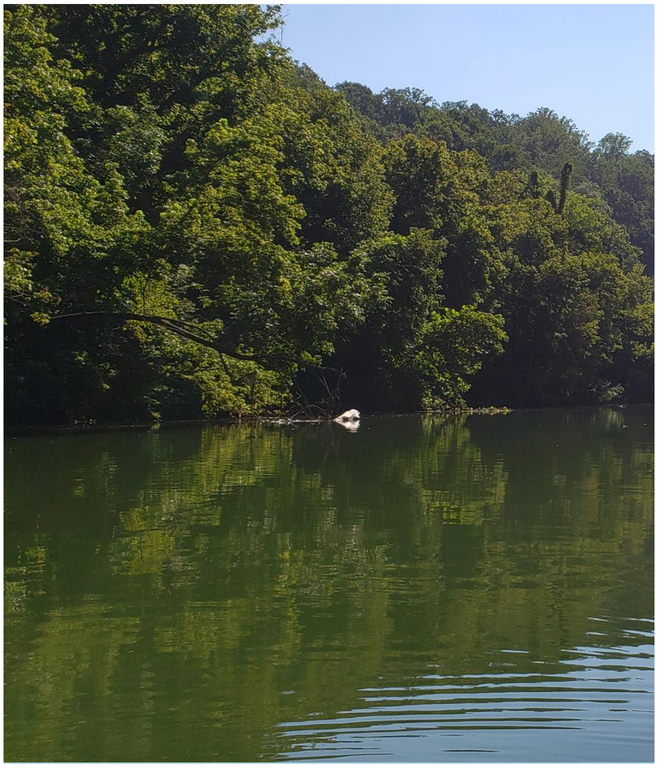
Lifestage	Velocity (ft/s)	Velocity (m/s)	Suitability Index	Depth (ft)	Depth (m)	Suitability Index	Channel Index	Suitability Index
	0.8	0.24	0.59	0.8	0.24	0.06	3	0.7
	1.2	0.37	0.70	1.0	0.31	0.14	4	0.75
	1.6	0.49	0.80	1.2	0.37	0.26	5	0.5
	2.0	0.61	0.89	1.4	0.43	0.41	6	0.55
	2.4	0.73	0.95	1.6	0.49	0.56	7	0.3
	2.8	0.85	0.99	1.8	0.55	0.7	8	0.45
	3.2	0.98	1	2.0	0.61	0.81	9	0.7
	3.6	1.10	0.97	2.2	0.67	0.9	10	0.75
	4.0	1.22	0.91	2.4	0.73	0.96	11	0.62
	4.2	1.28	0.86	2.6	0.79	0.99	12	0.75
	4.4	1.34	0.8	2.8	0.85	1	13	0.78
	4.6	1.40	0.71	5	1.52	1	14	0.75
	4.8	1.46	0.58	12	3.66	1	15	0.78
	4.9	1.49	0.47	13	3.96	0.11	16	0.85
	5.0	1.51	0.36	14	4.27	0.09	17	0.7
	5.0	1.52	0.16	15	4.57	0.07	18	0
	5.0	1.52	0	17	5.18	0.05	--	--
	--	--	--	19	5.79	0.03	--	--
	--	--	--	24	7.32	0.01	--	--
	--	--	--	28	8.53	0	--	--

Table 3. Target Species Habitat and Suitability Criteria source and Code Table

Species or Guild	Life Stage/ Category	Representative	Source Study	HSC Code
Roanoke Logperch	Adult	--	Rosenberger and Angermeier 2003	RLPA
	Subadult	--	Rosenberger and Angermeier 2003	RLPSA
	Young-of-Year	--	Rosenberger and Angermeier 2003	RLPYOY
Shallow-Slow Guild	Fine substrate no cover	Redbreast sunfish spawning	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFS
	All substrate with aquatic vegetation	Silver redhorse Young of Year	Sutton Hydroelectric Project, Elk River, WV	SRHAV
	Coarse substrate	Generic shallow-slow guild	Sutton Hydroelectric Project, Elk River, WV	SHSLO
Shallow-Fast Guild	Moderate velocity with coarse substrate	Generic shallow-fast guild	Claytor Hydroelectric Project New River, VA	SHFST
Deep-Slow Guild	Cover	Redbreast sunfish Adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	RBSFA
	No cover	Generic deep-slow guild	Sutton Hydroelectric Project, Elk River, WV	DSLON
Deep-Fast Guild	Slightly weighted for fine substrate, Cover	Silver redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SRHAD
	Coarse-mixed substrate	Shorthead redhorse adult	Smith Mountain Hydroelectric Project, Roanoke River, VA	SHRHA

Appendix B

Appendix B – Preliminary Water Quality Study Report



Preliminary Water Quality Report

Niagara Hydroelectric Project
(FERC No. 2466)

January 11, 2021

Prepared by:

Prepared for:

Appalachian Power Company

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Contents

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Acronyms and Abbreviations

°C	degrees Celsius
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
DO	dissolved oxygen
CFR	Code of Federal Regulations
CWA	Clean Water Act
FERC or Commission	Federal Energy Regulatory Commission
Ft	feet/foot
mg/l	milligrams per liter
Hydrolab	Hach Hydrolab® MS5
ILP	Integrated Licensing Process
ISR	Initial Study Report
PAD	Pre-Application Document
PM&E	protection, mitigation, and enhancement
Project	Niagara Hydroelectric Project
RSP	Revised Study Plan
SPD	Study Plan Determination
TMDL	total maximum daily load
USGS	U.S. Geological Survey
VAC	Virginia Administrative Code
VDEQ	Virginia Department of Environmental Quality
μS/cm	microsiemens per centimeter

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD).

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Water Quality Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

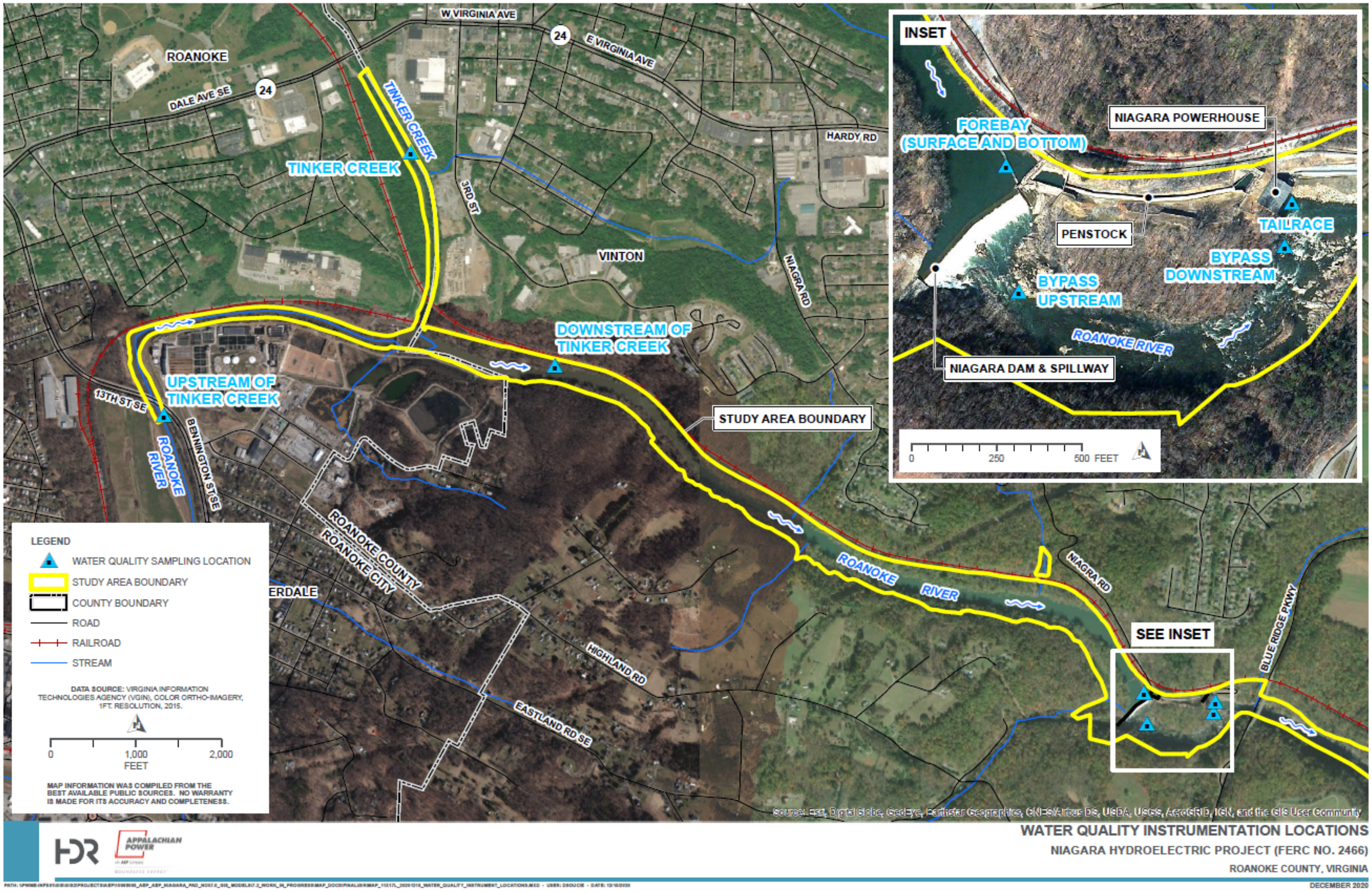
Appalachian's proposed Water Quality Study employs standard methodologies that are consistent with the scope and level of effort of water quality monitoring conducted at hydropower projects in the region. Appalachian believes that this study provides sufficient information to support an analysis of the potential Project-related effects on water quality. The goals and objectives of this study are to:

- Gather baseline water quality data sufficient to determine consistency of existing Project operations with applicable Virginia state water quality standards and designated uses (Virginia Administrative Code [VAC] Chapter 260).
- Provide data (temperature and dissolved oxygen [DO] concentration) to determine the presence and extent, if any, of temperature or DO stratification in the Niagara impoundment.
- Provide data to support a Virginia Water Protection Permit application (Clean Water Act [CWA] Section 401 Certification).
- Provide information to support evaluation of whether additional or modified protection, mitigation, and enhancement (PM&E) measures may be appropriate for the protection of water quality at the Project.

3 Study Area

The study area for the Water Quality Study includes the Roanoke River within and immediately upstream and downstream of the Niagara Project boundary as shown on Figure 3-1. Appalachian established eight water quality monitoring locations for approximately three months in 2020:

- One location in the free-flowing section of river upstream of the reservoir and confluence with Tinker Creek;
- One location in Tinker Creek;
- One location in the reservoir downstream of the confluence with Tinker Creek;
- Two locations in the forebay area (one near surface and the other near bottom);
- One location in the tailrace below the powerhouse; and
- Two locations in the bypass reach (upstream location and downstream location).



DATA SOURCE: VIRGINIA INFORMATION TECHNOLOGIES AGENCY (VGIN), COLOR ORTHO-IMAGERY, 1FT. RESOLUTION, 2015.

MAP INFORMATION WAS COMPILED FROM THE BEST AVAILABLE PUBLIC SOURCES. NO WARRANTY IS MADE FOR ITS ACCURACY AND COMPLETENESS.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

WATER QUALITY INSTRUMENTATION LOCATIONS
NIAGARA HYDROELECTRIC PROJECT (FERC NO. 2466)
ROANOKE COUNTY, VIRGINIA
DECEMBER 2020

Figure 3-1. Water Quality Study Monitoring Locations

4 Background and Existing Information

Existing relevant and reasonably available information regarding water quality in the Project vicinity was presented in Section 5.3 of the Pre-Application Document (PAD). The PAD included historical water quality data collected by the U.S. Geological Survey (USGS) and the Virginia Department of Environmental Quality (VDEQ) upstream and downstream of the study area. Temperature, DO, pH, and specific conductivity data indicate that inflows to and outflows from the Project meet numeric water quality standards (9VAC25-260-50) required to support designated uses identified at 9VAC25-260-10. No recent water quality data specifically for the Project reservoir or bypass reach were available for preparation of the PAD.

The VDEQ is responsible for carrying out the mandates of the State Water Control Law as well as meeting federal obligations under the CWA (VDEQ 2017a). Waters in the Roanoke River Basin are classified in 9VAC25-260-450. The Roanoke River is designated as Class IV (Mountainous Zone) waters. Tinker Creek is designated as Class VII (Swamp Waters). Numerical criteria for DO, pH, and water temperature for Class IV and VII waters are identified in 9VAC25-260-50 and are summarized in Table 4-1.

Table 4-1. Numeric Water Quality Criteria for Class IV and VII Waters

Parameter	Class IV Standard (Roanoke River)	Class VII (Tinker Creek)
Minimum DO	4.0 milligram per liter (mg/l)	*
Daily Average DO	5.0 mg/l	*
pH	6.0 – 9.0	3.7-8.0*
Maximum water temperature	31 degrees Celsius (ºC)	**

*This classification recognizes that the natural quality of these waters may fluctuate outside of the values for DO and pH set forth above as water quality criteria in Class I through VI waters. The natural quality of these waters is the water quality found or expected in the absence of human-induced pollution. Water quality standards will not be considered violated when conditions are determined by the VDEQ to be natural and not due to human-induced sources. The State Water Control Board may develop site specific criteria for Class VII waters that reflect the natural quality of the waterbody when the evidence is sufficient to demonstrate that the site-specific criteria rather than narrative criterion will fully protect aquatic life uses. Virginia Pollutant Discharge Elimination System limitations in Class VII waters shall not cause significant changes to the naturally occurring dissolved oxygen and pH fluctuations in these waters.
** Maximum temperature will be the same as that for Classes I through VI waters as appropriate.
Note: mg/L = milligrams per liter

Due to factors unrelated to Project operations, multiple reaches within the Project boundary were listed as impaired in the 2018 §305(b)/303(d) Water Quality Assessment Integrated Report, including fish consumption advisories (VDEQ 2019). However, the source of impairment is not associated with the Project and it is expected that continued operation of the Project will have no effect on whether not these reaches continue to be listed as impaired. Potential sources for water quality impairment include discharges from an upstream wastewater treatment plant, municipal separate storm sewer systems, industrial point source discharge, landfills, municipal areas, individual private treatment systems, sanitary sewer outflows, and wildlife (VDEQ 2019).

Total maximum daily loads (TMDLs) for aquatic life (benthic) use, polychlorinated biphenyls, and bacteria have been developed for the Roanoke River (Berger 2006; Tetra Tech, Inc. 2009; GMU & Berger 2006).

According to the benthic TMDL prepared for the upper Roanoke River (Berger 2006), sediment has been identified as the most probable stressor impacting benthic macroinvertebrates in the biologically impaired segments of the Roanoke River. Excessive sediment loading can negatively impact benthic macroinvertebrates through siltation of habitat, water quality degradation (e.g., decreased light, temperature, and DO concentrations) due to excess sediment in the water column, and bringing invertebrates into contact with other pollutants that enter surface water via adhesion to sediment particles. Potential sources of sediment loading in the watershed include urban stormwater runoff, streambank erosion, and sediment loss from habitat degradation associated with urbanization.

In late July 2017, approximately 165 gallons of Termix 5301, a type of surfactant that is added to herbicide and pesticide products before application, was spilled into Tinker Creek in Cloverdale, Virginia, upstream of the Project. The resulting fish kill was estimated at tens of thousands of fish in Tinker Creek. The fish kill occurred outside of the Project boundary, and no effects have been identified in the mainstem of the Roanoke River. The VDEQ continues to work with the U.S. Fish and Wildlife Service and the Virginia Department of Wildlife Resources (formerly the Virginia Department of Inland Fisheries) on monitoring the recovery of Tinker Creek (VDEQ 2017b).

5 Methodology

5.1 Data Collection

Appalachian performed continuous temperature and DO monitoring, discrete multiparameter water quality sampling, and reservoir and forebay vertical profile data collection at the eight locations identified on Figure 3-1. Combined water temperature and DO data loggers were set to record water temperature and DO at 15-minute intervals from July 29 through November 10, 2020. Calibrated Onset® HOBO U26 DO/Temperature Loggers (i.e. sondes) were deployed for continuous in situ measurements. Protective measures were used such as weighting the data sondes or attaching them to permanent structures to maintain position during high flow events and housing the sonde within protective porous housing to minimize impact from movement during high flow events and/or floating debris.

At each monitoring location, two data sondes were deployed to provide redundancy. In the two deeper monitoring locations (i.e., reservoir downstream of the confluence with Tinker Creek and the reservoir forebay area) the data sondes were deployed both near the reservoir bottom and near the surface to capture temperature and DO stratification (if any). During the continuous monitoring period, the data sondes were downloaded five times (August 12 and 26, September 22-23, October 21, and November 9-10, 2020). Field staff downloaded data using a data shuttle or directly to a laptop computer. The sondes were cleaned, checked for operation, calibration, and battery life; and adjusted as necessary based on manufacturer’s specifications. The cable, housing, and other installation materials were visually inspected for damage and repaired or replaced as necessary. The download schedule was accelerated from monthly to bi-weekly when possible to reduce effects associated with biofouling, which was greater than anticipated at the time of the RSP development.

During the initial deployment and subsequent download events, discrete multi-parameter water quality measurements (i.e. spot measurements) of temperature, DO concentration, pH, and specific conductivity were collected at each monitoring location using a Hach Hydrolab® MS5 (Hydrolab). For riverine monitoring locations, Hydrolab water quality data was collected at one location within the water column at a depth similar to the sondes. Profiles were collected at 1-foot (ft) intervals using the Hydrolab for the two reservoir monitoring locations to document temperature and DO stratification at the time of the data sonde downloads.

5.2 Data Analysis and Processing

Upon completion of the field data collection effort, data was checked for errors and omissions. Data that more closely matched the discrete measurement readings made in the field during download events were preferentially reported and analyzed for each monitoring location. Note there are several data gaps that occurred during the field data collection period that were the result of biofouling, equipment malfunction, and/or equipment theft (details provided in Section 8). These data gaps did not affect the overall summary results and conclusions of this study report.

Real-time flow data (15-minute) was obtained from the USGS Roanoke River at Niagara Gage (USGS 02056000), which is approximately 500 ft downstream of the Niagara powerhouse and includes the combined flows from the powerhouse and bypass reach. Flows have been recorded since October 1990 at the USGS Roanoke River at Niagara Gage and corresponding stage from October 2007 to present.

5.3 Equipment Calibration and Quality Assurance

Prior to the first deployment, Onset HOBO® Model U26 DO/Temperature Loggers were initialized with a new DO sensor cap and calibrated. The Hydrolab multi-parameter water quality sonde was lab calibrated by the manufacturer. Prior to each instantaneous sample collection, the Hydrolab was checked against a suite of standards. A Hydrolab® Surveyor 4a (Surveyor) is the handheld display that connects to the Hydrolab sonde for attended monitoring applications. The Surveyor was sent to the manufacturer for calibration prior to the field deployment. The water quality sensor specifications as specified by the manufacturer are presented in Table 5-1.

Table 5-1. Water Quality Sensor Specifications

Water Quality Sensor Accuracy		
Sensor	Hydrolab® MS5[2]	Onset HOBO® Model U26[3]
Temperature	+/- 0.1°C	+/- 0.2°C
DO[1]	+/- 0.1 mg/l for 0 – 8 mg/l; +/- 0.2 mg/l for greater than 8 mg/l	+/- 0.2 mg/L for 0 – 8 mg/l; +/- 0.5 mg/L for greater than 8 mg/l
Specific conductivity	+/- 0.5 % of reading; +/- 0.001 millisiemens/centimeter	N/A
pH	+/- 0.2 units	N/A

Note:

[1] Hach LDO® - Luminescent Dissolved Oxygen sensor or Onset RDO ® - Rugged Dissolved Oxygen. Both use light to optically measure dissolved oxygen.

[2] Specifications for the Hydrolab® MS5: https://s.campbellsci.com/documents/ca/product-brochures/series_5_br.pdf

[3] Specifications for the Onset HOBO® Model U26: https://www.onsetcomp.com/products/data-loggers/u26-001/

6 Study Results

6.1 Water Temperature

Figure 1-1 in Attachment 1 provides continuous and discrete water temperature data at all locations. At the time of initial data sonde deployment on July 29, 2020, water temperatures were in the 24 – 27ºC range at the Roanoke River monitoring locations and in the 20 – 25ºC range at the Tinker Creek monitoring location. Water temperatures recorded at the USGS 02055080 Roanoke River at the Thirteenth Street Bridge in Roanoke, Virginia water quality monitoring station (immediately upstream of the reservoir) peaked at 28.7ºC on July 20, 2020; approximately one week prior to initial deployment of the data sondes. Water temperatures generally decreased during the 2020 study period and dropped to approximately 10ºC by early November 2020. Tinker Creek water temperatures were several degrees cooler and exhibited larger daily fluctuations compared to the Roanoke River monitoring locations. The Tinker Creek monitoring location is heavily canopied which may contribute to the cooler temperatures, and the drainage area is relatively small[1] which may contribute to the larger daily fluctuations.

Water temperature vertical profile data is presented in Figure 3-1 (forebay monitoring location) and Figure 3-4 (reservoir monitoring location) of Attachment 3. While water temperature varied seasonally, there was no thermal stratification at the reservoir monitoring location and no to very weak (i.e., <0.5 ºC) thermal stratification at the forebay monitoring location.

6.2 Dissolved Oxygen

Figure 1-2 in Attachment 1 provides continuous and discrete DO concentration data at the Thirteenth Street Bridge and Tinker Creek monitoring locations which are both inflows to the reservoir. All measurements were greater than the 5.0 mg/l daily average DO standard with daily fluctuations in the 2 – 3 mg/l range at both locations. The sharp decline in Tinker Creek DO concentrations the first week of September 2020 were likely the result of a 3-inch rainfall runoff event that occurred at the beginning of that week (see Figure 4-1 of Attachment 4 for rainfall and streamflow data during the study period).

Figure 1-3 (Attachment 1) provides continuous and discrete DO concentration data at the Project’s forebay and tailrace monitoring locations. Most measurements were greater than the 5.0 mg/l daily average DO standard with the exceptions of September 8, 9, and 11, 2020 when instantaneous DO concentrations dropped to 3.3 mg/l, 4.1 mg/l, and 3.4 mg/l, respectively. Each of these occurrences lasted less than 1.5 hours and the daily average DO concentrations were all greater than 5.0 mg/l. These short duration events are likely related to a powerhouse outage which began on September 8, 2020 and lasted through the end of the study period on November 10, 2020. Because there was no flow through the powerhouse, instantaneous DO concentrations fluctuated (albeit it very short-lived) between the forebay surface and bottom elevations. During these three brief periods, DO

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[1] The drainage area at the Tinker Creek monitoring location is approximately 78 square miles; 66 of which are classified as urban land use, as compared to the Roanoke River drainage area at the Thirteenth Street Bridge monitoring location which is approximately 390 square miles.

concentrations near the surface remained above 5.0 mg/l and as a result, overall DO concentrations in the forebay met the state's DO criteria.[2]

Daily fluctuations in DO concentrations were in the 1 – 2 mg/l range at the forebay and tailrace monitoring locations; slightly less than the daily fluctuations at the two upstream monitoring locations. Similar to water temperature, there was little (i.e., typically < 1 mg/l) to no difference in DO concentrations between the forebay surface and bottom locations (with the exception of the three events noted above); indicating little to no stratification of DO concentrations throughout the forebay water column. DO concentrations in the tailrace were generally higher (by less than 0.5 mg/l) compared to the surface forebay monitoring location during both periods of generation and non-generation (see data pre- and post- powerhouse outage on September 8, 2020).

Figure 1-4 in Attachment 1 provides continuous and discrete DO concentration data at the bypass reach upstream and downstream monitoring locations. Overall magnitude and trends in DO concentrations were very similar between the forebay, tailrace and bypass reach monitoring locations. All measurements were greater than the 5.0 mg/l daily average DO standard with daily fluctuations in the 1.5 – 2.5 mg/l range prior to the powerhouse outage that occurred on September 8, 2020; after which, daily fluctuations were less than 1 mg/l due to the large flow throughput in the bypass reach when generation flows ceased.

DO vertical profile data is presented in [Attachment 3] Figure 3-1 (forebay monitoring location) and Figure 3-4 (reservoir monitoring location). Similar to the water temperature profile data, there was no stratification of DO concentrations at the reservoir monitoring location and no to very weak (i.e., typically <1.0 mg/l) stratification at the forebay monitoring location.

6.3 pH

Vertical profile data showing pH is presented in [Attachment 3] Figure 3-2 (forebay monitoring location) and Figure 3-5 (reservoir monitoring location). pH range at both locations was tightly packed (between 7.6 and 7.85) during each discrete sampling event, and there was little to no stratification between the reservoir surface and bottom measurements at both monitoring locations.

6.4 Specific Conductivity

While Virginia does not have a state standard for specific conductivity, concentrations between 150-500 microsiemens per centimeter (µS/cm) are generally considered suitable for most fish species (USEPA 2012). Specific conductivity vertical profile data is presented in Attachment 3, Figure 3-3 (forebay monitoring location) and Figure 3-6 (reservoir monitoring location). Specific conductivity at the forebay monitoring location varied each sampling event, but concentrations were typically the same from reservoir surface to bottom and ranged from 370 – 435 µS/cm over four sampling events during the study period (see Figure 3-3). Specific conductivity at the reservoir monitoring location also varied each sampling event and concentrations were typically the same from reservoir surface

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[2] For a thermally stratified man-made lake or reservoir in Class III, IV, V or VI waters that are listed in 9VAC25-260-187, these dissolved oxygen and pH criteria apply only to the epilimnion of the waterbody. When these waters are not stratified, the dissolved oxygen and pH criteria apply throughout the water column.

to bottom, but with a slightly higher (and narrower) range between 411 – 436 µS/cm (see Attachment 3, Figure 3-3) over the four sampling events.

Discrete measurements of specific conductivity at the Tinker Creek monitoring location ranged from 461 – 494 µS/cm which is slightly higher than at the Thirteenth Street Bridge monitoring location, which ranged from 319 – 396 µS/cm (see Table 2-1 for discrete sampling results). As expected, specific conductivity concentrations at the monitoring locations downstream from these two sampling points fit within these two ranges, the result of blended inflow to the reservoir.

7 Summary and Discussion

7.1 Consistency with Applicable Virginia State Water Quality Standards

Continuous and discrete water quality data collected during the 2020 study period met Virginia Class IV (Roanoke River) and Class VII (Tinker Creek) water quality standards for temperature (<31 ºC), DO (>4.0 mg/l instantaneous minimum; >5.0 mg/l daily average), and pH (range 6.0 – 9.0 for Class IV and 3.7 – 8 for Class VII) at all monitoring locations during the study period. The continuous monitoring data captured three events when forebay bottom DO concentrations dropped to, or slightly below 4 mg/l for a short periods (typically less than 1.5 hours), which was likely the result of a powerhouse outage. Even with these short-lived events, the Project met state water quality criteria throughout the 2020 study period.

7.2 Temperature and Dissolved Oxygen Stratification in the Niagara Impoundment

Continuous and discrete water quality data collected during the 2020 study period indicated little to no thermal or DO stratification at the reservoir and forebay monitoring locations. Water temperatures typically varied less than 1.0ºC from reservoir surface to bottom, and DO concentrations typically varied less than 1.0 mg/l from reservoir surface to bottom.

Continuous water temperatures recorded at the USGS Thirteenth Street Bridge water quality monitoring station (immediately upstream of the reservoir) peaked at 28.7ºC on July 20, 2020; approximately one week prior to initial deployment of the data sondes. As a result, water temperatures recorded during this study are representative of both warmer summer months and cooler fall months.

7.3 Need for Protection, Mitigation, and Enhancement Measures to Protect Water Quality

Water quality in the streams flowing into the Niagara reservoir, the reservoir itself (including the Project’s forebay area), tailrace, and bypass reach is consistent with applicable Virginia state water quality standards for temperature, DO, and pH for Class IV (Roanoke River) and Class VII (Tinker Creek) surface waters. While there is no state standard for specific conductivity, concentrations were above 150 µS/cm and less than 500 µS/cm, which is generally considered to be suitable for most fish (USEPA 2012). As a result, there is no need for additional PM&E measures to protect water quality at the Project.

7.4 Additional Future Water Quality Data Needs

Flows in the Niagara bypass reach exceeded the 8 cfs minimum bypass flow (required by the current FERC operating license) during the entire 2020 study period. This was the result of higher than normal Project inflows (from the Roanoke River and Tinker Creek), damage to the trash sluice gate hoist operating system (resulting in the sluice gate providing a higher than required minimum flow throughout the study period), and a powerhouse outage which began on September 8, 2020 and lasted through the end of the study period on November 10, 2020. Higher than normal Project inflows resulted in many periods where the powerhouse generating capacity was exceeded and excess flow was routed to the bypass reach via the trash sluice gate, main spillway, and/or auxiliary spillway.

Figure 4-1 provides estimated bypass reach flows on an hourly basis during the 2020 study period. During this period, the trash sluice gate was open approximately 1.5 ft to route excess Project inflows to the bypass reach to help maintain the FERC authorized 1-ft reservoir operating band. As a result, bypass flows were typically in excess of 30 cfs until the powerhouse outage began on September 8, 2020; at which time 100 percent of Project inflows were routed to the bypass reach.

While all water quality measurements in the bypass reach during the 2020 study period met Virginia Class IV (Roanoke River) water quality standards, flows in the bypass reach were atypical (i.e., much higher) than the “normal” flow regime. As a result, it is recommended that two continuous temperature and DO data sondes be re-installed in the bypass reach (one at the upstream monitoring location and the other at the downstream monitoring location) during the warmest portion of the summer in 2021 (typically July and August) to record daily fluctuations in temperature and DO concentrations under a more typical bypass flow regime (i.e., flows closer to the 8 cfs minimum flow requirement), provided such operation of the Project is feasible at that time given anticipated commissioning of replacement of the trash sluice gate and operating system, which is presently expected to be completed by January 2021.

8 Variances from FERC-Approved Study Plan

To date, the study has been conducted in accordance with the FERC-approved RSP, with the exception of the following variances:

- The field season for this study was not able to commence until late July 2020 due to delays associated with travel restrictions and uncertainties related to the ongoing COVID-19 pandemic.
- Due to instrument malfunction, continuous DO and water temperature data were not captured from August 12-26, 2020.
- The forebay profile was not measured during deployment or the first download (August 12, 2020).
- As proposed in the RSP, water quality data downloads were to occur on a monthly basis; however, significant biofouling was observed at the instruments located in the reservoir downstream from Tinker Creek. Data download and instrument maintenance frequency was modified to a two-week interval; however, the biofouling resulted in several additional time periods where continuous water quality data is not available at this location.
- Discrete (i.e., spot) measurements were not collected at the Tailrace and Bypass Reach locations during the 8/12/2020 download due to instrument malfunction.
- One level logger and two DO sondes were stolen from the reservoir monitoring location downstream from Tinker Creek prior to the October download; these were not replaced since the theft occurred late in the study period and after peak water temperatures had occurred.
- Discrete (i.e., spot) measurements were not collected at the tailrace location during the 10/21/2020 download.

9 Germane Correspondence and Consultation

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the ISR to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021. These delays pushed the start of the 2020 field season into late July 2020. FERC letters of correspondence are included in Attachment 1 of the ISR.

10 References

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Attachment 1

Attachment 1 – Continuous Temperature and Dissolved Oxygen Plots

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Figure 1-1. Continuous and Discrete Temperature Measurements at All Water Quality Monitoring Locations

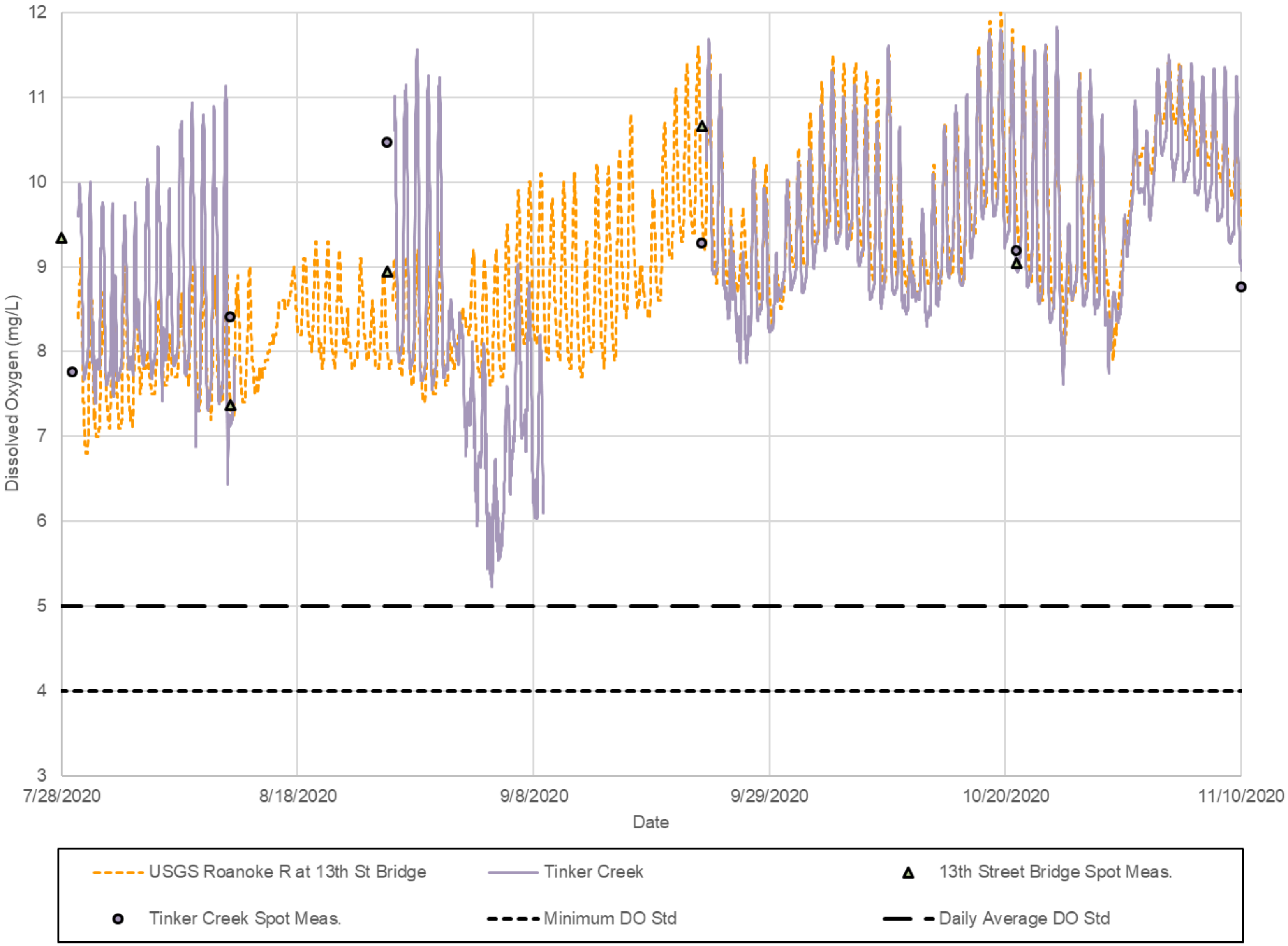

Figure 1-2. Continuous and Discrete Dissolved Oxygen Concentrations at the Upstream Water Quality Monitoring Locations

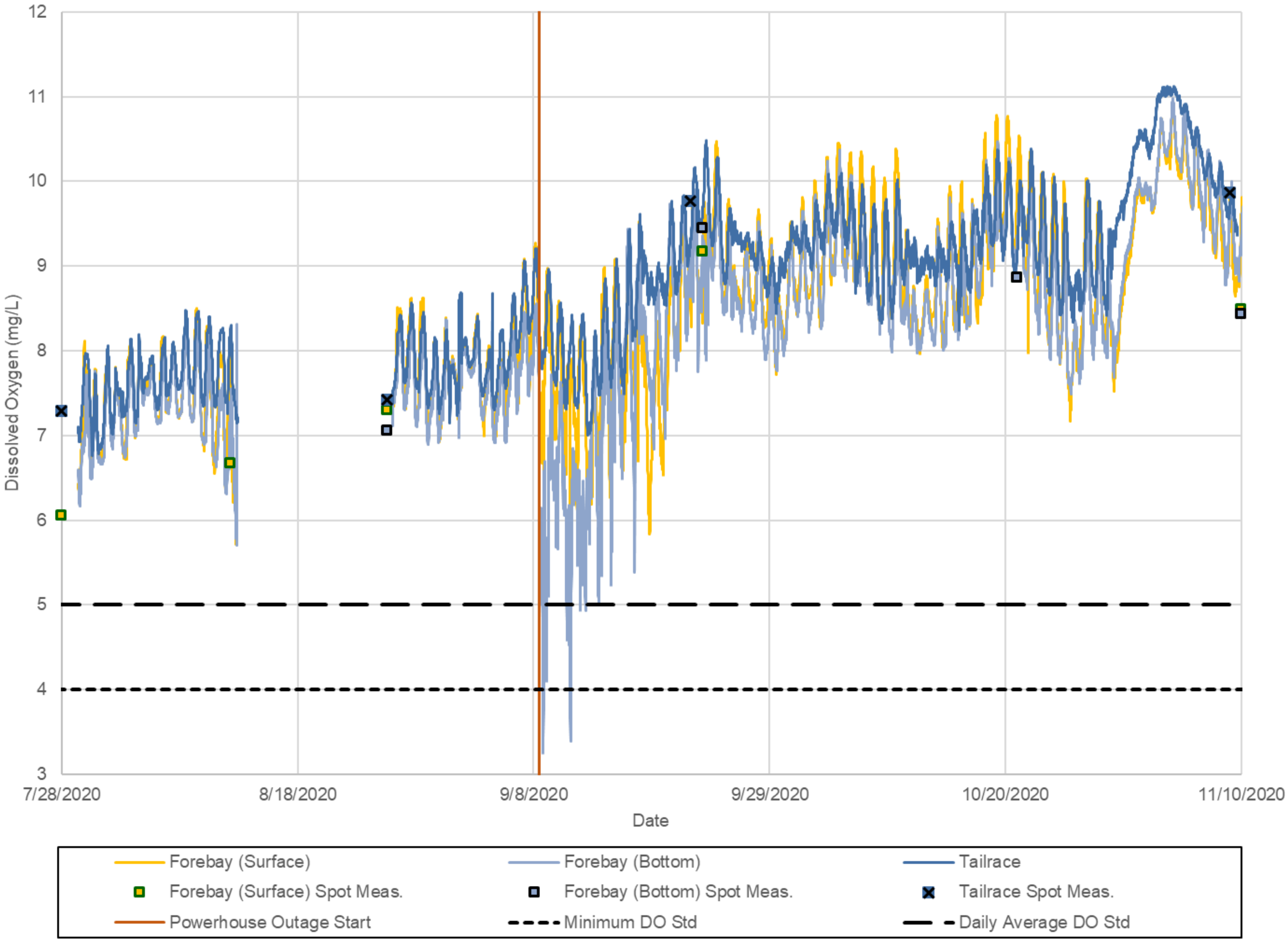

Figure 1-3. Continuous and Discrete Dissolved Oxygen Concentrations at the Forebay and Tailrace Water Quality Monitoring Locations

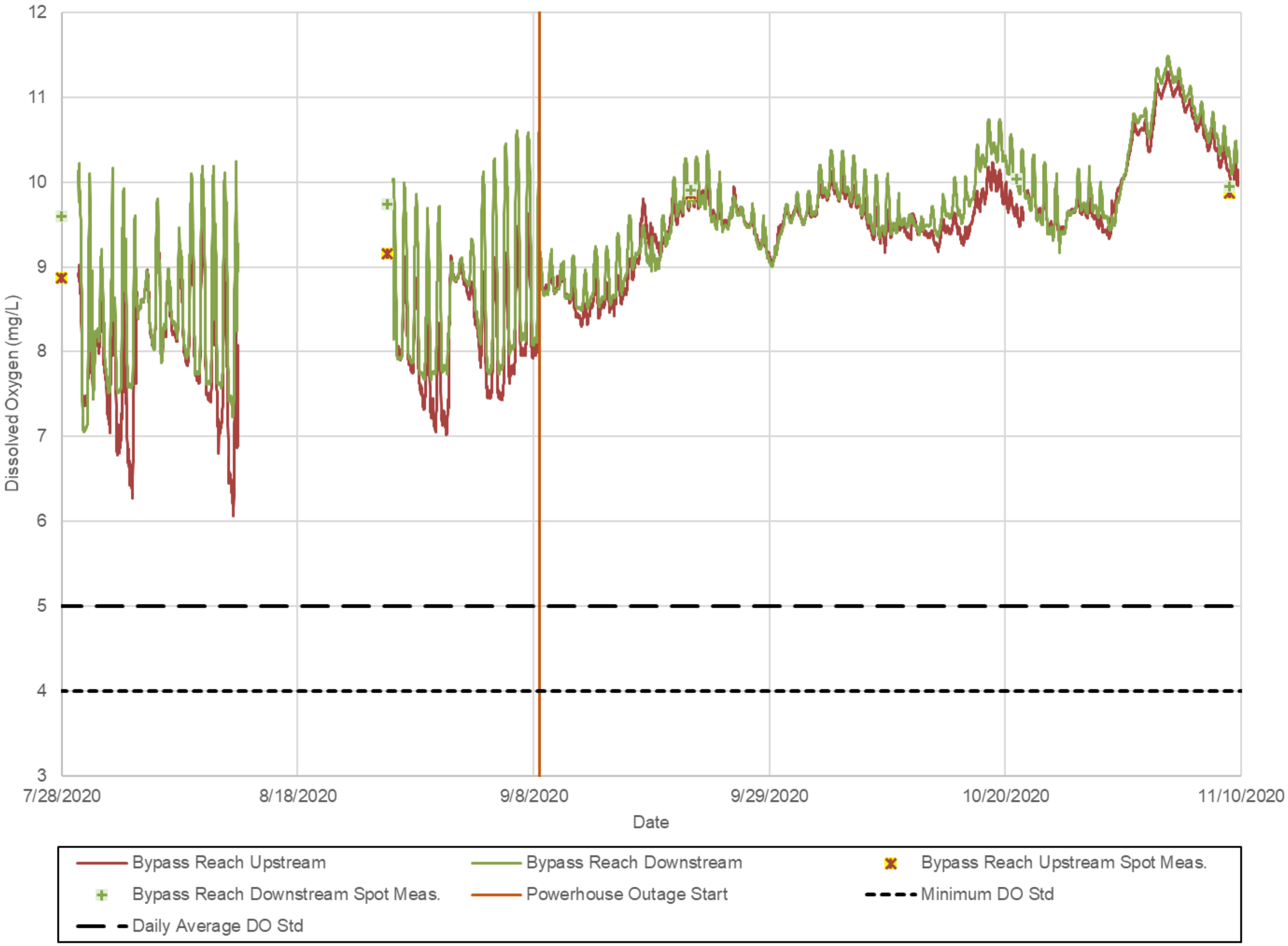

Figure 1-4. Continuous and Discrete Dissolved Oxygen Concentrations at the Bypass Reach Water Quality Monitoring Locations

Attachment 2

Attachment 2 – Discrete Measurement Tables

Table 2-1. Discrete Measurements at each Water Quality Monitoring Location

Location	Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductivity (µS/cm)
13th Street Bridge	7/28/2020	27.4	9.3	8.2	396
	8/12/2020	24.7	7.4	8.0	389
	8/26/2020	24.6	9.0	8.3	319
	9/23/2020	16.5	10.7	8.3	NA
	10/21/2020	14.6	9.0	8.0	365
	11/10/2020	15.1	9.5	8.1	339
Tinker Creek	7/29/2020	21.4	7.8	7.8	461
	8/12/2020	21.6	8.4	7.9	479
	8/26/2020	22.7	10.5	8.2	482
	9/23/2020	14.4	9.3	7.9	489
	10/21/2020	14.3	9.2	7.9	497
	11/10/2020	15.0	8.8	7.9	494
Reservoir	7/29/2020	23.7	6.4	7.8	457
	8/12/2020	23.6	6.7	7.7	450
	8/26/2020	24.5	8.1	7.9	392
	9/23/2020	16.1	8.5	7.7	436
	10/21/2020	15.3	NA	7.8	432
	11/10/2020	15.1	8.5	7.8	423
	11/10/2020	15.2	8.7	7.8	411
Forebay	7/28/2020	25.9	6.1	7.6	470
	8/12/2020	24.5	6.7	7.7	439
	8/26/2020	23.3	7.3	7.8	369
	9/23/2020	17.8	9.2	7.9	433
	10/21/2020	16.2	8.9	7.9	435
	11/10/2020	15.3	8.5	7.8	405
Tailrace	7/28/2020	25.5	7.3	7.7	467
	8/12/2020	NA	NA	NA	NA
	8/26/2020	23.2	7.4	7.8	373
	9/22/2020	17.2	9.8	7.8	423
	10/21/2020	NA	NA	NA	NA
	11/9/2020	14.4	9.9	7.9	397
Bypass Reach Upstream	7/28/2020	25.8	8.9	8.1	460
	8/12/2020	NA	NA	NA	NA
	8/26/2020	24.0	9.2	8.2	371
	9/22/2020	17.4	9.9	8.1	427
	10/21/2020	16.3	NA	8.1	432
	11/9/2020	14.3	9.9	8.0	394
Bypass Reach Downstream	7/28/2020	25.9	9.6	8.2	456
	8/12/2020	NA	NA	NA	NA

Location	Date	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductivity (µS/cm)
	8/26/2020	24.4	9.7	8.3	367
	9/22/2020	17.5	9.9	8.2	425
	10/21/2020	16.5	10.0	8.3	434
	11/9/2020	14.4	10.0	8.0	395

Note:

NA = not available. Instrument was not functioning correctly and/or conditions did not provide a valid reading

Table 2-2. Forebay Profile Data

	Temperature (°C)				Dissolved Oxygen (mg/L)				pH (SU)				Specific Conductivity (µS/cm)			
Depth	8/26/2020	9/23/2020	10/21/2020	11/10/2020	8/26/2020	9/23/2020	10/21/2020	11/10/2020	8/26/2020	9/23/2020	10/21/2020	11/10/2020	8/26/2020	9/23/2020	10/21/2020	11/10/2020
1	23.3	17.8	16.2	15.3	7.3	9.2	8.9	8.5	7.8	7.9	7.9	7.8	369	433	435	405
2	23.3	17.3	16.0	15.3	7.3	9.2	8.9	8.5	7.8	7.9	7.9	7.7	370	433	435	405
3	23.2	17.1	15.8	15.2	7.3	9.3	8.9	8.5	7.8	7.9	7.9	7.7	374	431	433	406
4	23.0	17.1	15.7	15.1	7.2	9.4	8.9	8.5	7.8	7.9	7.9	7.7	373	430	433	406
5	22.9	17.0	15.7	15.1	7.2	9.4	9.0	8.5	7.8	7.9	7.9	7.7	373	429	432	407
6	22.9	17.0	15.7	15.1	7.1	9.4	9.0	8.4	7.8	7.9	7.9	7.7	374	429	431	407
7	22.9	17.0	15.6	15.1	7.1	9.5	8.9	8.5	7.8	7.9	7.9	7.7	374	428	431	407
8	22.9	16.9	15.5	15.1	7.1	9.5	8.9	8.4	7.8	7.9	7.9	7.7	374	427	431	407
9	--	16.9	15.5	15.1	--	9.5	8.7	8.5	--	7.9	7.8	7.7	--	426	430	407
10	--	16.8	--	15.1	--	9.5	--	8.4	--	7.9	--	7.7	--	426	--	407
11	--	16.8	--	15.1	--	9.5	--	8.4	--	7.9	--	7.7	--	425	--	407

Table 2-3. Vertical Profile Water Quality Measurements at the Reservoir and Forebay Monitoring Locations

Depth	Temperature (°C)				Dissolved Oxygen (mg/L)				pH (SU)				Specific Conductivity (µS/cm)			
	9/23/2020	10/21/2020	11/10/2020	11/10/2020	9/23/2020	10/21/2020	11/10/2020	11/10/2020	9/23/2020	10/21/2020	11/10/2020	11/10/2020	9/23/2020	10/21/2020	11/10/2020	11/10/2020
1	16.1	15.3	15.1	15.2	8.5	NA	8.5	8.7	7.7	7.8	7.8	7.8	436	432	423	411
2	15.9	15.2	15.1	15.2	8.6	NA	8.6	8.6	7.7	7.8	7.8	7.8	436	432	423	412
3	15.9	15.2	15.1	15.2	8.7	NA	8.6	8.7	7.6	7.8	7.8	7.8	436	432	423	413
4	15.9	15.2	15.1	15.2	8.7	NA	8.6	8.6	7.6	7.8	7.8	7.8	435	432	424	413
5	15.9	15.2	15.1	15.2	8.7	NA	8.5	8.6	7.6	7.8	7.8	7.8	435	432	424	413
6	15.9	15.2	15.1	15.2	8.7	NA	8.5	8.6	7.6	7.5	7.8	7.8	435	432	424	413
6.5	--	--	15.1	--	--	--	8.5	--	--	--	7.8	--	--	--	424	--
7	15.9	15.3	--	15.2	8.8	8.8	--	8.6	7.6	7.7	--	7.8	435	430	--	414
7.5	--	--	--	15.1	--	--	--	8.5	--	--	--	7.8	--	--	--	NA

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Attachment 3

Attachment 3 – Water Quality Vertical Profile Figures

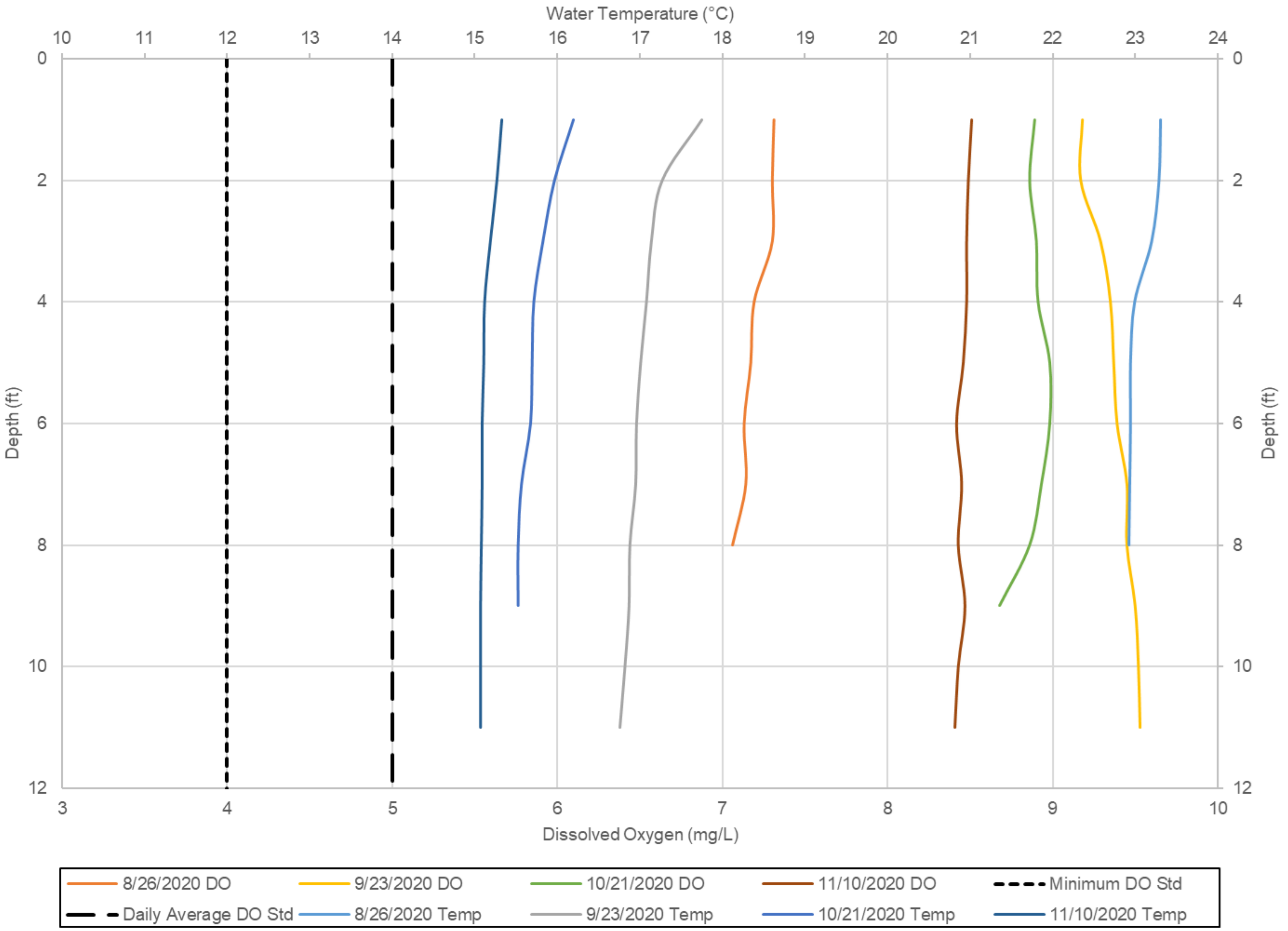

Figure 3-1. Forebay Vertical Profile—Temperature and Dissolved Oxygen Concentration

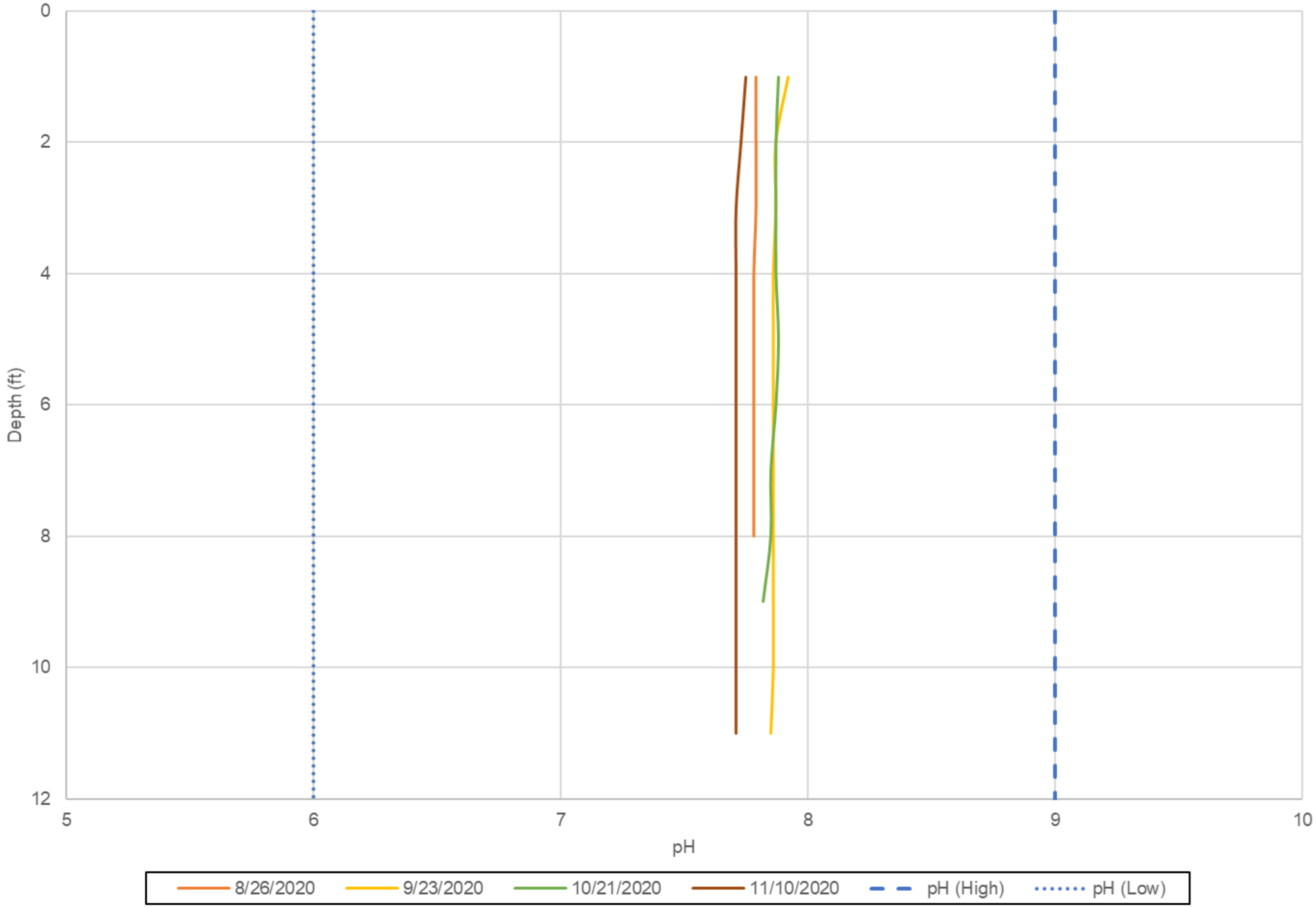

Figure 3-2. Forebay Vertical Profile—pH

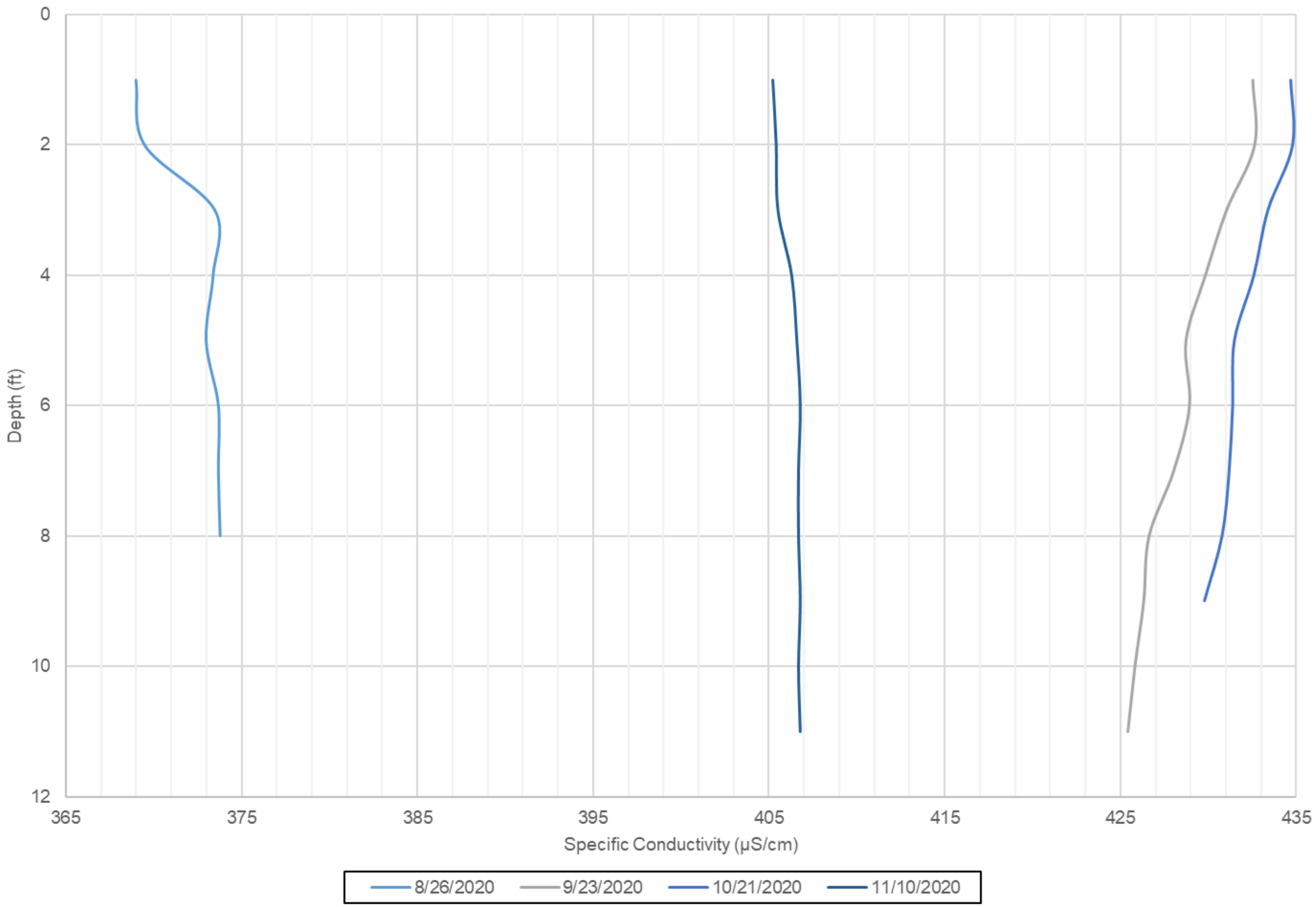

Figure 3-3. Forebay Vertical Profile—Specific Conductivity

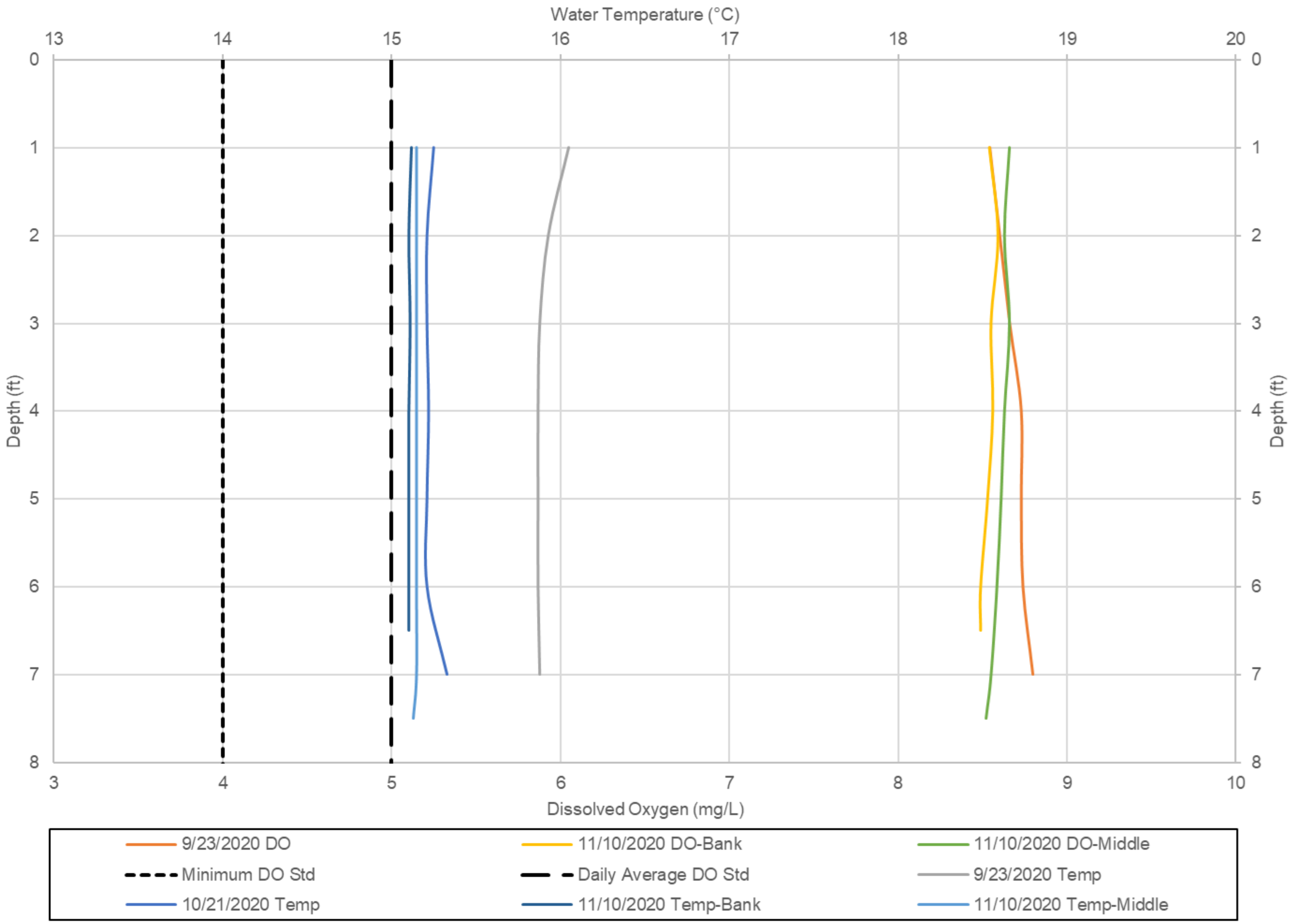

Figure 3-4. Reservoir Vertical Profile—Temperature and Dissolved Oxygen Concentration

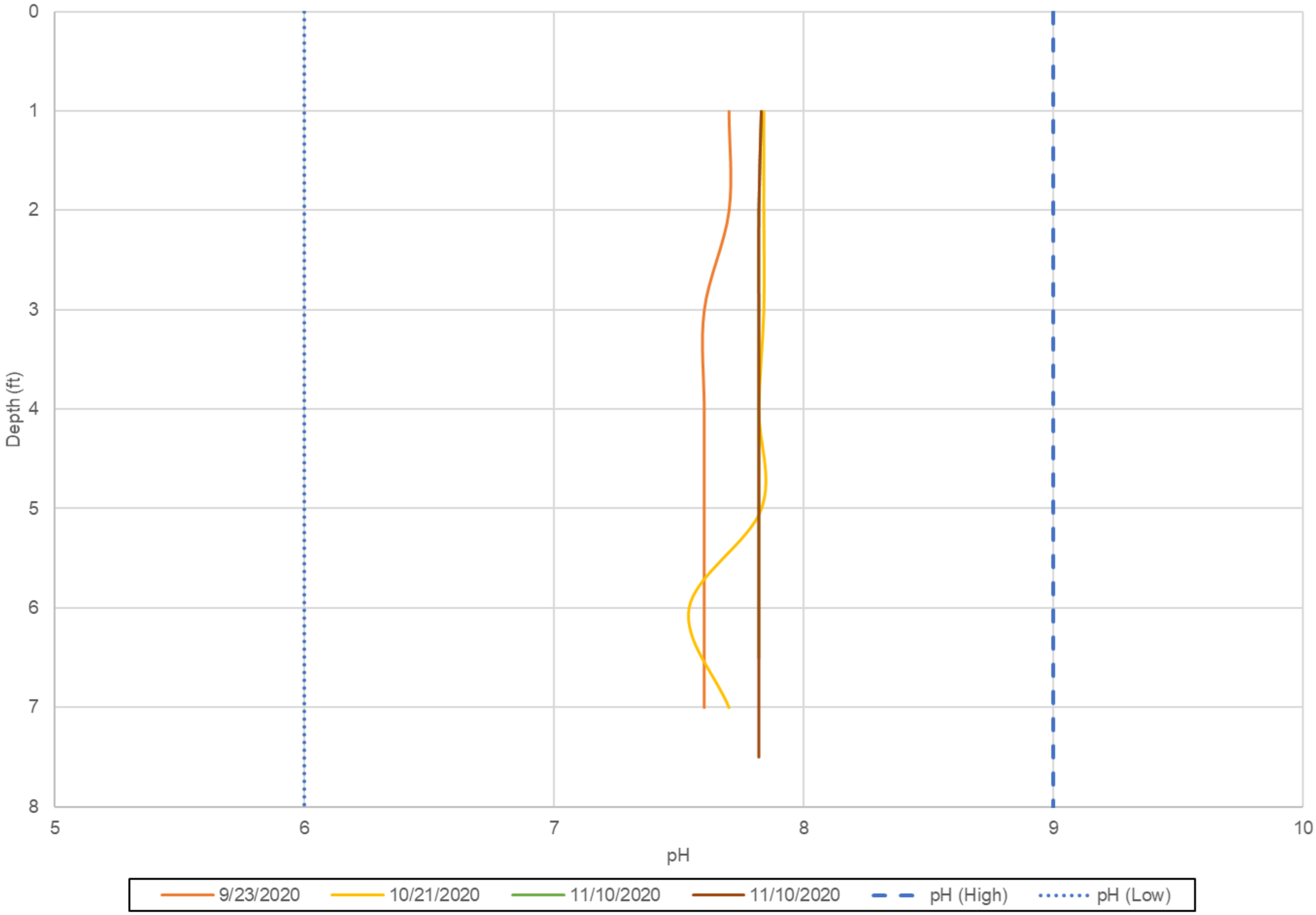

Figure 3-5. Reservoir Vertical Profile—pH

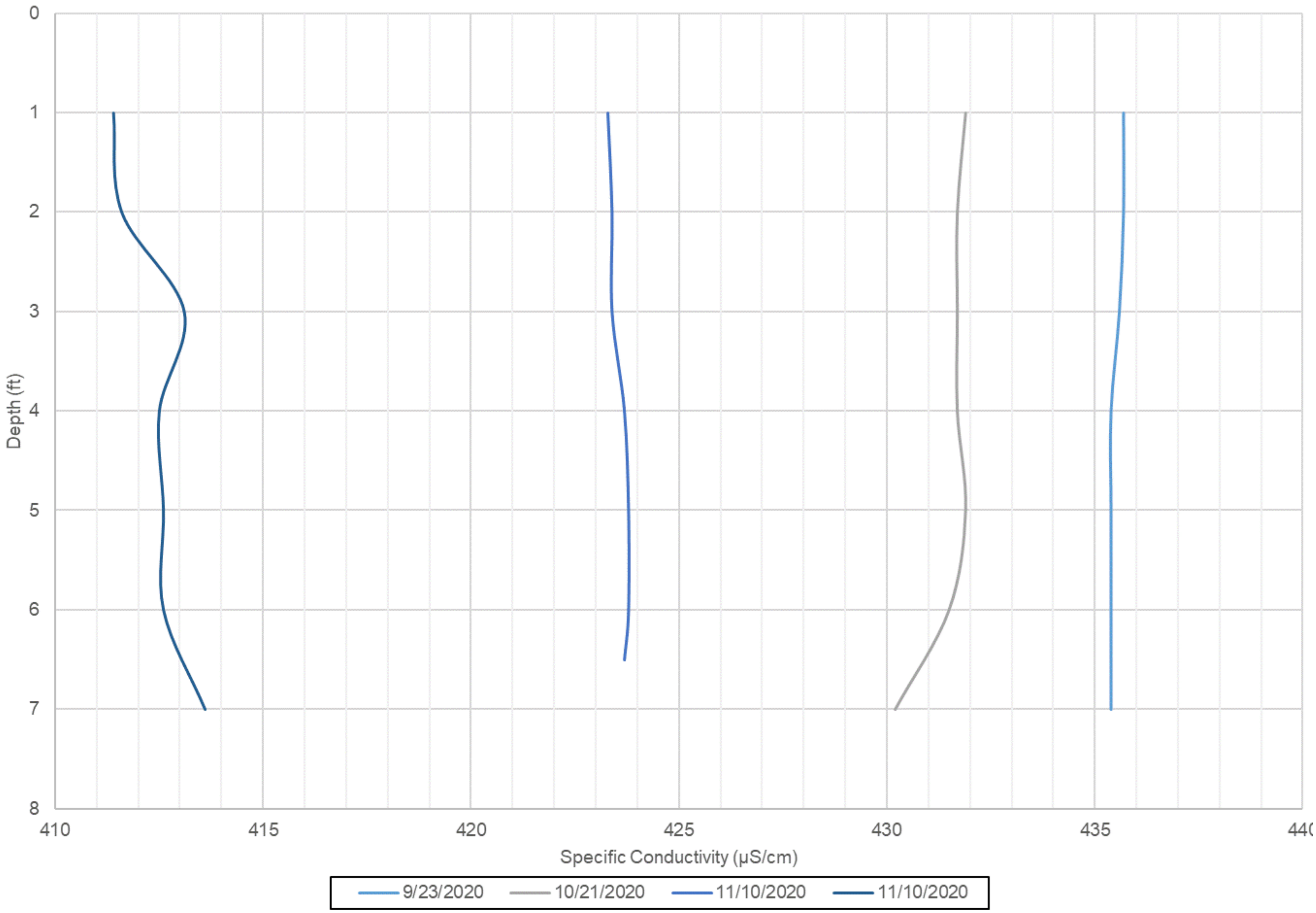

Figure 3-6. Reservoir Vertical Profile—Specific Conductivity

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Attachment 4

Attachment 4 – Estimated Flow and Precipitation Comparison

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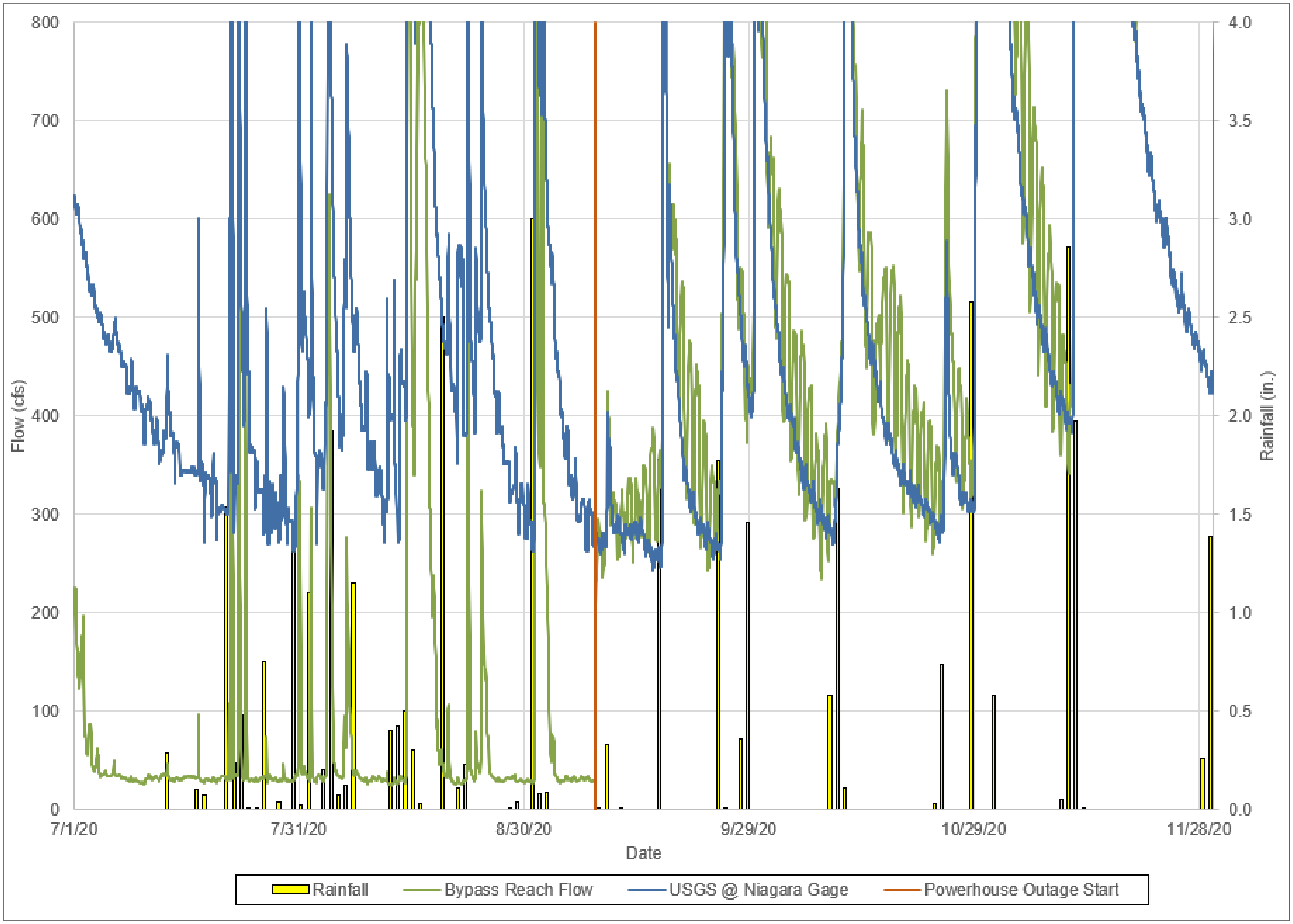
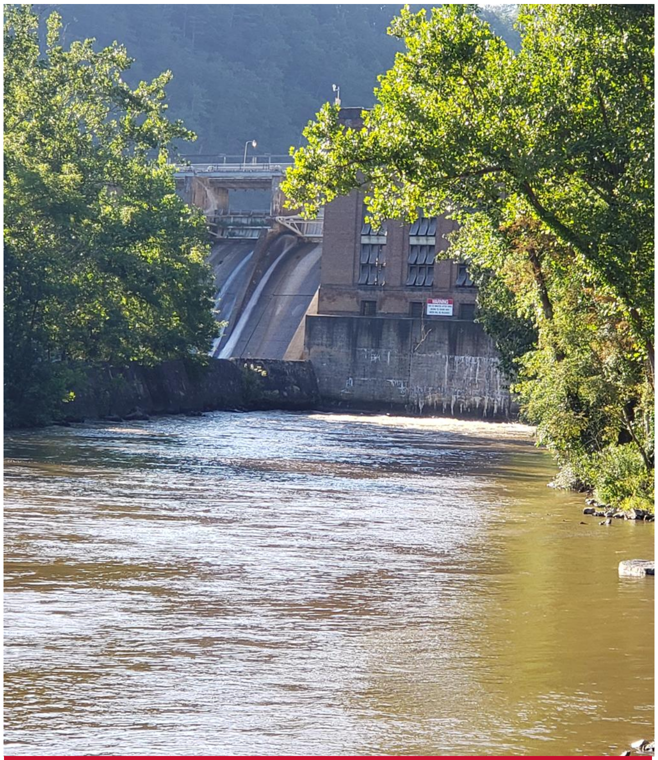


Figure 4-1. Bypass Reach Estimated Flow, Downstream Roanoke River Flow, and Rainfall Comparison

Appendix C

Appendix C – Preliminary Fish Community Study Report



Preliminary Fish Community Study Report

Niagara Hydroelectric Project (FERC No. 2466)

January 11, 2021

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

Attachments

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD).

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Fish Community Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goal of the Fish Community Study is to obtain current information on the fish community in the Roanoke River in the vicinity of the Project to support an analysis of Project effects. The study includes a comparison of newly collected fish community data with historical fish community data collected in the Project area. The study also includes a desktop assessment of entrainment and impingement at Niagara, along with a turbine blade strike analysis to be completed at the conclusion of field data collection in 2021.

To achieve the goals of the Fish Community Study, the following objectives were identified:

- Collect a comprehensive baseline of the existing fish community in the Project vicinity.
- Compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution.
- Collect a comprehensive baseline (abundance and distribution) of the Roanoke Logperch population (including larval, young-of-year, and adults) in the vicinity of the Project.
- Confirm flow velocities at the intake to facilitate a desktop assessment of entrainment and impingement potential at Niagara.
- Perform a desktop assessment of entrainment and impingement potential at Niagara, including an assessment of turbine mortality and survival using the USFWS Turbine Blade Strike Analysis Model.

3 Study Components

The Preliminary Fish Community Study report comprises the following study reports:

1. 2020 Fish Community Survey
2. Preliminary Impingement and Entrainment Study Report

For existing background information, study methods, study results, and analyses, please refer to the individual study reports included in Attachments 1 and 2.

Attachment 1

Attachment 1 – 2020 Fish Community Survey Results

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Niagara Hydroelectric Project
(FERC Project No. 2466)

2020 Fish Community Survey Results, Virginia

January 4, 2021

Prepared for:

AMERICAN ELECTRIC POWER

BOUNDLESS ENERGY™

Niagara → HDR2020-0002

Prepared by:

EDGE ENGINEERING & SCIENCE

further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

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APPENDICES

LIST OF ACRONYMS

AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CFS	Cubic feet per second
CPUE	Catch per unit effort
DCR	Department of Conservation and Recreation
DO	Dissolved oxygen
EDGE	Edge Engineering and Science, LLC
EF	Electrofishing
FERC	Federal Energy Regulatory Commission
HDR	HDR, Inc. – Client
LDB	Left descending bank
OFM	Orangefin Madtom
RDB	Right descending bank
RLP	Roanoke Logperch
RSP	Revised Study Plan
SAV	Submerged aquatic vegetation
TL	Total length
USFWS	U.S. Fish and Wildlife Service
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries (now VDWR)
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)

1.0 INTRODUCTION

The Niagara Hydroelectric Project (Project) is a 2.4-megawatt hydroelectric generating facility located at river mile 355 of the Roanoke River in Roanoke County, Virginia. Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license from the Federal Energy Regulatory Commission (FERC or Commission) for the Project as their existing license (FERC No. 2466) expires in 2024. Aquatic biological studies were completed to support the existing license and results of these studies are ultimately used as a record and reference for current relicensing efforts. The Roanoke River, along with the approximately 2-mile-long reservoir resulting from the Niagara Dam, harbors a diverse community of aquatic biota including the federally endangered Roanoke Logperch (*Percina rex*; RLP). The state threatened Orangefin Madtom (*Noturus gilberti*; OFM) may also occur within two miles of the Project in the Roanoke River and Tinker Creek, a tributary to the Roanoke River within the Project boundary, as stated in a Project-specific letter from Virginia Department of Conservation and Recreation (VDCR) referencing Virginia Department of Game and Inland Fisheries (VDGIF [now Virginia Department of Wildlife Resources; VDWR]) (2009). However, previous relicensing studies did not collect Orangefin Madtom within the Project area and Jenkins and Burkhead (1994) established that Orangefin Madtom have likely been extirpated within the city of Roanoke. Aquatic biological studies are required to survey and document the contemporary community of organisms present within the Project area (Figure 1). The Roanoke River and lower reaches of tributary streams are included in the Project area. The information gained from these studies will document the current conditions of fish abundance, diversity, and distribution in the vicinity of the Project.

Study scoping with state and federal agencies resulted in the development and approval of a project-specific Revised Study Plan (RSP) that identified three objectives for Project studies (AEP 2019) pertaining to the fish community.

Goals and Objectives

1) Collect a comprehensive baseline of the existing fish community in the Project vicinity
2) Compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution
3) Collect information regarding the current status (abundance and distribution) of the Roanoke Logperch (including adults, young-of-year, and larvae) in the vicinity of the Project for the purpose of establishing a baseline

In accordance with the RSP, field sampling efforts were necessary to satisfy each of the three objectives. Some of the objectives were not accomplished during the 2020 calendar year due to delays resulting from unforeseeable circumstances including heavy precipitation and high flows and the COVID-19 global pandemic; therefore, this report herein serves as an interim, progress report of findings. Roanoke Logperch surveys were not completed in 2020; therefore, RLP-specific methods and results will not be discussed in this initial report. Additional field work is scheduled in 2021 and a comprehensive report of findings is planned for completion thereafter.

2.0 METHODS

The RSP provided guidance on the sampling framework for the Project that included general fish community and RLP-specific methodologies. Fish community sampling employs backpack and boat electrofishing (EF) methods to target representative fish habitats at seven and eight sites, respectively, throughout the Project area. The methods, including techniques, seasonality, and number and location of sample sites, were developed to document a contemporary representation of the Project area and correspond to previous sampling efforts for comparison.

2.1 Fish Community Sampling

General fish community sampling was completed in a single survey season (i.e., fall 2020) as prescribed in the RSP for the Project. Sampling methods were derived from National Rivers and Streams Assessment (NRSA) Field Operations Manual (USEPA 2019), which guides standardized electrofishing methods in lotic waterbodies of variable sizes. Within the constraints of the Project's objectives and geographic limits, electrofishing techniques were employed to most-effectively target specific sites based on the specific habitat types present in the Project area. Backpack electrofishing were used to target wadeable (riffle/run) habitats whereas boat electrofishing targeted deeper (i.e., non-wadeable) pool habitats. Two backpack electrofishing sites were located upstream, and five sites were located downstream of Niagara Dam while all boat electrofishing sites were in the Niagara impoundment upstream of the dam. Sampling techniques are further described in subsequent sections. Specific sampling dates are based on factors including (but not limited to) weather conditions, water temperatures, river flows and reservoir elevations, and safety of field staff and the public. Site naming conventions are as follows: Location-Seasonality-Method-Site Number. For example, NFBP1 = Niagara Fall Backpack Site 1 and NFB1 = Niagara Fall Boat Site 1.

2.1.1 Backpack Electrofishing

Backpack electrofishing surveys of the fish community occurred at seven riffle/run sites (i.e., backpack electrofishing; NFBP site names) along 100-meter transects. Upon arrival at wadeable sites (Figures 1-8), transects were delineated in riffle/run habitat and the start and endpoint coordinates were recorded. Site photos were taken in four directions (upstream, downstream, left descending bank [LDB], and right descending bank [RDB]; all 90 degrees to one another) and substrate, and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). At each sample site, habitat characteristics (e.g., substrate, estimated water velocity, depth, and instream cover) and water quality parameters (e.g., pH, water temperature, dissolved oxygen [DO], and conductivity) were measured and recorded. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site. Prior to initiating sample collection, electrofishing equipment was calibrated based on the conductivity of the water at each sample site. Sampling effort (i.e., time electrofishing) was also recorded during each sampling event.

Starting at the downstream end of the transect and moving upstream, all riffle/run habitats were candidates for sampling throughout the reach. All major habitat types identified within the transect were sampled and particular care was taken to thoroughly sample complex habitat and instream structures, while a netter(s) actively captured stunned fish with a dip net. In areas of elevated stream velocities (e.g., riffles/runs), a stationary seine (2.4 meters wide by 1.8 meters tall with 0.48-centimeter mesh) was positioned downstream of the sample location and perpendicular to stream flow and the operator of the backpack electrofishing unit simultaneously performing kicks/sweeps in a downstream manner toward the seine. Stunned fishes were driven into the net with the aid of stream currents and the seine was then swept upward and fish retrieved for processing. For each 100-meter transect, a minimum of five minutes EF time was expended, and more time may have been necessary depending on the complexity of the habitat. All collected fish were kept in aerated buckets and/or instream live wells during surveys and processing and then returned to the stream at the survey location.

Each fish was identified to the lowest taxonomic level practicable, enumerated, and examined for signs of external parasites, disease, or physical abnormalities. In addition, the total length (TL) and weight was recorded for the first 30 individuals of a species per sample site. All captured individuals were enumerated. In the event that more than 30 individuals of a single species were collected at a given sample site, the additional fish were counted, and length measurements were recorded for specimens that exceed the upper or lower maximum recorded lengths from the 30 individuals measured. Photos were taken in the field for a representative specimen of each fish taxon collected during the study and for those fish that could not be identified to species (e.g., minnows, juvenile *Moxostoma sp*.), representative specimens were preserved and identified in a laboratory setting based on sampling permit specifications. For RLP specimens collected during sampling efforts, a photo voucher was taken, a GPS data point was recorded, and client and agencies were notified according to permit specifications.

2.1.2 Boat Electrofishing

Boat electrofishing techniques were used to survey the fish community at eight pool sites (i.e., boat electrofishing; NFB site names) along 100-meter transects. Upon arrival at pool sites (Figure 1 and Figures 9-12), transects were delineated in pool habitat and the start and endpoint coordinates were recorded. Boat electrofishing becomes less effective in deeper water (i.e., greater than three meters), especially during daylight hours; therefore, sampling occurred within 30 meters of shore. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as backpack electrofishing sites (see Section 2.1.1). In addition, a Secchi disk reading was taken at each sample site at the time of sampling. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site. Prior to initiating sample collection, electrofishing equipment was calibrated based on the conductivity of the water at each sample site. Sampling effort (i.e., time electrofishing) was also recorded during each sampling event.

Starting at the downstream end of the transect and moving upstream, all available habitat types (i.e., shallow shoreline, deep shoreline, emergent vegetation, submerged wood, etc.) were candidates for sampling throughout the reach and particular care was taken to thoroughly sample complex habitat and instream structures. During sampling, a boat driver maneuvered the boat along each transect (nosing into and then away from the bank) while two field personnel or netters collected stunned fish in dip nets and one person guided the driver. For each 100-meter transect, a minimum of five minutes electrofishing was required, and more time may have been necessary depending on the complexity of the habitat. Fish were placed in live wells until sampling for that transect had concluded and then returned to the stream at the survey location. All samples were processed in the same manner as backpack methods (see Section 2.1.1).

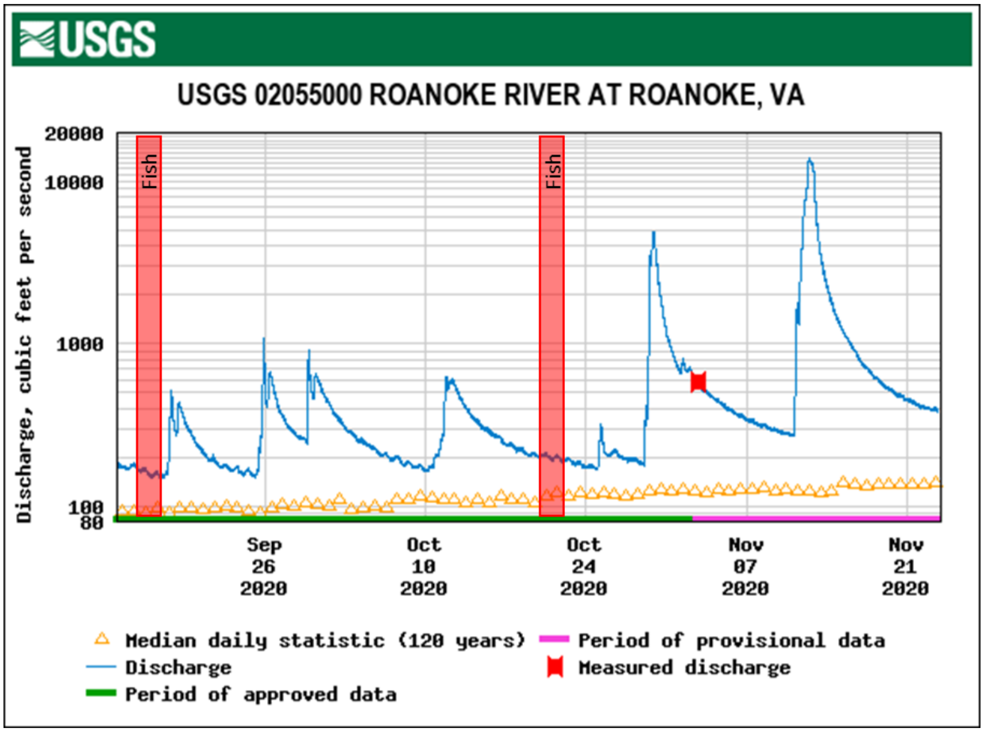
2.2 Deviations from Revised Study Plan

2.2.1 Covid-19 Delays

Initially, RLP sampling activities were proposed for completion in 2020, which included larval drift sampling during spring months, YOY and adult sampling during the fall, and an additional adult sampling event during the summer to specifically target habitats within the bypass reach. The spring larval and summer adult surveys were cancelled due to restrictions on non-essential travel and safety considerations in response to the Covid-19 pandemic. As a result, AEP requested and was granted an extension to accommodate the change in schedule as the VDCR, VDWR, United States Fish and Wildlife Service (USFWS), and Virginia Department of Environmental Quality (VDEQ) concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020. The remaining adult RLP study was also delayed and moved into 2021 due to weather delays and conflicts with overlapping efforts with the fall general fish community sampling effort. Roanoke Logperch sampling efforts are now scheduled to occur through the 2021 field season to accommodate the life stage-specific spring, summer and fall RLP survey timelines as originally proposed. All general fish community surveys were scheduled for the 2020 field season and were successfully completed. Thus, as part of the fish community studies, only RLP sampling (adult, YOY, and larvae) is scheduled for 2021.

2.2.2 Weather Delays

Periodic delays associated with weather and water conditions plagued the fall 2020 sampling season. Average annual rainfall for Roanoke, Virginia is approximately 105 centimeters (U.S. Climate Data 2021) and, as of December 1, 2020, Roanoke already accumulated over 157 centimeters of rain (National Weather Service 2020). Sampling efforts were completed at this year's assumed baseflow, which was likely around 150-200 cubic feet per second (CFS) during the sampling period. The 47 percent increase in average precipitation made it difficult to sustain contiguous field sampling efforts and did not allow the Roanoke River to reach average annual baseflow throughout the sampling period at the study location (see figure below).



3.0 RESULTS

All sample locations provided in the RSP were adhered to as closely as possible. Upon arrival at sample locations, biologists chose nearest locations that exhibited habitat required for sampling method efficacy, provided target habitats, and avoided exceptionally high flows. No notable or drastic changes were made to proposed sampling locations for fish community survey efforts. At three wadeable sites (NFBP1, 3, and 5), two separate transects totaling 100 meters were used to maximize sampling within target habitat (e.g., NFBP1 was made up of two 50-meter transects).

3.1 Fish Community Sampling

Fish community surveys were conducted between September 15 and 16 and October 20 and 21, 2020, following methods outlined in the RSP during relatively low flow and clear stream conditions. Sampling was performed by EDGE's state permitted fish biologist under Virginia Scientific Collecting Permit Nos. 068630 and 068631 (see Appendix A). As expected, there were clear differences in habitat type and substrates between wadeable and non-wadeable sites (Appendix B); however, differences in sampling dates, time of day, and low number of intra- and inter-site samples do not facilitate statistical comparison of physiochemical properties between riffle/run and pool sites. Dissolved oxygen and stream velocity were much greater at riffle/run sites (average 110% and 0.3 m/s, respectively) than pool sites (average 95% and 0.025 m/s, respectively), as expected, and are the only two physiochemical parameters that appear notably disparate between site types. Results of physiochemical data collected at sample sites met the state water quality standards established for the Roanoke River, indicating that water quality within the Project area is capable of supporting fish communities (this will be detailed further in the Project-specific water quality study report referencing Virginia Administrative Code [VAC] Chapter 260).

A total of 590 individuals were collected representing 32 species with backpack electrofishing surveys accounting for 525 individuals of 28 species and boat electrofishing surveys accounting for 65 individuals of 10 species. Twenty-six (26) species were collected upstream of Niagara Dam between two backpack electrofishing sites and all eight boat electrofishing sites while 23 species were collected downstream of the dam between five backpack electrofishing sites. Central Stoneroller (*Campostoma anomalum*), Rosefin Shiner (*Lythrurus ardens*), and Riverweed Darter (*Etheostoma podostemone*) were the most abundant species at riffle/run sites (27.4% [144], 25.5% [134], and 8.2% [43], respectively) while Redbreast Sunfish (*Lepomis auratus*), Golden Redhorse (*Moxostoma erythrurum*), and Bluegill (*Lepomis macrochirus*) were the most abundant species at pool sites (40.0% [26] 18.5% [12], and 16.9% [11], respectively) (Appendix C). Central Stoneroller, White Sucker (*Catostomus commersonii*), and Rock Bass (*Ambloplites rupestris*) were the most dominant by weight at riffle/run sites (28.0%, 11.7%, and 11.0%, respectively) and Golden Redhorse, Redbreast Sunfish, and V-lip Redhorse (*Moxostoma pappillosum*) were the most dominant by weight at pool sites (82.5%, 6.3%, and 3.3%, respectively). The average catch per unit effort (CPUE; individuals per minute) was 6.55 at riffle/run sites with average diversity (H'; Shannon index) of 1.83, and CPUE was 1.44 at pool sites with average diversity of 1.10. Representative site and fish photos are provided in Appendix B and raw data for fish collections are provided in Appendix C. Site-specific information is provided below.

3.1.1 Backpack Electrofishing

Seven riffle/run sites were sampled as part of fish community studies including two sites upstream and five sites downstream of Niagara Dam (Figure 1; NFBP). Substrates at riffle/run sites consisted of bedrock, boulder, cobble, and gravel, but sites ranged from primarily homogenous bedrock substrate to relatively even heterogeneous substrates. Water quality parameters varied per site and ranged from 13.7 to 21.4 °C, pH 7.3 to 8.5, DO 8.55 to 12.60 mg/L and 96.9 to 130.3 percent saturation, velocity 0.13 to 0.45 m/s, and conductivity 390 to 478 μs/cm (Table 1).

Table 1: Water Quality at Backpack Electrofishing Sites

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Velocity (m/s)	Conductivity (us/cm)
9/15/2020	NFBP1	21.4	8.4	8.55	96.9	0.41	390
9/15/2020	NFBP2	19.6	8.5	12.02	130.3	0.40	478
9/16/2020	NFBP3	19.0	8.4	9.53	102.1	0.45	437
9/16/2020	NFBP4	20.8	8.5	9.64	103.3	0.13	444
9/16/2020	NFBP5	20.8	8.5	9.74	109.3	0.36	447
10/20/2020	NFBP6	13.7	7.3	11.04	103.4	0.15	421
10/20/2020	NFBP7	14.7	7.5	12.60	123.0	0.20	419

Above/below dashed line represents above/below Niagara Dam

Fish abundance at wadeable sites ranged from 35 to 109 individuals with an average of 75 (SD = 26.4) individuals per site (Table 2). Species richness ranged from 10 to 15 species with an average of 12 species per site. Species diversity ranged from 1.41 (0.52 evenness) to 2.14 (0.86 evenness). Evenness is a diversity index that indicates how equal the community is numerically. For example, a community with relatively equal abundance of each species has a higher evenness value than a community with one dominant species. Catch per unit effort (CPUE) ranged from 2.93 to 14.16 individuals per minute. The wide range of total electrofishing effort at each site resulted from and was dependent upon availability of different microhabitats and complexity of instream features; however, greater EF time did not necessarily result in greater abundance. For example, complexity of habitat at site NFBP1 was relatively low, which led to minimal EF time; however, this site exhibited the highest abundance and subsequent CPUE.

Table 2: Fish Community Results for Backpack Electrofishing Sites

Date	Site #	Abundance	Richness	Diversity (H’)	Evenness	EF Time (min)	CPUE (#/min)
9/15/2020	NFBP1	109	15	1.41	0.52	7.7	14.16
9/15/2020	NFBP2	35	11	2.04	0.85	11.3	3.10
9/16/2020	NFBP3	98	12	1.50	0.60	13.0	7.56
9/16/2020	NFBP4	49	12	2.14	0.86	16.7	2.93
9/16/2020	NFBP5	89	14	1.83	0.69	14.0	6.36
10/20/2020	NFBP6	70	12	1.94	0.78	12.2	5.75
10/20/2020	NFBP7	75	10	1.93	0.84	12.5	5.99

Above/below dashed line represents above/below Niagara Dam (H’ = Shannon Diversity and EF = Electrofishing)

Rosefin Shiner, Roanoke Darter (*Percina roanoka*), and Central Stoneroller were the most abundant species at riffle/run sites above the dam (60.4% [87], 6.3% [9], and 3.5% [5], respectively), whereas Central Stoneroller, Rosefin Shiner, and Riverweed darter were the most abundant species at riffle/run sites below the dam (36.5% [139], 12.3% [47], and 10.8% [41], respectively). Average abundance at riffle/run sites above the dam was 72 individuals with an average diversity of 1.73, average evenness of 0.69, and average CPUE of 8.63. Average abundance at riffle/run sites below the dam was 76 individuals with an average diversity of 1.87, average evenness of 0.75, and average CPUE of 5.72. Riffle/run sites above the dam were dominated by invertivore (13 species), omnivore-herbivore (4 species), and invertivore-piscivore (3 species) trophic guilds and by the benthic (11 species) and water column (9 species) habitat guilds (McCormick et al. 2001). Riffle/run sites below the dam were dominated by invertivore (15 species), invertivore-piscivore (4 species), and omnivore-herbivore (2 species) trophic guilds and by the water column (12 species) and benthic (9 species) habitat guilds. A single Roanoke Logperch individual (adult) was collected at the upstream-most riffle/run site (NFBP1) in the mainstem of the Roanoke River.

3.1.1.1 Roanoke River – NFBP1

Substrates at NFBP1 consisted of bedrock (35%), boulder (20%), cobble (25%), gravel (10%), and sand (10%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 2). The site is best classified as a riffle. Occasional patches of submerged aquatic vegetation (SAV) were present as well as filamentous algae. Survey efforts included 7.7 minutes of electrofishing along two 50-meter transects to maximize sampling within the target habitat. This site had the highest CPUE of any riffle/run site; however, it had the lowest diversity and evenness because Rosefin Shiner comprised 68% of all individuals collected followed by Central Stoneroller and Roanoke Darter at under 5% relative abundance each (Appendix C).

3.1.1.2 Tinker Creek – NFQT2

Substrates at NFQT1 consisted of sand (45%), gravel (35%), cobble (18%), and boulder (2%). Habitat structure generally consisted of a sand/gravel/cobble mix with occasional boulders; rootwads and undercut banks were prevalent (particularly along the LDB), and the site is best classified as riffle/run habitat (Figure 3). The site was strongly influenced by anthropogenic impacts and featured heavy trash deposits, human feces, and combined sewer outfalls. Survey efforts included 11.3 minutes of electrofishing starting downstream at the RDB and working upstream and across to the LDB. This site had the second lowest richness and CPUE; however, it had the second highest diversity and evenness. Rosefin Shiner was the most abundant at this site comprising 37% of individuals while all other species were relatively even between 3 and 11% relative abundance (Appendix C).

3.1.1.3 Roanoke River – NFBP3

Substrates at NFBP3 consisted of bedrock (50%), cobble (30%), boulder (10%), and gravel (10%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 4). The site is best classified as a riffle. Patches of SAV and filamentous algae were thick and covered most of the cobble and boulders. Survey efforts included 13 minutes of electrofishing performed along one 60- and one 40-meter transect to focus effort within the target habitat. This site had the second highest CPUE but the second lowest diversity. Central Stoneroller and Rosefin Shiner dominated this site comprising 56 and 20% relative abundance, respectively, followed Riverweed Darter and Cutlip Minnow (*Exoglossum maxillingua*) at 4% each (Appendix C).

3.1.1.4 Roanoke River – NFBP4

Substrates at NFBP4 consisted of bedrock (50%), boulder (30%), and cobble (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 5). The site is best classified as a riffle. Patches of SAV were present along the LDB. Survey efforts included 16.7 minutes of electrofishing, which was the highest of any site, because sampling was conducted along the LDB (as the thalweg was too deep and swift) where bedrock and boulder substrates made for relatively complex habitat and difficult sampling conditions. This site had the lowest CPUE but the highest diversity and evenness. Central Stoneroller was the most abundant species (22%) but there were 4 additional species having greater than 12% relative abundance (Appendix C).

3.1.1.5 Roanoke River – NFBP5

Substrates at NFBP4 consisted of bedrock (50%), boulder (30%), and cobble (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 6). The site is best classified as a riffle. Patches of SAV were present along the LDB. Survey efforts included 14 minutes of electrofishing, which was the second highest of any site, for similar reasons to those stated in Section 3.1.1.4 above. One 60- and one 40-meter transect were surveyed to focus efforts within target habitat. This site was about average for riffle/run sites regarding CPUE, diversity, and evenness. The most abundant species were Central Stoneroller, Rosefin Shiner, and Blacktip Jumprock (*Moxostoma cervinum*) with 42, 18, and 17% relative abundance, respectively. There were more Blacktip Jumprock collected at this site (15) than the rest of the riffle/run sites combined (14) (Appendix C).

3.1.1.6 Roanoke River – NFBP6

Substrates at NFBP6 consisted of bedrock (40%), slab boulder (20%), cobble (20%), and gravel (20%). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop (Figure 7). The site is best classified as a riffle. Large slab boulders were common near the shore. Survey efforts included 12.2 minutes of electrofishing along the RDB. This site was just below average CPUE and just above average in diversity and evenness compared to all other riffle/run sites. The most abundant species were Central Stoneroller, Riverweed Darter, and Fantail Darter (*Etheostoma flabellare*) with 29, 26, and 14% relative abundance, respectively (Appendix C). This site exhibited the highest CPUE of darters at 2.79, just ahead of NFBP7 at 2.56.

3.1.1.7 Roanoke River – NFBP7

Substrates at NFBP7 consisted of bedrock (30%), cobble (30%), slab boulder (20%), and gravel (20%). Habitat structure generally consisted of shallow bedrock and cobble riffles and glides with large boulder riffles at the downstream extent of the site (Figure 8). The site is best classified as a riffle overall with similar depths along the entire width of the stream. Survey efforts included 12.5 minutes of electrofishing starting downstream at the RDB and working upstream and across to the LDB. This site had the lowest species richness and was below average CPUE, but diversity was above average because species were present in relatively even abundance. Margined Madtom (*Noturus insignis*) had the highest relative abundance at 23% and more individuals were found here (17) than all other riffle/run sites combined (15). The next most abundant species were Central Stoneroller at 21% and Fantail Darter and Riverweed Darter at 17% relative abundance each (Appendix C). This site exhibited the second highest CPUE of darters just behind site NFBP6.

3.1.2 Boat Electrofishing

Eight pool sites were sampled as part of fish community studies, all of which were located in the impounded area above the Niagara Dam (Figure 1; NFB). Substrate composition varied from bedrock to silt, with a general longitudinal pattern observed in substrate sizes that decreased in the downstream direction towards the dam. Water parameters varied per site and ranged from 14.5 to 15.9 °C, pH 7.3 to 7.5, DO 9.23 to 10.02 mg/L and 94.6 to 96.9 percent saturation, velocity 0.02 to 0.04 m/s, and conductivity 405 to 436 µs/cm (Table 3).

Table 3: Water Quality at Boat Electrofishing Sites

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Velocity (m/s)	Conductivity (us/cm)
10/21/2020	NFB1 & 2	14.8	7.3	10.02	96.8	0.04	405
10/21/2020	NFB3 & 4	14.5	7.4	9.63	94.6	0.02	418
10/21/2020	NFB5 & 6	15.2	7.5	9.68	96.9	0.02	428
10/21/2020	NFB7 & 8	15.9	7.4	9.23	91.6	0.02	436

Sites are in order from upstream to downstream

No fish were collected at the two most upstream pool sites (NFB1 & 2); therefore, survey results are not addressed below. Potential reasons for this are discussed in detail in Section 4.1. Fish abundance at non-wadeable sites ranged from 7 to 19 individuals with an average of 10 (SD = 4.8) individuals per site (Table 4). Species richness ranged from 3 to 5 species with an average of 4 species per site. Species diversity ranged from 0.54 (0.49 evenness) to 1.35 (0.98 evenness). Catch per unit effort (CPUE) ranged from 0.84 to 2.91 individuals per minute. Electrofishing time was relatively consistent between sites based on similarities in habitat complexity.

Table 4: Fish Community Results for Boat Electrofishing Sites

Date	Site #	Abundance	Richness	Diversity (H')	Evenness	EF Time (min)	CPUE (#/min)
10/21/2020	NFB3	14	5	1.13	0.70	8.5	1.65
10/21/2020	NFB4	7	4	1.35	0.98	8.3	0.84
10/21/2020	NFB5	10	4	1.22	0.88	8.6	1.17
10/21/2020	NFB6	8	4	1.07	0.77	8.0	1.01
10/21/2020	NFB7	19	3	0.54	0.49	6.5	2.91
10/21/2020	NFB8	7	4	1.28	0.92	6.8	1.03

Sites are in order from upstream to downstream (H’ = Shannon Diversity and EF = Electrofishing)

Golden redhorse (9) was the most abundant species in the upper impoundment, Redbreast Sunfish (6) and Bluegill (6) were the most abundant species in the middle of the impoundment, and Redbreast Sunfish (16) was the most abundant species in the lower impoundment. Average abundance in the upper impoundment (NFB3 & 4) was 10 individuals with an average diversity of 1.24, average evenness of 0.84, and average CPUE of 1.25. Average abundance in the middle of the impoundment (NFB5 & 6) was 9 individuals with an average diversity of 1.15, average evenness of 0.83, and average CPUE of 1.09. Average abundance in the lower impoundment (NFB7 & 8) was 13 individuals with an average diversity of 0.91, average evenness of 0.71, and average CPUE of 1.97. Pool sites within the impoundment were dominated by invertivore (4 species), invertivore-piscivore (3 species), and omnivore-herbivore (2 species) trophic guilds and by the water column (6 species) and benthic (3 species) habitat guilds (McCormick et al. 2001).

3.1.2.1 Roanoke River – NFB3 & 4

Substrates at NFB3 & 4 consisted of bedrock (50%), cobble (30%), and silt (20%) with heavy amounts of leaf pack, rootwads, and snags along the shore. The banks were relatively steep with abrupt increases in depth occurring close to shore, thus confining sampling efforts to near-shore habitats (Figure 10). The site is best classified as a pool. Survey efforts included 8.5 and 8.3 minutes of electrofishing at NFB3 and NFB4, respectively. NFB3 had twice the CPUE but less diversity and evenness overall. Twice as many fish were captured at NFB3 (RDB) with Golden Redhorse having the highest relative abundance at 64%. There were zero Golden Redhorse collected at NFB4. Overall, eight out of 10 species collected via boat electrofishing were represented between these two sites with exception of Redear Sunfish (*Lepomis microlophus*) and Bluntnose Minnow (*Pimephales notatus*) (Appendix C).

3.1.2.2 Roanoke River – NFB5 & 6

Substrates at NFB5 & 6 consisted of sand (60%) and silt (40%) with heavy amounts of leaf pack and snags along the shore. The banks were relatively steep and quickly dropped off from shore, so sampling efforts were confined to near-shore habitats (Figure 11). The site is best classified as a pool. Survey efforts included 8.6 and 8.0 minutes of electrofishing at NFB5 and NFB6, respectively. Site NFB5 (RDB) had marginally greater CPUE, diversity, and evenness. Redbreast Sunfish had the highest relative abundance at NFB5 with 50% and Bluegill had the highest at NFB6 with 63% (Appendix C). NFB5 represented both water column and benthic habitat guilds whereas NFB6 only represented water column species. Overall, six out of 10 species collected via boat electrofishing were present between these two sites.

3.1.2.3 Roanoke River – NFB7 & 8

Substrates at NFB7 & 8 consisted of sand (70%) and silt (30%) with moderate amounts of leaf pack, snags, SAV, and rootwads along the shore. The banks were relatively steep with abrupt increases in depth occurring close to shore, thus confining sampling efforts to near-shore habitats (Figure 12). Wolf Creek enters the Roanoke River at the upstream extent of NFB8 resulting in a deep deposit of fine sediment at the confluence. The site is best classified as a pool. Survey efforts included 6.5 and 6.8 minutes of electrofishing at NFB7 and NFB8, respectively. Site NFB7 had the highest CPUE of any pool site by far but the lowest diversity and evenness. It was dominated by Redbreast Sunfish, which had a relative abundance of 84%, followed by Bluegill at 11% relative abundance (Appendix C). Overall, five out of 10 species collected via boat electrofishing were present between these two sites.

4.0 DISCUSSION

4.1 Fish Community

The Project is located within a relatively urban environment, which may contribute to potential issues pertaining to water quality and habitat degradation in this portion of the Roanoke River that are independent of the Project. The Project influences habitat availability through formation of a reservoir (creating pool habitat and eliminating riffle habitat), which dictates what species can inhabit the Project area; however, the habitats present within the Project area appear to harbor a relatively diverse fish community with little evidence of physical abnormalities or stressors.

Of the 32 total species of fish collected, 11 (34 %) are listed as tolerant species (McCormick at al. 2001), and 4 (13%) are listed as intolerant (i.e., Northern Hogsucker [*Hypentelium nigricans*], Blacktip Jumprock, Mimic Shiner [*Notropis volucellus*], and Roanoke Logperch). Three of these four intolerant species were captured during previous relicensing surveys for the Project (excluding Blacktip Jumprock) (Appalachian and AEP 1991). The continued presence over time of a diverse fish community, in addition to the continued presence of these intolerant species, indicate that water quality and available habitats in the Roanoke River within the Project Area continues to support a balanced and resilient fish assemblage.

Thirty-four (34) species were collected during historical sampling efforts by Appalachian and AEP (1991), compared to 32 species collected during this study, and they employed three different methods (boat electrofishing, gillnets, and hoop nets) over six discrete sampling efforts per site. In 2020, 15 species were collected in riffle/run habitat upstream of the dam (excluding Tinker Creek) via backpack electrofishing, and although species composition differed slightly, 15 species were collected during riffle/run electrofishing surveys upstream of the dam in the 1991 study. In 2020, 23 species were collected in riffle/run habitats downstream of the dam (five sites, sampled once each), compared to 22 species during riffle/run electrofishing downstream of the dam in the previous study (one site, sampled six times). In 2020, 10 species were collected in the impoundment, compared to a maximum of 11 species collected via electrofishing during historical sampling by Appalachian and AEP (1991). Therefore, potential methodological limitations of our study (less sampling events and fewer disparate methods) do not appear to have impacted the observed species richness. Further, although there were no fish captured (or even observed) at sites NFB1 and NFB2 (likely because it was early morning, and the habitats were still shaded rendering most fish inactive) it is reasonable to assume that detection of more species was not likely. Similarly, some species collected in the impoundment during Appalachian and AEP (1991) were only captured with hoop nets and gill nets (e.g., all six catfish/bullhead species), gears that were not employed during the 2020 study. At a high level, the results from the 1991 and 2020 studies indicate comparable species richness, and suggest that the use of the same sampling gears/methods in 2020 could have yielded a greater species richness than observed in the 1991 study.

Differences documented between the fish communities present above and below the dam are likely attributable to differences in available substrates and habitat in the two sections of the Project area. The main difference in available habitats within the Project area occurs at riffle/run sites directly below the dam where substrates undergo frequent scouring in response to the altered flow regime created by the dam. However, downstream from the dam, riffle/run habitat begins to more closely resemble that of riffle/run habitats upstream of the dam (e.g., NFBP6 and NFBP7). The pool habitat created by the Project impoundment is a clear modification to the instream habitat available in the free-flowing Roanoke River reaches in the Project area.

Preliminary results from fall 2020 samples collected within pool habitats of the impoundment indicate the prevalence of species within the water column and benthic habitat guilds that also occur throughout the Roanoke River. The species composition may differ slightly from previous studies but that is likely due to gear differences (prior study included hoop and gillnet surveys) and the limited efficacy of boat electrofishing at depths. The historical surveys were also completed during the least productive time periods in terms of species abundance, and the reported temporal differences in catch were attributed to turbid waters created by precipitation events (Appalachian and AEP 1991). The current study was able to complete single sampling surveys when the Roanoke River was near baseflow conditions and thus avoided sampling during turbid conditions.

This report provides preliminary results based on the partial completion of the study objectives: 1) collect a comprehensive baseline of the existing fish community in the Project vicinity; 2) compare current fish community data to historical data to determine any significant changes to species composition, abundance, or distribution; and 3) collect information regarding the current status (abundance and distribution) of the Roanoke Logperch (including adults, young-of-year, and larvae) in the vicinity of the

Project for the purpose of establishing a baseline. The RLP-specific studies scheduled to be performed in 2021 will provide further insights regarding the fish community within the Project area using new and targeted methods (fixed area quadrat backpack electrofishing for adults, seine hauls for YOY, and drift nets for larvae). A final report detailing the conclusions of the general fish community and RLP sampling efforts with be provided in 2021 with the Updated Study Report.

5.0 LITERATURE CITED

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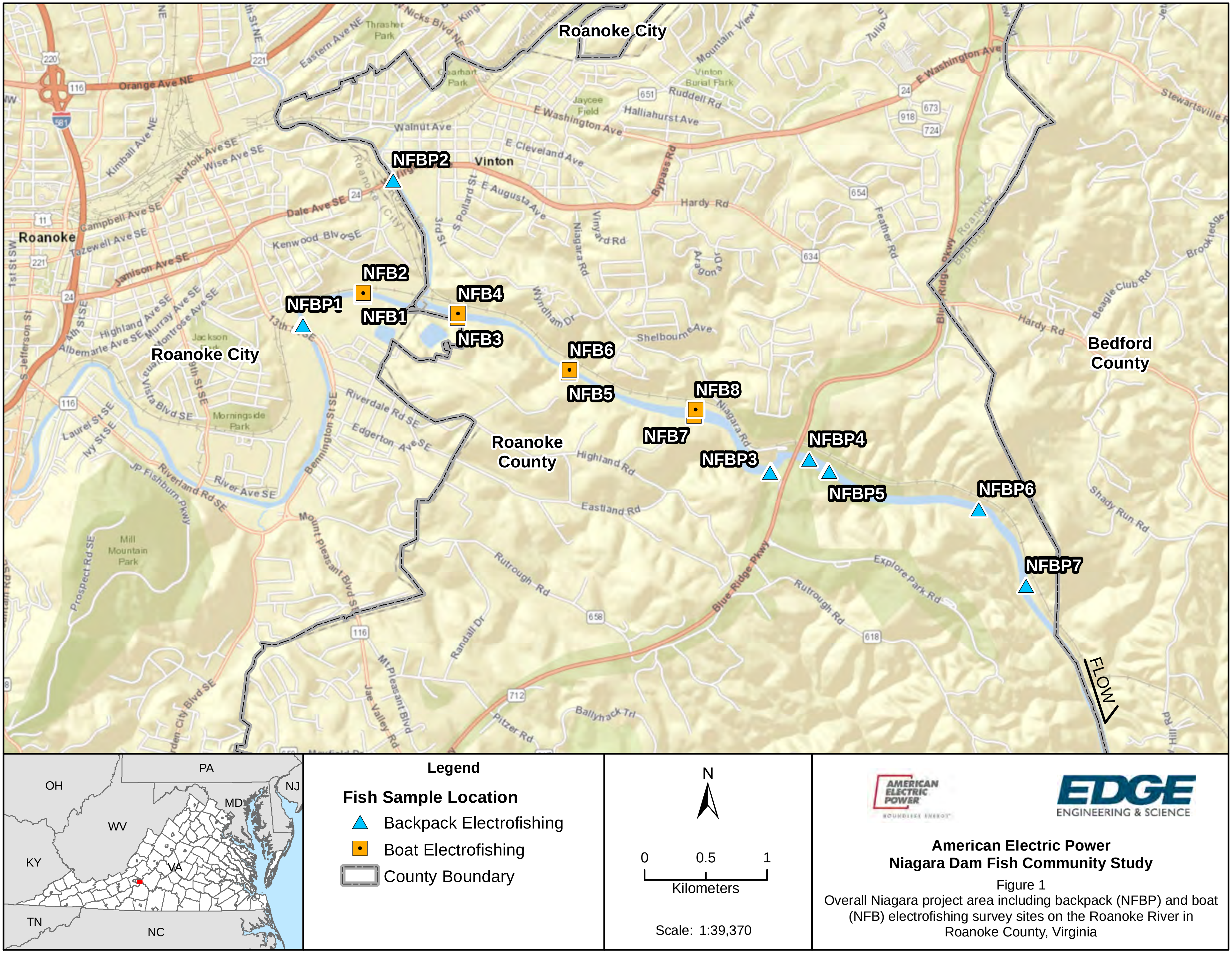
Figures



American Electric Power
Niagara Dam Fish Community Study

Figure 1
Overall Niagara project area including backpack (NFBP) and boat (NFB) electrofishing survey sites on the Roanoke River in Roanoke County, Virginia

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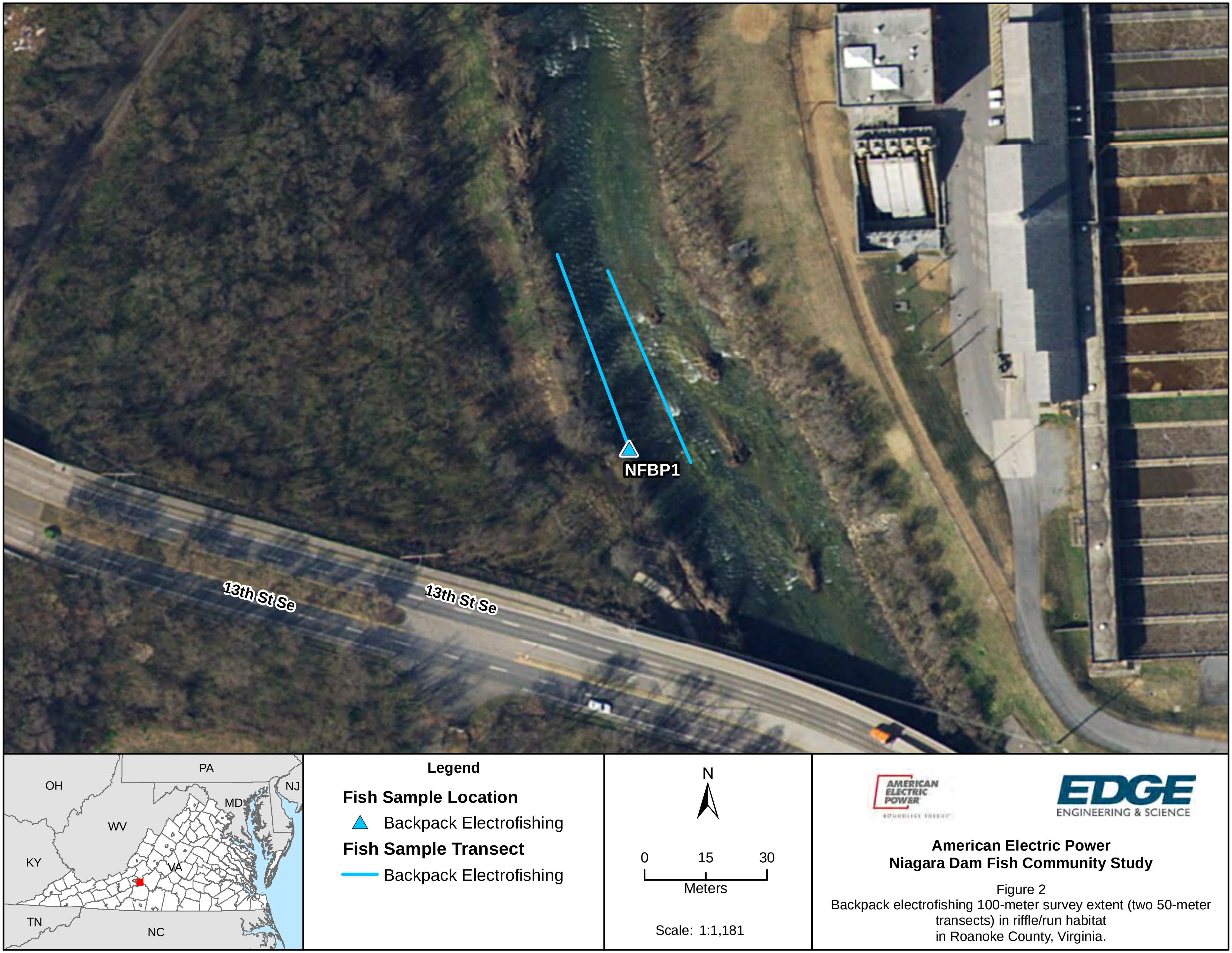

Legend

Fish Sample Location

- ▲ Backpack Electrofishing

Fish Sample Transect

- — Backpack Electrofishing

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 2
Backpack electrofishing 100-meter survey extent (two 50-meter transects) in riffle/run habitat in Roanoke County, Virginia.

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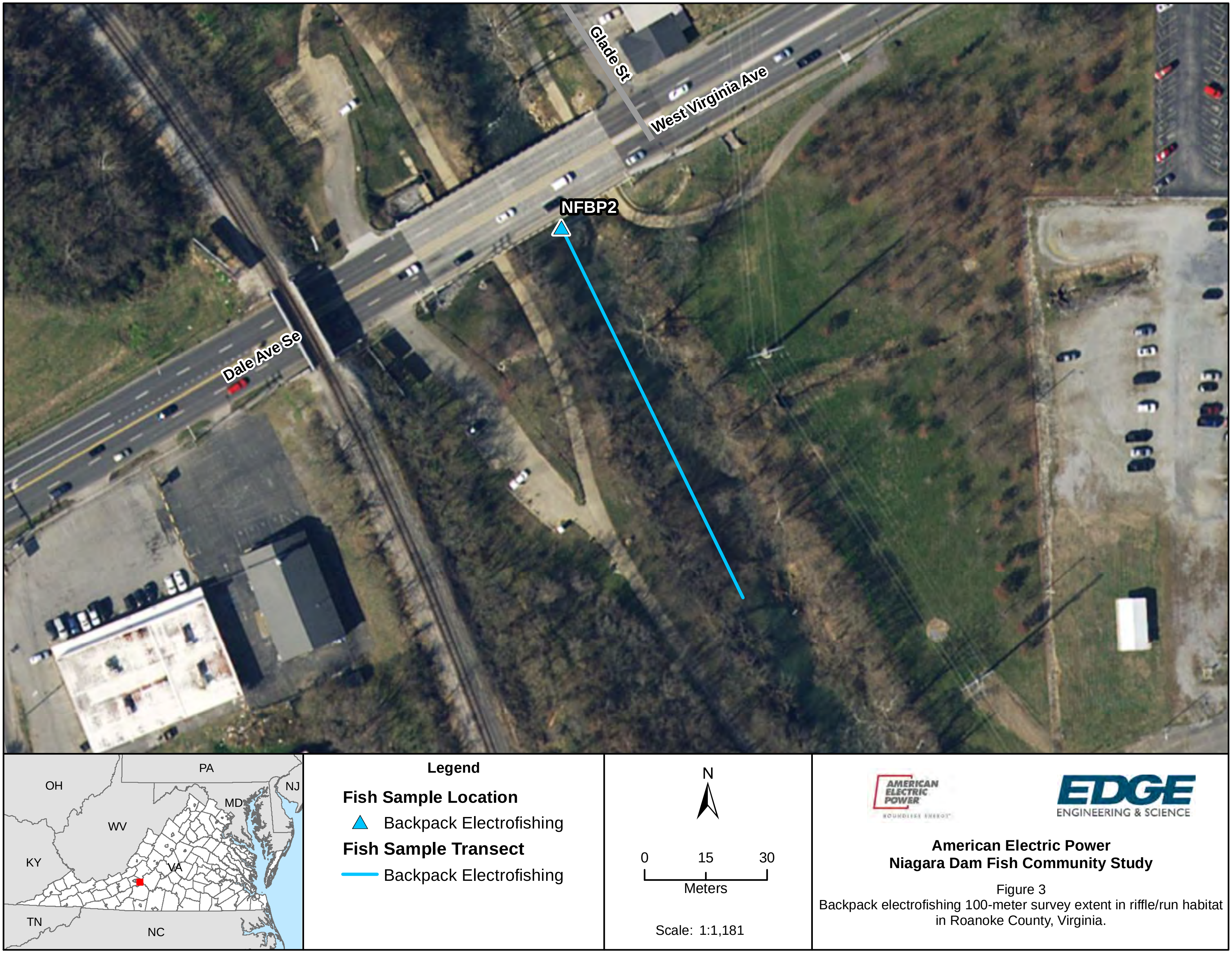

American Electric Power
Niagara Dam Fish Community Study

Figure 3
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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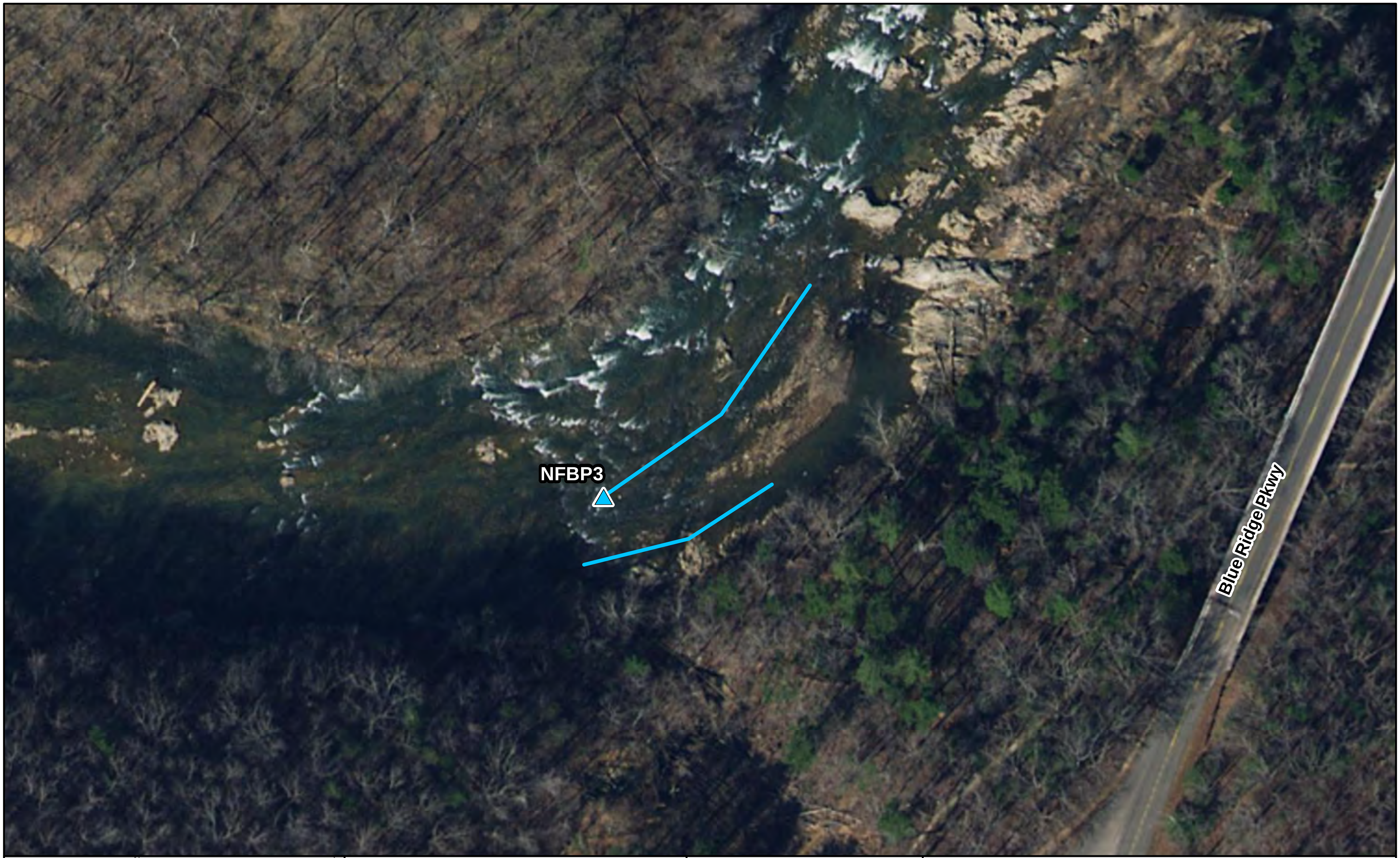

Legend

Fish Sample Location

△ Backpack Electrofishing

Fish Sample Transect

— Backpack Electrofishing

N

0 15 30

Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER

EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Fish Community Study

Figure 4
Backpack electrofishing 100-meter survey extent (one 60- and one 40-meter transect) in riffle/run habitat in Roanoke County, Virginia.

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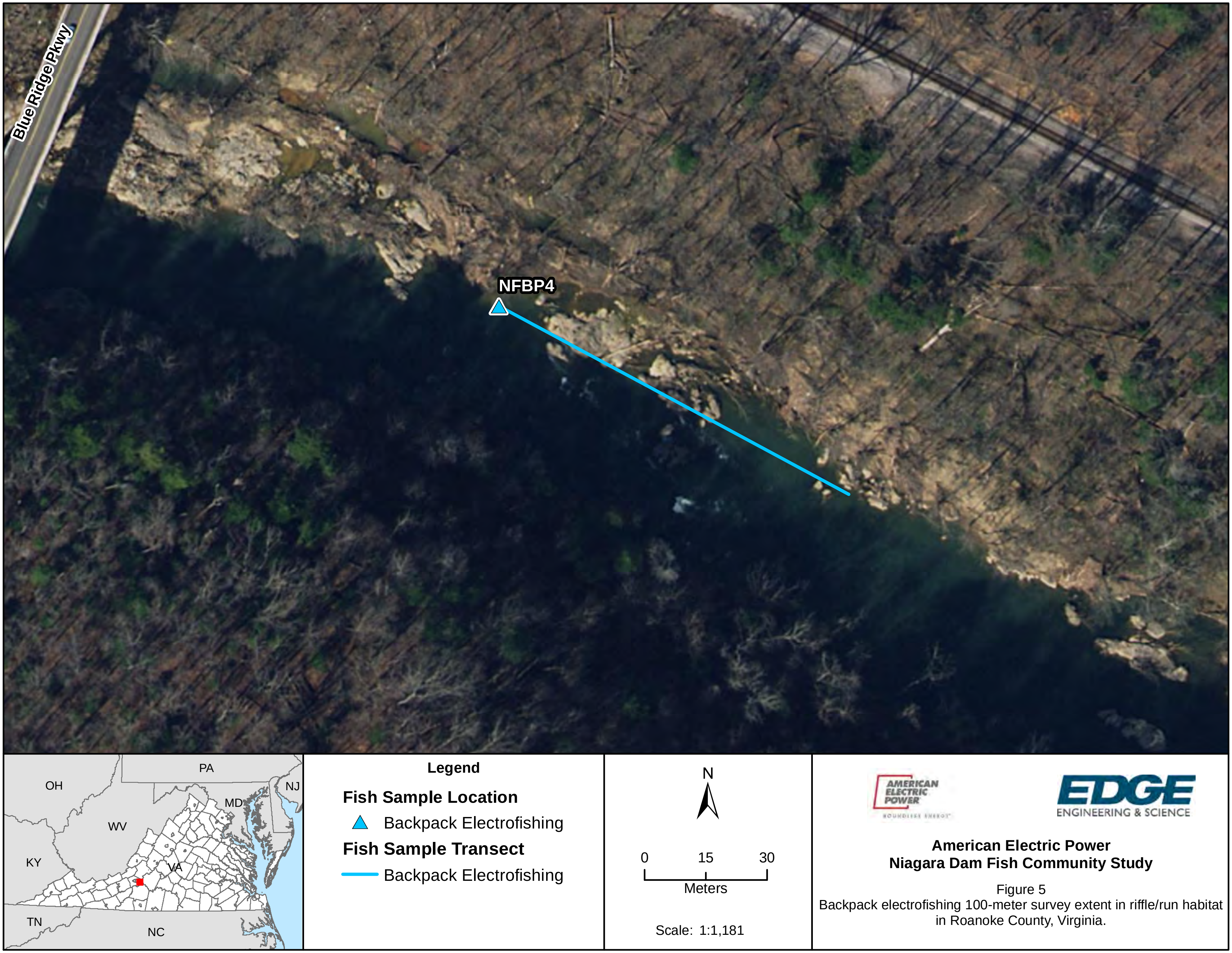

American Electric Power
Niagara Dam Fish Community Study

Figure 5
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

▲ Backpack Electrofishing

Fish Sample Transect

— Backpack Electrofishing

N

0 15 30
Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 6
Backpack electrofishing 100-meter survey extent (one 60- and one 40-meter transect) in riffle/run habitat
in Roanoke County, Virginia.

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Legend

Fish Sample Location

▲ Backpack Electrofishing

Fish Sample Transect

— Backpack Electrofishing

N

0 15 30
Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

EDGE
ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Fish Community Study

Figure 7
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

- ▲ Backpack Electrofishing

Fish Sample Transect

- — Backpack Electrofishing

Scale: 1:1,181

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

EDGE
ENGINEERING & SCIENCE

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Niagara Dam Fish Community Study

Figure 8
Backpack electrofishing 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia.

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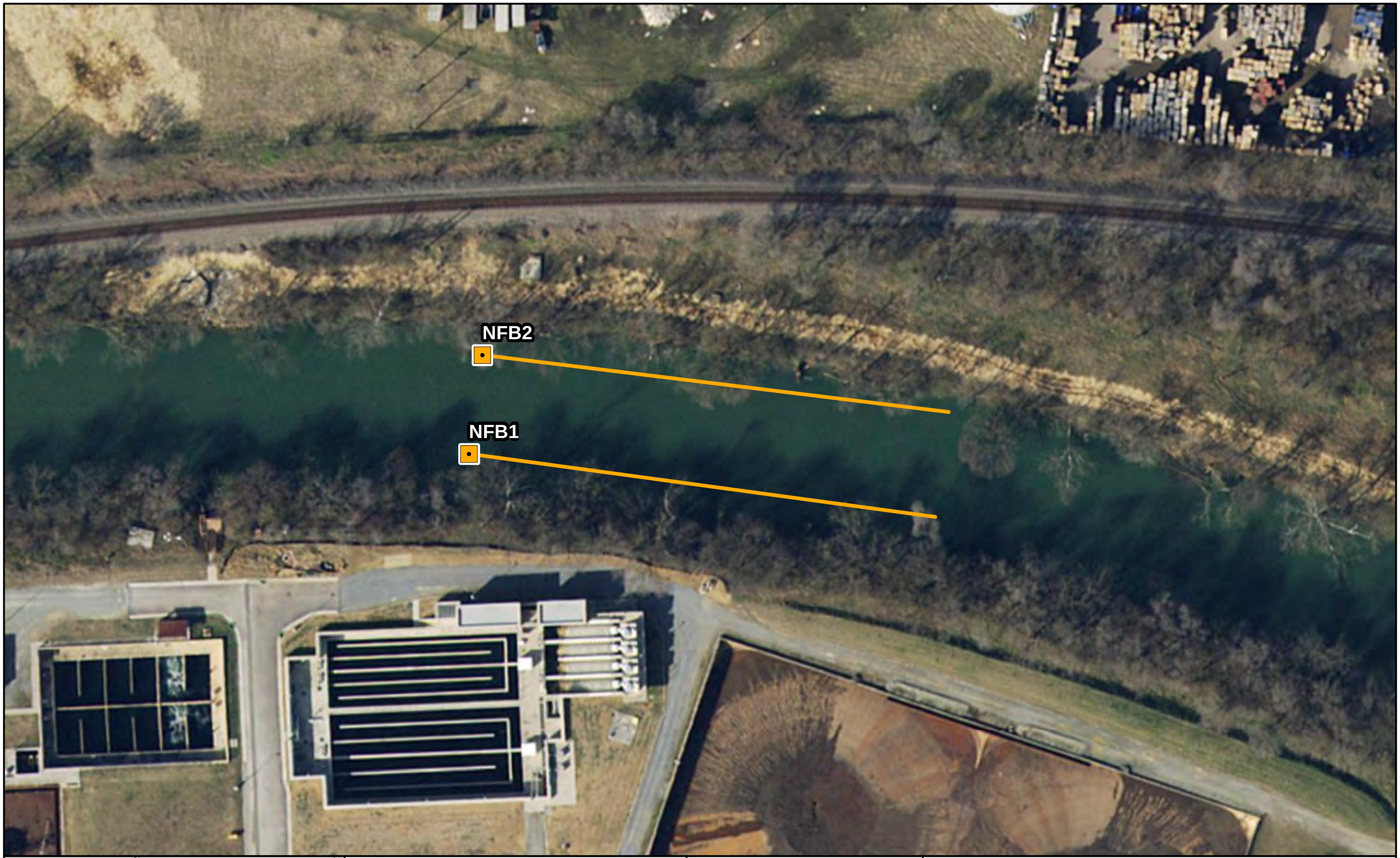

Legend

Fish Sample Location

🟧 Boat Electrofishing

Fish Sample Transect

― Boat Electrofishing

N

0 15 30
Meters

Scale: 1:1,181

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

EDGE
ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Fish Community Study

Figure 9
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Legend

Fish Sample Location

🟧 Boat Electrofishing

Fish Sample Transect

— Boat Electrofishing

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 10
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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American Electric Power
Niagara Dam Fish Community Study

Figure 11
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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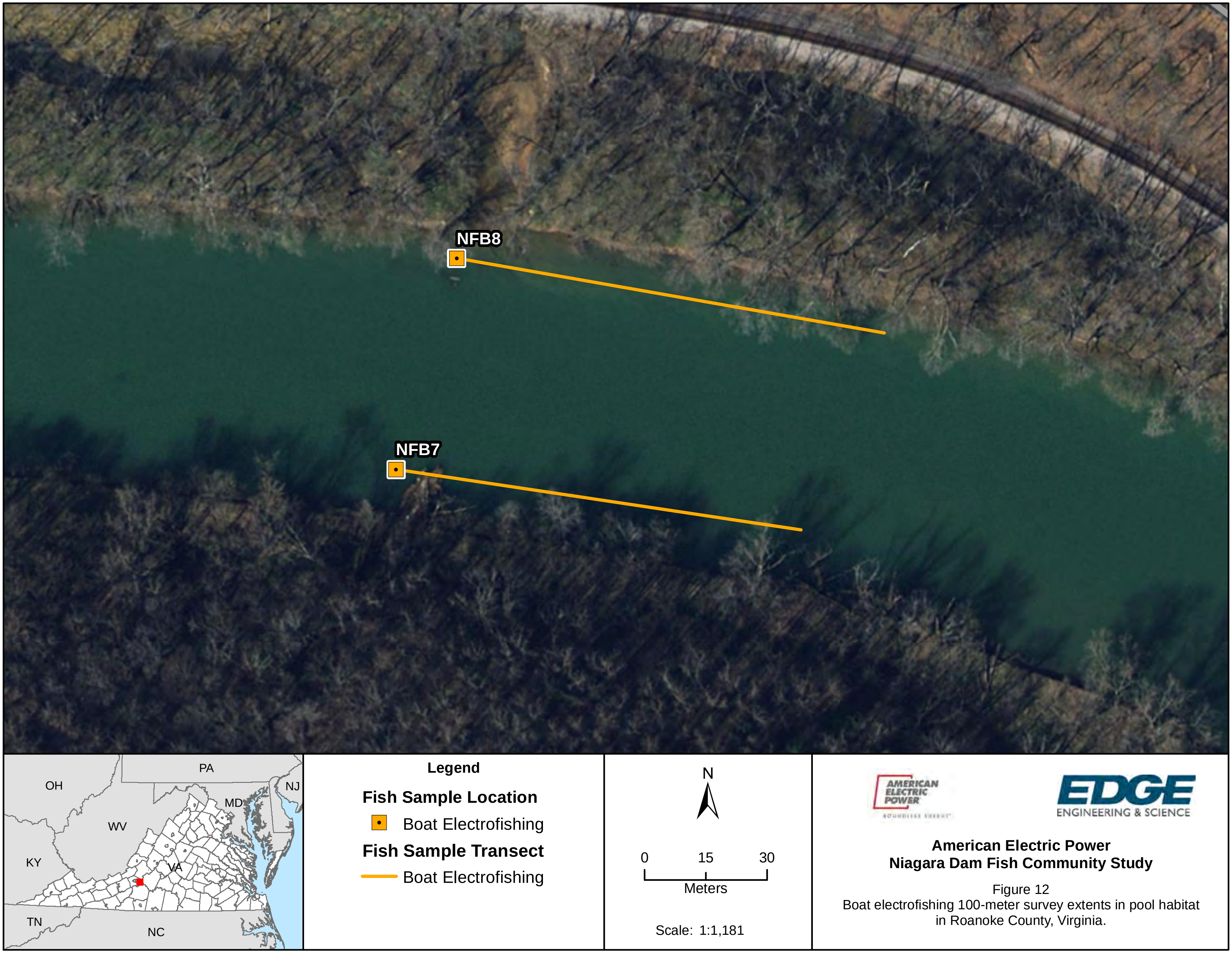

Legend

Fish Sample Location

🟧 Boat Electrofishing

Fish Sample Transect

— Boat Electrofishing

Scale: 1:1,181

American Electric Power
Niagara Dam Fish Community Study

Figure 12
Boat electrofishing 100-meter survey extents in pool habitat in Roanoke County, Virginia.

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Appendix A

SCIENTIFIC COLLECTION PERMITS

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Permittee: **Casey D Swecker**
Address: **4005 Ponder Drive**
Cincinnati, OH 45245
Email: **cdswecker@edge-es.com**

Home:
Office: **(304) 633-5808**
City/County: **Out of State**

Business: **Edge Engineering and Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245
City/County: **Out of State**

Contract Species Surveys/Research/Relocation

Authorized Collection Methods: By Hand/Dip Nets/Electrofishing/Gill Nets-Trawl Nets/Seine Nets/Snorkel/View Scope/Aquatic Kick Samples/Scuba/Nets-Traps (Fyke/Hoop/D-Frame)/Hooka (Third Lung)
All methods which are part of the project(s) outlined in the submitted and approved proposal.
Authorized Waterbodies: Blackwater River/New River/Banister River/Sandy River/North Fork Roanoke River/Little Creek/Crooked Creek/Roanoke River/Sinking Creek/North Fork Holston River/Mill Creek
Authorized Marking Techniques: N/A

SPECIAL CONDITIONS: It is recommended that the fish relocation best management practices be utilized while collecting fish for this project.
Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

PERMIT AMENDMENT 9/1/2020: The amendment changes the following:
Principal Permittee & Authorized Subpermittees Affiliation FROM: ESI to Edge Engineering and Science, LLC
This amendment deletes the following:
Authorized Subpermittees: Kyle McGill/Greg Anderson/Robert Paul/Brandon Yates/Keith Gibbs/Kyle Price/Brandon Bassinger/Tyler Slagle
This amendment adds the following: Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

Permittee MUST notify VDGIF a minimum of 7 days prior to each sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov

Report Due: 31 January 2021, 31 January 2022

ANNUAL REPORTS MUST BE SUBMITTED VIA:
https://vafwis.dgif.virginia.gov/collection_permits/

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:

Augusta
Bath
Brunswick
Buckingham
Carroll
Cumberland
Dinwiddie
Franklin
Giles
Greensville
Highland
Montgomery
Nelson
Nottoway
Pittsylvania
Prince Edward
Pulaski
Roanoke
Scott
Southampton
Radford
Statewide

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Authorized Species:

Description	**ID Number**	**Scientific Name**
Aquatic Insects		
Aquatic Invertebrates (excluding aquatic mollusks)		
Crayfish		
Freshwater Fish		
Freshwater Mussels		
Spiny Riversnail		***Io fluvialis***

Annual Report Due End of Each Year

Authorized Sub-Permittees:
See Attached Sheet

Approved by: Randall T Francis

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Title: **Randall T. Francis - Permits Manager**

Date: **4/21/2020**

20 Permit Effective **4/21/2020** through **12/31/2021** **21**

Scientific Collection Permit

Permit Type: **Renewal** FeePaid: **$40.00** VADGIF Permit No. **068630**

Authorized Sub-Permittees:

Dr. Tom Jones, Edge Engineering & Science, LLC
John Spaeth, Edge Engineering & Science, LLC
Aaron Prewitt, Edge Engineering & Science, LLC
Nancy Scott, Three Oaks Engineering
Adam Benshoff, Edge Engineering & Science, LLC
Dr. Art Bogan, NC Museum of Natural Sciences
Tom Dickinson, Three Oaks Engineering
Nathan Howell, Three Oaks Engineering
David Foltz, Edge Engineering & Science, LLC
Jonathan Studio, Edge Engineering & Science, LLC
Doug Locy, Edge Engineering & Science, LLC
Alyssa Brady, Edge Engineering & Science, LLC
Cody Parks, Three Oaks Engineering
Lizzy Stokes, Three Oaks Engineering
Tim Savage, Three Oaks Engineering
Mitchell Kriege, Edge Engineering & Science, LLC

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **Renewal** Fee Paid: **$20.00** VADGIF Permit No. **068631**

Permittee: **Casey D Swecker**
Address: **4005 Ponder Drive**
Cincinnati, OH 45245
Email:

Office: **(304) 633-5808**
City/County: **Out of State**

Business: **Edge Engineering and Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245
City/County: **Out of State**

Contract Species Surveys/Research/Relocation

Authorized Collection Methods: By Hand/Dip Nets/Seine Nets/Snorkel/View Scope/Aquatic Kick Samples/Scuba/Nets-Traps (Fyke/Hoop/D-Frame)/Electrofishing/Hooka (Third Lung)/Gill Nets-Trawl Nets
Authorized Waterbodies: Blackwater River/New River/North Fork Holston River/Roanoke River/Pigg River/Sandy River/North Fork Roanoke River/Little Creek/Crooked Creek/Roanoke River/Sinking Creek/Mill Creek
Authorized Marking Techniques: N/A

Special Conditions: No sampling in stocked trout waters from October 1st through June 15th. No sampling in tidal waters Auguststst 15th through November 30th per TOYR for sturgeon. No water bodies that have the potential for the Big Sandy Crayfish, unless added to the permit by amendment request.

Special Conditions: For the VDOT sampling on the North Fork Holston River permittee should attempt to use the least potentially lethal techniques first and then move onto other techniques. It is recommended that the fish relocation best management practices be utilized.

James Spinymussel (Parvaspina collina) – 1 foot tissue sample and 1 mantle tissue sample from DGIF dead specimen collected on 8/19/2015 from Little Oregon Creek, Craig County; provided by Brian Watson is authorized pursuant to this permit.

PERMIT AMENDMENT 9/14/2020: This amendment changes the permittee and several subpermittees affiliation from ESI to Edge Engineering and Services LLC. This amendment adds the following projects: Mill Lane Bridge Repair and Niagara Dam Hydro Project.

Permittee MUST notify VDGIF within the 7 day period prior to each sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov

Report Due: 31 January 2020

ANNUAL REPORTS MUST BE SUBMITTED VIA: https://vafwis.dgif.virginia.gov/collection_permits/

Authorized Counties / Cities:

Augusta
Bath
Brunswick
Buckingham
Carroll
Craig
Cumberland
Dinwiddie
Franklin
Giles
Greensville
Highland
Montgomery
Nelson
Nottoway
Pittsylvania
Prince Edward
Pulaski
Roanoke
Scott
Southampton
Radford

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **Renewal** Fee Paid: **$20.00** VADGIF Permit No. **068631**

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Species:

Description	ID Number	Scientific Name
Pistolgrip		***Quadrula (Tritogonia) verrucosa***
Spiny Riversnail		***Io fluvialis***
Threatened & Endangered Aquatic Mollusk Species		
Threatened & Endangered Crayfish		
Threatened & Endangered Fish Species		
Threatened & Endangered Freshwater Mussels		

Authorized Sub-Permittees:
See Attached Sheet

Approved by: Randall T Francis

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Title: **Randall T. Francis - Permits Manager** **Date:** **4/21/2020**

20 Permit Effective **4/21/2020** through **12/31/2020** **20**

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-568 of the Code of Virginia & DGIF Policy E-1-90

Threatened/Endangered Species Permit

Permit Type: **Renewal** FeePaid: **$20.00** VADGIF Permit No. **068631**

Authorized Sub-Permittees:

Dr. Tom Jones, Edge Engineering & Science, LLC
John Spaeth, Edge Engineering & Science, LLC
Aaron Prewitt, Edge Engineering & Science, LLC
Nancy Scott, Three Oaks Engineering
Adam Benshoff, Edge Engineering & Science, LLC
Dr. Art Bogan, NC Museum of Natural Sciences
Tom Dickinson, Three Oaks Engineering
Nathan Howell, Three Oaks Engineering
David Foltz, Edge Engineering & Science, LLC
Jonathan Studio, Edge Engineering & Science, LLC
Doug Locy, Edge Engineering & Science, LLC
Alyssa Brady, Marshall University
Cody Parks, Three Oaks Engineering
Lizzy Stokes, Three Oaks Engineering
Tim Savage, Three Oaks Engineering
Mitchell Kriege, Edge Engineering & Science, LLC
Adam Mann, GAI Consultants, Inc.

Appendix B

REPRESENTATIVE PHOTOGRAPHS

NFBP1 - Downstream
Backpack Electrofishing Sample Site

NFBP2 - Upstream
Backpack Electrofishing Sample Site

NFBP3 - Upstream
Backpack Electrofishing Sample Site

NFBP4 - Upstream
Backpack Electrofishing Sample Site

NFBP5 - Downstream
Backpack Electrofishing Sample Site

NFBP6 - Upstream
Backpack Electrofishing Sample Site

NFBP7 - Downstream
Backpack Electrofishing Sample Site

Rock Bass
(*Ambloplites rupestris*)

Central Stoneroller
(*Campostoma anomalum*)

White Sucker
(*Catostomus commersonii*)

Satinfin Shiner
(*Cyprinella analostana*)

Spotfin Shiner
(*Cyprinella spiloptera*)

Fantail Darter
(*Etheostoma flabellare*)

Johnny Darter
(*Etheostoma nigrum*)

Riverweed Darter
(*Etheostoma podostemone*)

Cutlip Minnow
(*Exoglossum maxillingua*)

Northern Hog Sucker
(*Hypentelium nigricans*)

Redbreast Sunfish
(*Lepomis auritus*)

Green Sunfish
(*Lepomis cyanellus*)

Bluegill
(*Lepomis macrochirus*)

Rosefin Shiner
(*Lythrurus ardens*)

Smallmouth Bass
(*Micropterus dolomieu*)

Blacktip Jumprock
(*Moxostoma cervinum*)

Bull Chub
(*Nocomis raneyi*)

Spottail Shiner
(*Notropis hudsonius*)

Swallowtail Shiner
(*Notropis procne*)

Mimic Shiner
(*Notropis volucellus*)

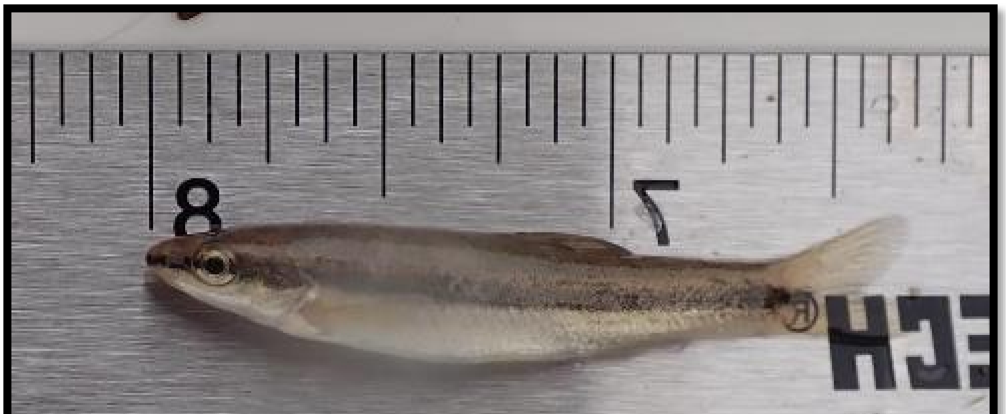
Margined Madtom
(*Noturus insignis*)

Chainback Darter
(*Percina nevisense*)

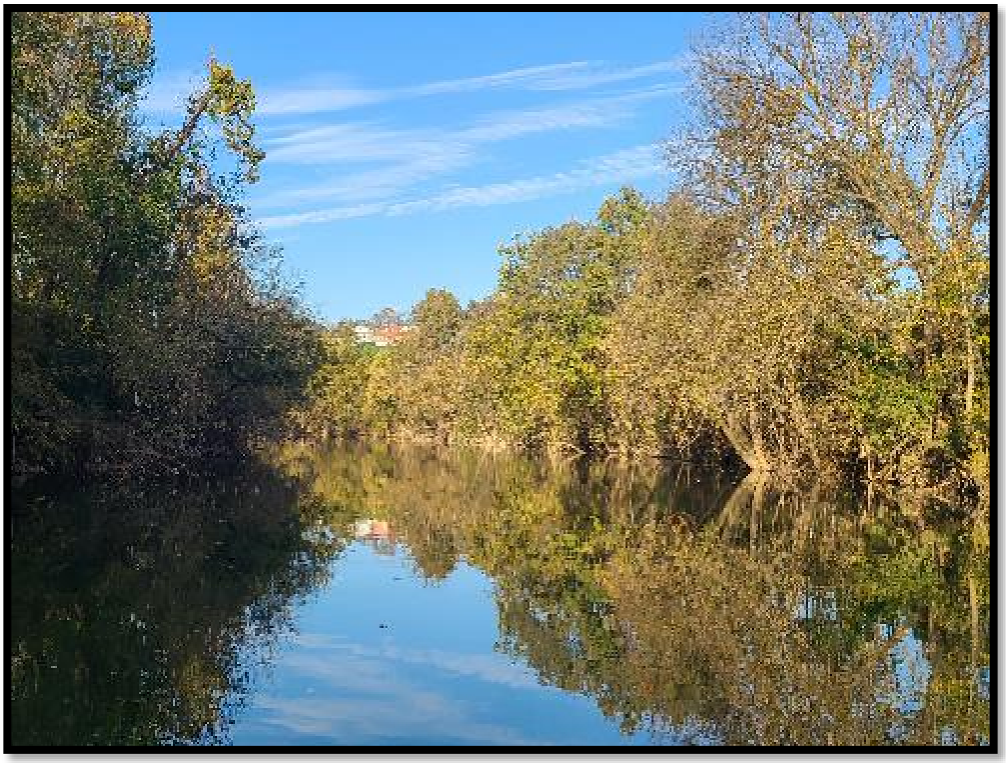
Roanoke Logperch
(*Percina rex*)

Roanoke Darter
(*Percina roanoka*)

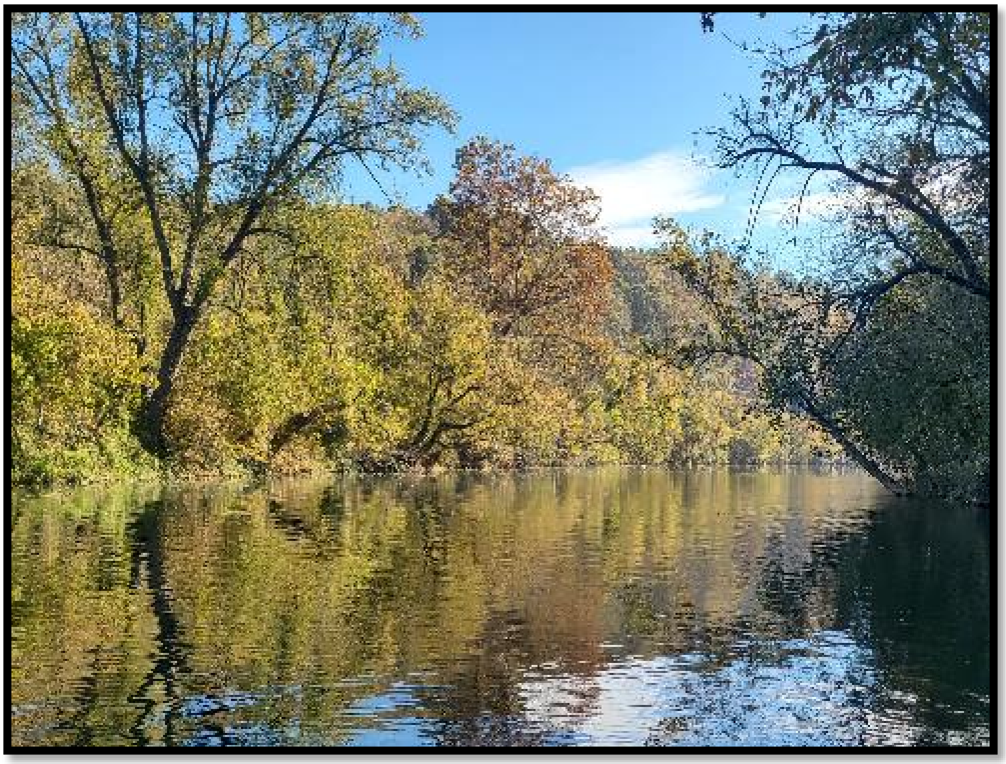
Bluntnose Minnow
(*Pimephales notatus*)



Blacknose Dace
(*Rhinichthys atratulus*)



NFB1 & 2 - Upstream
Boat Electrofishing Sample Site



NFBP3 & 4 - Downstream
Boat Electrofishing Sample Site

NFBP5 & 6 - Upstream
Boat Electrofishing Sample Site

NFBP7 & 8 - Downstream
Boat Electrofishing Sample Site

Redear Sunfish
(*Lepomis microlophus*)

Largemouth Bass
(*Micropterus salmoides*)

Golden Redhorse
(*Moxostoma erythrurum*)

V-lip Redhorse
(*Moxostoma pappillosum*)

Appendix C

RAW DATA

Backpack Electrofishing Data

Common Name	**Species**	**NFBP1**	**NFBP2**	**NFBP3**	**NFBP4**	**NFBP5**	**NFBP6**	**NFBP7**	**Total**	**Rel. Abundance**
Rock Bass	*Ambloplites rupestris*	1	3	-	-	1	1	-	6	1.1%
Central Stoneroller	*Campostoma anomalum*	5	-	55	11	37	20	16	144	27.4%
White Sucker	*Catostomus commersonii*	-	3	-	-	-	-	-	3	0.6%
Satinfin Shiner	*Cyprinella analostana*	2	-	3	1	-	-	1	7	1.3%
Spotfin Shiner	*Cyprinella spiloptera*	-	-	1	1	-	-	-	2	0.4%
Fantail Darter	*Etheostoma flabellare*	3	-	-	-	-	10	13	26	5.0%
Johnny Darter	*Etheostoma nigrum*	1	1	1	-	-	1	-	4	0.8%
Riverweed Darter	*Etheostoma podostemone*	2	-	4	2	4	18	13	43	8.2%
Cutlip Minnow	*Exoglossum maxillingua*	1	-	4	-	3	2	1	11	2.1%
Northern Hog Sucker	*Hypentelium nigricans*	-	2	3	-	-	1	-	6	1.1%
Redbreast Sunfish	*Lepomis auritus*	-	2	3	-	1	-	-	6	1.1%
Green Sunfish	*Lepomis cyanellus*	-	-	-	1	1	-	-	2	0.4%
Bluegill	*Lepomis macrochirus*	-	3	-	-	1	-	-	4	0.8%
Sunfish	*Lepomis sp.*	-	1	-	3	1	-	-	5	1.0%
Rosefin Shiner	*Lythrurus ardens*	74	13	20	6	16	1	4	134	25.5%
Smallmouth Bass	*Micropterus dolomieu*	1	-	1	-	-	1	1	4	0.8%
Blacktip Jumprock	*Moxostoma cervinum*	-	-	1	7	15	3	3	29	5.5%
Bull Chub	*Nocomis raneyi*	4	-	-	-	-	-	-	4	0.8%
Chub	*Nocomis sp.*	4	-	2	-	-	-	-	6	1.1%
Spottail Shiner	*Notropis hudsonius*	-	-	-	8	3	-	-	11	2.1%
Swallowtail Shiner	*Notropis procne*	-	-	-	1	-	-	-	1	0.2%
Mimic Shiner	*Notropis volucellus*	-	-	-	7	-	-	-	7	1.3%
Margined Madtom	*Noturus insignis*	4	-	-	-	4	7	17	32	6.1%
Chainback Darter	*Percina nevisense*	-	2	-	-	-	-	-	2	0.4%
Roanoke Logperch	*Percina rex*	1	-	-	-	-	-	-	1	0.2%
Roanoke Darter	*Percina roanoka*	5	4	-	1	1	5	6	22	4.2%
Bluntnose Minnow	*Pimephales notatus*	-	1	-	-	-	-	-	1	0.2%
Blacknose Dace	*Rhinichthys atratulus*	1	-	-	-	1	-	-	2	0.4%
	Total	109	35	98	49	89	70	75	525	
	Rel. Abundance	20.8%	6.7%	18.7%	9.3%	17.0%	13.3%	14.3%		

Boat Electrofishing Data

Common Name	**Species**	**NFB1**	**NFB2**	**NFB3**	**NFB4**	**NFB5**	**NFB6**	**NFB7**	**NFB8**	**Total**	**Rel. Abundance**
White Sucker	*Catostomus commersonii*	-	-	-	1	-	-	-	-	1	1.5%
Redbreast Sunfish	*Lepomis auritus*	-	-	2	2	5	1	16	-	26	40.0%
Bluegill	*Lepomis macrochirus*	-	-	1	-	1	5	2	2	11	16.9%
Redear Sunfish	*Lepomis microlophus*	-	-	-	-	-	1	-	-	1	1.5%
Sunfish	*Lepomis sp.*	-	-	-	2	-	1	-	-	3	4.6%
Smallmouth Bass	*Micropterus dolomieu*	-	-	1	-	-	-	-	-	1	1.5%
Largemouth Bass	*Micropterus salmoides*	-	-	-	2	2	-	1	1	6	9.2%
Golden Redhorse	*Moxostoma erythrurum*	-	-	9	-	2	-	-	1	12	18.5%
V-lip Redhorse	*Moxostoma pappillosum*	-	-	1	-	-	-	-	-	1	1.5%
Bluntnose Minnow	*Pimephales notatus*	-	-	-	-	-	-	-	3	3	4.6%
	Total	0	0	14	7	10	8	19	7	65	
	Rel. Abundance	0.0%	0.0%	21.5%	10.8%	15.4%	12.3%	29.2%	10.8%		

Attachment 2

Attachment 2 – Preliminary Fish Impingement and Entrainment Study Report

Preliminary Fish Impingement and Entrainment Study Report

Niagara Hydroelectric Project (FERC No. 2466)

January 11, 2020

Prepared by:

HDR

Prepared for:

Appalachian Power Company

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Contents

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Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
cfs	cubic feet per second
EPRI	Electric Power Research Institute
FERC or Commission	Federal Energy Regulatory Commission
fps	feet per second
ft	feet/foot
hr	hour
ILP	Integrated Licensing Process
ISR	Initial Study Report
m	meter
Project	Niagara Hydroelectric Project
RSP	Revised Study Plan
SPD	Study Plan Determination
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources

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1 Project Introduction and Background

1.1 Introduction

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission's Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD).

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Preliminary Fish Impingement and Entrainment Study conducted in support of preparing an application for new license for the Project.

This report uses recent, site-specific fish community data collected in fall 2020 and provided in the Preliminary Fish Community Study Report. The Preliminary Fish Community Study will be finalized in 2021 after the completion of the 2021 field sampling season; therefore, this report was developed using preliminary fisheries data and results may change once all data have been collected, evaluated, and finalized.

1.2 Background

A desktop entrainment study was conducted for the Project during the previous relicensing (Appalachian 1991). Electric Power Research Institute (EPRI) data, project characteristics and operations, as well as the behavioral and life history characteristics of the resident fish in the Roanoke River were used to assess entrainment potential. Appalachian notes that the intake (including trash racks) and generating equipment at the Project have not significantly changed since the time this desktop study was conducted.

Based on behavior, habitat preferences, and life-history characteristics of resident species, the desktop study indicated that the likelihood of substantial numbers of fish occurring in the forebay was expected to be minimal. The eggs of most species evaluated were adhesive and demersal, or were known to be deposited into nests, sheltered vegetation, or other substrate. Additionally, the larvae of most species would remain on the nest or in sheltered slackwater areas until they become free-swimming. Therefore, the evaluation suggests that only larvae of some of the cyprinids and Gizzard Shad (*Dorosoma cepedianum*) would be expected to enter the current in large numbers and may be susceptible to entrainment (Appalachian 1991).

In general, adult and juvenile fish differ in their susceptibility to entrainment because of differences in movement behaviors, depending on species. For example, taxa such as suckers (family Catostomidae), Flathead Catfish (*Pylodictis olivaris*), and centrarchids are unlikely to enter forebay areas in substantial numbers because of preference for sheltered areas with cover as opposed to deep, open-water habitat. Additionally, the desktop study indicated that these fish display sedentary behavior, except for short spawning migrations which are usually upstream (such as exhibited by suckers) rather than closer (downstream) to the forebay. Gizzard Shad, Common Carp (*Cyprinus carpio*) and shiners (*Cyprinella* spp., *Notropis* spp., etc.), White Catfish (*Ameiurus catus*), channel catfish (*Ictalurus punctatus*), bullheads (*Ameiurus* spp.), and Black Crappie (*Pomoxis nigromaculatus*) were determined to be more likely to be found in the forebay areas because of their greater mobility associated with feeding (Appalachian 1991).

The calculated intake velocities at upper and lower normal forebay operating elevations at the Project ranged from 0.9 to 1.2 feet per second (fps), which is similar to the present-day velocity of the free-flowing portion of the Roanoke River. Therefore, the intake velocities would be easily managed by most fish (Appalachian 1991).

In the event a fish enters the turbine, turbine passage effects are primarily restricted to contact with runner blades. The historical desktop assessment of the probability of contact for juvenile fish (with higher likelihood of entrainment than adult fish) was estimated to be less than 10 percent, with a subset of those individuals suffering mortality (Appalachian 1991). Pressure changes, cavitation, turbulence, and shear were not expected to be likely causes of substantial harm to fish at the Project. Due to low head and slow runner speed, blade contact was estimated to be minimal and mortality would not exceed 10 percent. The study concluded impacts from turbine passage on fish populations in the vicinity of the Project were negligible.

Given this context and background, the Preliminary Fish Impingement and Entrainment Study focused on reexamining and updating (as applicable) the prior evaluation of entrainment potential and turbine passage at the Project during operation.

2 Study Goals and Objectives

In accordance with Appalachian’s November 6, 2019 RSP and the Commission’s December 6, 2019 SPD for the Project, the goal of this study is to verify or update certain aspects pertaining to the Niagara dam and examine entrainment potential at the Project. The study objectives are to:

- Confirm flow velocities at and near the Niagara dam intake/outlet structure located within the Roanoke River to facilitate a desktop assessment of entrainment and impingement potential at the Project.
- Perform an updated desktop review of entrainment potential at the Project during hydropower generation.
- Perform a blade strike evaluation using the U.S. Fish and Wildlife Service (USFWS) Turbine Blade Strike Analysis Model (USFWS 2020). This model is a probabilistic Excel-based Visual Basic for Applications implementation of the methods outlined by Franke et al. (1997) for evaluating fish mortalities due to turbine entrainment.

3 Study Area

The study area includes the lower reach of the impoundment of the Roanoke River and the intake structure of the Niagara dam, as shown in Figure 3-1.

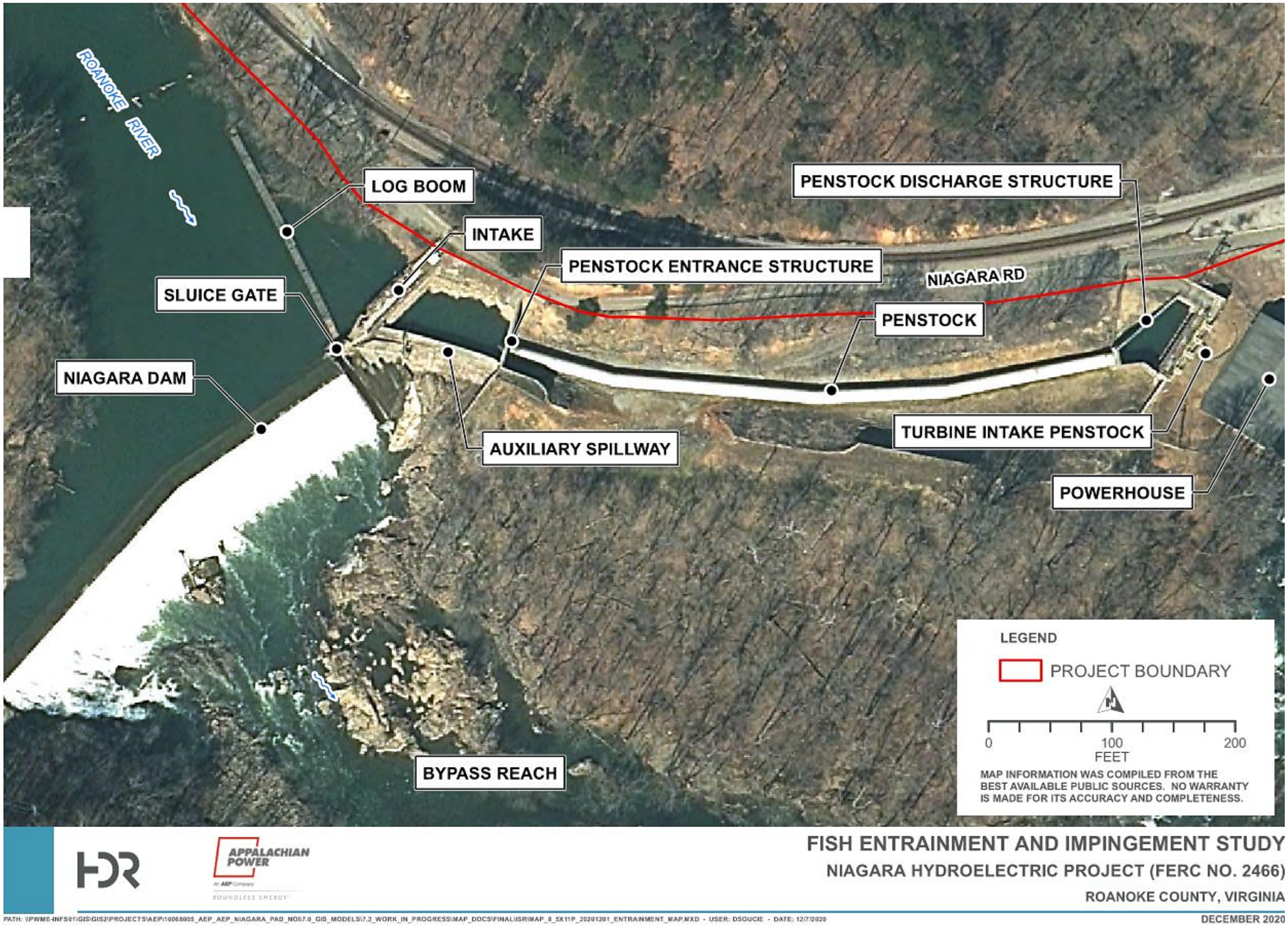

Figure 3-1. Preliminary Fish Impingement and Entrainment Evaluation Study Area

4 Methodology

4.1 Intake Characteristics and Velocities

The intake structure at the Project is located on the left (looking downstream) side of the main dam and is equipped with steel trash racks that slopes 15 degrees from top to bottom. Per the Project RSP and Commission's SPD, intake velocities would be measured using an Acoustic Doppler Current Profiler (ADCP) along the upstream face of the angled trash racks to determine the approximate approach velocity immediately upstream of the intake structure. During the 2020 field season, a combination of high flow events and inoperable units prevented field data collection efforts. As a result, approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the two generating units.

4.2 Desktop Review of Impingement and Entrainment Potential

The potential for fish to become entrained or impinged at a hydroelectric facility is dependent on a variety of factors such as fish life history, size and swimming ability, water quality, operating regimes, inflow, and intake/turbine configurations (Cada et al. 1997). Impingement occurs when a fish is held against or entrapped on the exterior intake structure screen (i.e., trash racks) due to forces created by the intake velocities. Entrainment occurs when the fish passes through the trash racks and is withdrawn into the intake structure.

The potential for fish entrainment is variable throughout a given year depending on life stage and project-specific operations. Early life stage and smaller-sized fish may be more abundant during certain portions of the year, thus increasing their susceptibility to entrainment. In addition, diurnal and seasonal movements of both small and large fish may bring them in close proximity to intake structures. Physical and operational characteristics of a given project, including trash rack bar spacing, intake velocities, intake depth, waterbody stratification, and intake proximity to feeding and rearing habitats also affect the potential for a fish to become entrained. These factors were used to make general assessments of entrainment and impingement potential at the Project using a desktop study approach.

A targeted species list was developed based on recent (Appalachian 2020) and historical (Appalachian 1991) fish community studies, as well as a species list developed by the former Virginia Department of Game and Inland Fisheries (VDGIF), currently named the Virginia Department of Wildlife Resources (VDWR), for the Roanoke River at the time of the historical fish community study (Appalachian 1991). The list includes consideration of fish community composition and abundance of the Roanoke River and any other species of interest due to state and/or federal protections, or angler significance. Selected species were evaluated for potential of entrainment and impingement based on swim speed, behavior, habitat preferences, life stages, and other life history characteristics. Risk assessment of impingement and entrainment potential also considered seasonal or temperature-dependent behavioral changes in fish species.

4.2.1 Assessment of Impingement Potential at the Intake

Appalachian considered impingement and intake avoidance based on the 3.625-inch clear spacing at the Project. This process involved comparing available target fish swim speeds with calculated intake velocities, as well as estimating minimum fish lengths for the target fish species that would be excluded or impinged by the 3.625-inch clear spacing. A scaling factor relating fish length to body width was used for the entrainment assessment to determine minimum sizes of the target fish species that would physically be excluded by the trash racks (Smith 1985).

4.2.2 Fish Entrainment Rates

4.2.2.1 EPRI Database and Data Selection

A database developed by EPRI (1997) provides detailed results of fish entrainment and turbine passage survival studies from 43 hydroelectric projects. This database was designed specifically to facilitate the desktop analysis of available data to assess entrainment and impingement impacts at a hydroelectric facility.

Although some projects used to compile the database may not match the exact specifications of the Project, using as many projects as possible from the EPRI database accounts for the variability of aquatic ecosystems and fish populations, while providing a robust database for calculating average monthly entrainment rates for a wide range of species. This is a commonly applied approach in desktop entrainment evaluations.

Site characteristics (i.e., reservoir size, usable storage, plant capacity, operating mode, average velocity at trash racks, trash rack spacing) and available data (i.e., entrainment data, collection efficiency) were reviewed for applicability to the Project using the (EPRI 1997) database. Five projects were eliminated due to trash rack spacing wider than specifications at the Project and an additional five project were eliminated due to a lack of collection efficiency data. Therefore, 33 facilities were used in in this Preliminary Fish Impingement and Entrainment study (Appendix A).

4.2.2.2 Entrainment Rate Calculation

The EPRI (1997) entrainment database provides results from field trials conducted at hydroelectric facilities using full-flow tailrace netting. This involves the placement of a conical net in the immediate tailrace to collect the entire discharge on a seasonal or monthly basis. This results in the calculation of entrainment rates (fish/volume of water if recorded, or fish/hour (hr)/cubic feet per second [cfs] of sampled unit capacity), including the number, species, and size of entrained fish.

The studies included in the EPRI (1997) database recorded number of hours sampled and hydraulic capacity of the sampled units. Using this information, data was standardized to the number of fish/hr of unit capacity, and then used to calculate fish entrainment rates (fish/hr) at maximum design turbine discharge at the Project (684 cfs). Entrainment rates were compiled by season (winter = December, January, and February; spring = March, April, and May; summer = June, July, and August; and fall = September, October, and November) and annually.

With consideration of entrainment rates based on the EPRI (1997) database, ability of intake avoidance based on swim burst speed, size exclusion, and life history characteristics (i.e., migratory behavior, spawning periodicity, habitat preferences, etc.), a qualitative assessment of entrainment risk was made for each target species/group. EPRI (1997) developed a five-tier qualitative index of entrainment abundance (i.e., an estimate of the relative amount of fish to become entrained) from low to high based upon break points in relative entrainment abundance between species and sizes. These qualitative categories are utilized in this study to describe entrainment potential of the target fish species on a monthly basis. Most species showed a peaked seasonal distribution of entrainment densities in the EPRI database. The mean monthly, seasonal, and annual estimates of entrainment provide a general assessment of entrainment risk for the target species based on empirical data at various hydroelectric projects; however, it does not adequately describe the true potential of a species as a function of the site-specific layout and hydraulics of the Project. A matrix of target species' entrainment potential at the Project was constructed on a seasonal basis using the empirical entrainment rate data from the EPRI database, species periodicity, abundance, and expected distributions.

4.2.3 Turbine Blade Strike Evaluation

This evaluation uses the most recent version of the Turbine Blade Strike Analysis Model (USFWS 2020) created by the USFWS, which is a probabilistic Excel-based Visual Basic for Applications implementation of the methods outlined by Franke et al. (1997) for evaluating fish mortalities due to turbine entrainment, as well as through non-turbine routes. This tool allows for the estimation of turbine passage and mortality (blade strikes) based on site-specific information (i.e., turbine type, number of units, bar rack spacing, etc.) and length distribution for target species used in this impingement and entrainment assessment. Using the model, fish can be subjected up to 20 hazards, or routes, including 3 turbine types and bypasses, incorporating the Franke et al. (1997) equations into a Monte Carlo simulation that produces a probabilistic model result for turbine and non-turbine mortality.

While the greatest opportunity for fish mortality through a facility lies in potential contact with the turbine runner blades, injuries and mortalities can result from other mechanisms including extreme pressure changes, shear stress, water turbulence, cavitation, and grinding (Deng et al. 2005). However, the historical study (Appalachian 1991) determined that these factors are minimal at the Project; and since no significant changes have occurred at the facility that would change these parameters since the last relicensing, injuries and mortalities caused by factors other than turbine strikes are expected to be negligible.

5 Study Results

5.1 Intake Structure Characteristics

Pursuant to the SPD, the key physical characteristics, operational information, and intake velocities associated with the Project intake structure were compiled from Project drawings, field data, and hydraulic calculations.

5.1.1 Intake Specifications

The intake structure at the Project (also referred to as the “upper intake”) is integrated into the left non-overflow section of the main dam. Flow to the penstock is controlled by five inlets equipped with steel head gates, each 6.4-feet (ft) wide by 8.25-ft high. Steel trash racks with 3.625-inch clear bar spacing are inclined upstream of the head gates (Figure 5-1). An automated trash rake system (known as a “drag rake”) is utilized to clean the trash racks and prevent sediment and debris buildup in front of the intake (Appalachian 1991).

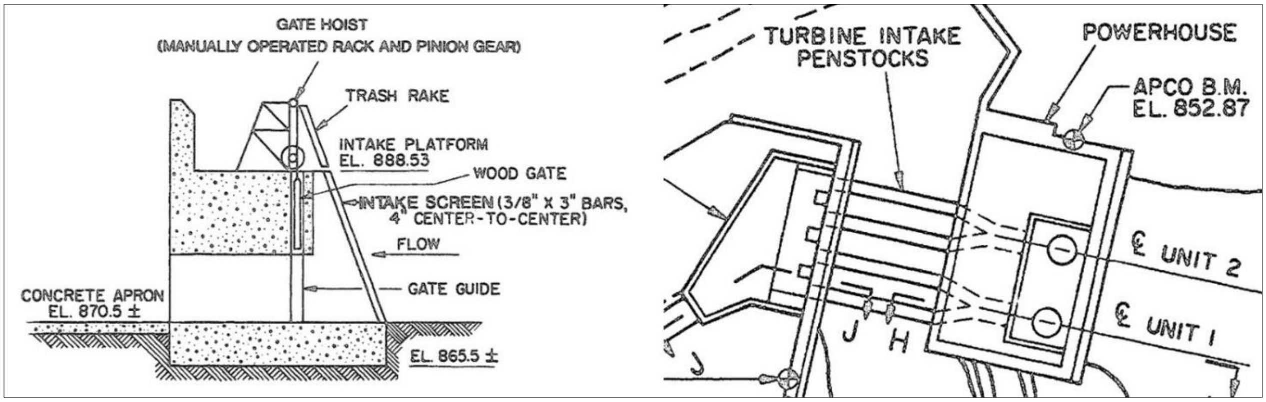

Figure 5-1. Intake Drawings of the Niagara Hydroelectric Project

A logboom consisting of interconnected floating platforms is used to direct larger floating objects away from the intake screens. The logboom is anchored to the north bank of the river, approximately 90 feet upstream of the upper intake structure and extends for approximately 135 feet to the south side of the intake structure.

5.1.2 Intake Flows

The design maximum flow capacity of the two generating units is 379 cfs for Unit 1 and 305 cfs for Unit 2, for a total plant capacity of 684 cfs. An evaluation of U.S. Geological Survey (USGS) gage data (USGS 02056000 Roanoke River at Niagara) from January 1990 to October 2020 showed that river flows exceeded total plant capacity an average of 3 months per year (Figure 5-2), indicating that the Project could theoretically operate at maximum turbine discharge approximately 29 percent of the time (particularly during the higher flow months of February, March, and April).

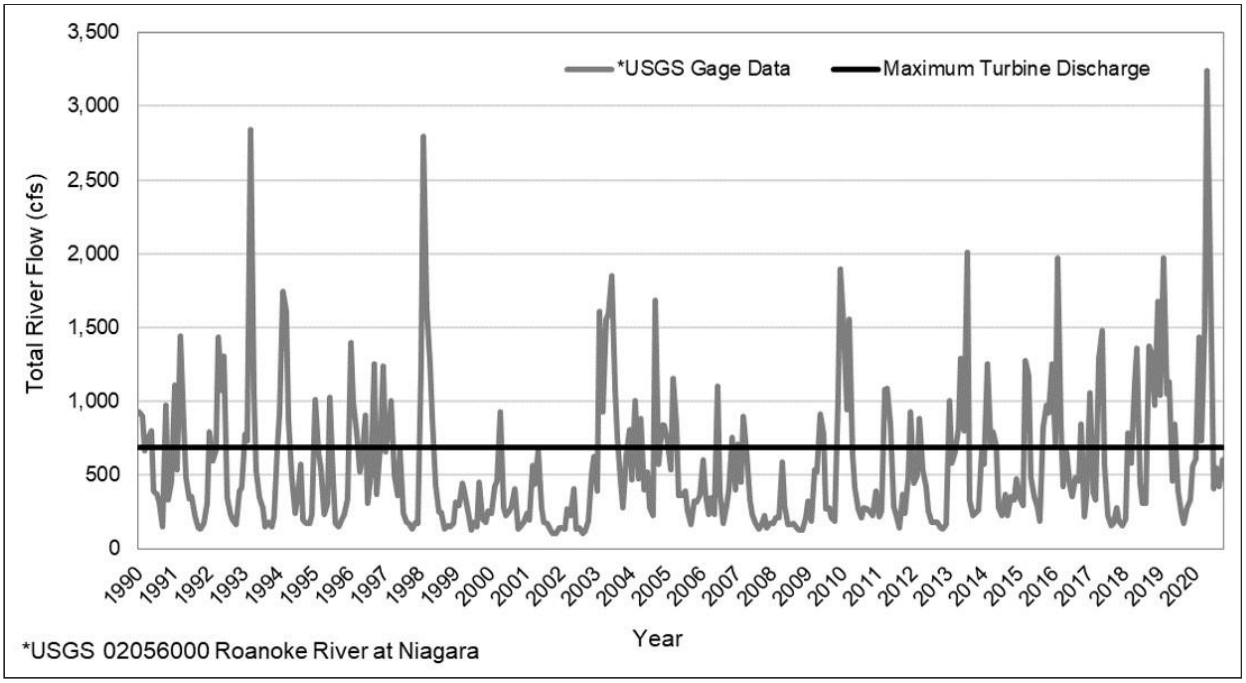

Figure 5-2. U.S. Geological Survey (USGS) Gage Data versus Maximum Turbine Discharge (684 cfs) at Niagara Hydroelectric Project

5.1.3 Intake Velocities

Using intake opening structure dimensions of 40-ft wide and 15.4-ft high[1], the calculated approach velocity in front of the intake is approximately 1.1 fps (i.e., 40 ft x 15.4 ft / 684 cfs). This approach velocity is similar to those presented in the historical entrainment report (Appalachian 1991).

A desktop evaluation using Roanoke River morphometrics and flow data from the nearest upstream gage (USGS 02055000 Roanoke River at Roanoke, Virginia) suggests that the velocity of the river in the vicinity of the Project is comparable to that estimated in front of the intake, therefore it is likely that fish in this area are able to navigate intake flows similar to normal river conditions.

5.2 Desktop Review of Impingement and Entrainment Potential

5.2.1 Fish Community and Target Species

The initial field sampling efforts for the Preliminary Fish Community Study were performed in 2020 with the remaining field efforts scheduled for completion in the spring and summer of 2021 with the goal to characterize the Roanoke River fishery in the vicinity of the Project. Details of the methods and preliminary results of the study is included in the Preliminary Fish Community Study Report.

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[1] The top of the normal reservoir operating band is 884.4 ft NGVD. At this reservoir level, the depth in front of the intake structure is approximately 13.9 ft. The trash racks are angled at a 15 degree slope from top to bottom, therefore wetted height of the trash racks is approximately 15.4 ft.

A total of 15 sites were sampled for the Preliminary Fish Community Study, including 7 wadeable (i.e., backpack electrofishing) sites and 8 non-wadeable (i.e., boat electrofishing) sites. For non-wadeable sites, the impoundment was divided into three study reaches: Upper, Middle, and Lower reaches. Two additional boat electrofishing transects were located in the Roanoke River upstream of its confluence with Tinker Creek. Within each reach, two parallel 100-meter (m) transects were established along the shoreline (one on each side of the reservoir in representative habitat) for a total of eight, 100-m transects. All non-wadeable electrofishing sites were located upstream of the Niagara dam.

Two wadeable electrofishing locations were located above the dam: one at the 13th Street Bridge and one located in Tinker Creek. The remaining five locations were located below the dam, including one in the bypass reach. Fish species collected by boat and backpack electrofishing are presented in Table 5-1 and Table 5-2.

Table 5-1. Fish Species Collected from Non-wadeable Electrofishing Sites for the Niagara Hydroelectric Project 2020 Fish Community Study

Common Name	Scientific Name	Impoundment Reach					
		Lower		Middle		Upper	
		N	RA[1] (%)	N	RA[1] (%)	N	RA[1] (%)
Bluegill	*Lepomis macrochirus*	4	15.4	6	33.3	1	4.8
Bluntnose Minnow	*Pimephales notatus*	3	11.5	--	--	--	--
Golden Redhorse	*Moxostoma erythrurum*	1	3.8	2	11.1	9	42.9
Largemouth Bass	*Micropterus salmoides*	2	7.7	2	11.1	2	9.5
Lepomis Sunfish	*Lepomis* spp.	--	--	1	5.6	2	9.5
Redbreast Sunfish	*Lepomis auritus*	16	61.5	6	33.3	4	19.0
Redear Sunfish	*Lepomis microlophus*	--	--	1	5.6	--	--
Smallmouth Bass	*Micropterus dolomieu*	--	--	--	--	1	4.8
V-lip Redhorse	*Moxostoma pappillosum*	--	--	--	--	1	4.8
White Sucker	*Catostomus commersonii*	--	--	--	--	1	4.8
Total		**26**	**100.0**	**18**	**100.0**	**21**	**100.0**

[1] Relative Abundance (RA)

Table 5-2. Fish Species Collected from Wadeable Electrofishing Sites for the Niagara Hydroelectric Project 2020 Fish Community Study

Common Name	Scientific Name	Upstream of Confluence with Tinker Creek		Tinker Creek		Bypass Reach		Downstream of Niagara Dam	
		N	RA[1] (%)	N	RA (%)	N	RA (%)	N	RA (%)
Blacknose Dace	*Rhinichthys atratulus*	1	0.9	--	--	--	--	1	0.4

Common Name	Scientific Name	Upstream of Confluence with Tinker Creek		Tinker Creek		Bypass Reach		Downstream of Niagara Dam	
		N	RA[1] (%)	N	RA (%)	N	RA (%)	N	RA (%)
Blacktip Jumprock	*Moxostoma cervinum*	--	--	--	--	1	1.0	28	9.9
Bluegill	*Lepomis macrochirus*	--	--	3	8.6	--	--	1	0.4
Bluntnose Minnow	*Pimephales notatus*	--	--	1	2.9	--	--	--	--
Bull Chub	*Nocomis raneyi*	4	3.7	--	--	--	--	--	--
Central Stoneroller	*Campostoma anomalum*	5	4.6	--	--	55	56.1	84	29.7
Chainback Darter	*Percina nevisense*	--	--	2	5.7	--	--	--	--
Cutlip Minnow	*Exoglossum maxillingua*	1	0.9	--	--	4	4.1	6	2.1
Fantail Darter	*Etheostoma flabellare*	3	2.8	--	--	--	--	23	8.1
Green Sunfish	*Lepomis cyanellus*	--	--	--	--	--	--	2	0.7
Johnny Darter	*Etheostoma nigrum*	1	0.9	1	2.9	1	1.0	1	0.4
Lepomis sp.	*Lepomis* spp.	--	--	1	2.9	--	--	4	1.4
Margined Madtom	*Noturus insignis*	4	3.7	--	--	--	--	28	9.9
Mimic Shiner	*Notropis volucellus*	--	--	--	--	--	--	7	2.5
Nocomis Species	*Nocomis* spp.	4	3.7	--	--	2	2.0	--	--
Northern Hogsucker	*Hypentelium nigricans*	--	--	2	5.7	3	3.1	1	0.4
Redbreast Sunfish	*Lepomis auritus*	--	--	2	5.7	3	3.1	1	0.4
Riverweed Darter	*Etheostoma podostemone*	2	1.8	--	--	4	4.1	37	13.1
Roanoke Darter	*Percina roanoka*	5	4.6	4	11.4	--	--	13	4.6
Roanoke Logperch	*Percina rex*	1	0.9	--	--	--	--	--	--
Rock Bass	*Ambloplites rupestris*	1	0.9	3	8.6	--	--	2	0.7
Rosefin Shiner	*Lythrurus ardens*	74	67.9	13	37.1	20	20.4	27	9.5
Satinfin Shiner	*Cyprinella analostana*	2	1.8	--	--	3	3.1	2	0.7
Smallmouth	*Micropterus dolomieu*	1	0.9	--	--	1	1.0	2	0.7
Spotfin Shiner	*Cyprinella spiloptera*	--	--	--	--	1	1.0	1	0.4
Spottail Shiner	*Notropis hudsonius*	--	--	--	--	--	--	11	3.9
Swallowtail Shiner	*Notropis procne*	--	--	--	--	--	--	1	0.4
White Sucker	*Catostomus commersonii*	--	--	3	8.6	--	--	--	--
Total		**109**	**100.0**	**35**	**100.0**	**98**	**100.0**	**283**	**100.0**

[1] Relative Abundance (RA)

An evaluation of the 2020 Preliminary Fish Community Study data, historical sampling data (Appalachian 1991), and a VDWR list of Roanoke River species (Appalachian 1991) were used to determine the target species list representative of those species and species groups of management (i.e., state/federal protection), economic, and ecological interest (Table 5-3). The EPRI (1997) database was used to determine entrainment rates for the selected species and species groups (using surrogate species representatives where necessary). Additionally, where appropriate, representative or surrogate species were also used when evaluating other factors, such as swim burst speed and impingement potential.

Table 5-3. Target Fish Species and Species Groups Included in the Impingement and Entrainment Study for Niagara Hydroelectric Project

Common Name[1]	Scientific Name	Surrogate Representation
Largemouth Bass	*Micropterus salmoides*	Largemouth Bass
Smallmouth Bass/Spotted Bass	*Micropterus dolomieu/M. punctulatus*	Smallmouth Bass, Spotted Bass
Black Crappie	*Pomoxis nigromaculatus*	Black Crappie, White Crappie
Rock Bass	*Ambloplites rupestris*	Rock Bass, Roanoke Bass
Lepomis Sunfishes	*Lepomis* spp.	Bluegill, Redear Sunfish, Redbreast Sunfish, Green Sunfish, Pumpkinseed, and Warmouth
Shiners, Chubs, and Minnows	Leuciscinae	Blacknose Dace, Bluntnose Minnow, Bull Chub, Central Stoneroller, Common Carp, Creek Chub, Cutlip Minnow, Mimic Shiner, Rosefin Shiner, Satinfin Shiner, Spotfin Shiner, Spottail Shiner, and Whitetail Shiner
Bullheads and Madtoms	*Ameiurus* spp. and *Noturus* spp.	Black Bullhead, Brown Bullhead, Flat Bullhead, Yellow Bullhead, Margined Madtom, and Orangefin Madtom
Catfishes	*Ictalurus* spp.	Channel Catfish, White Catfish, and Flathead Catfish
Suckers and Redhorse	Catostomidae and *Moxostoma* spp.	Blacktip Jumprock, Golden Redhorse, Silver Redhorse, White Sucker, and Northern Hogsucker
Darters	*Etheostoma* spp.	Fantail Darter, Johnny Darter, and Riverweed Darter
Logperch	*Percina* spp.	Chainback Darter, Roanoke Darter, and Roanoke Logperch

[1] Target species/groups were based on species collected in recent (2020) or historical fish studies (Appalachian 1990) in the Roanoke River or that are known to occur in Roanoke River in or near the Project area.

5.2.2 Intake Avoidance

Burst swim speeds for target or representative species were compared to the estimated intake velocity to evaluate whether fish may be susceptible to intake flows at the Project. Burst swim speed is the swim speed used to escape predation, maneuver through high flows, or in this case, escape intake velocities and avoid entrainment. Burst swim speed data were compiled from the literature, however if data for a specific species or group was not directly available, it was calculated as 2x critical swim speed based on Bell (1991).

As described in Section 5.1 of this study report, impingement and entrainment characterizations at the Project consider velocities under maximum turbine discharge of 684 cfs, corresponding to a maximum approach velocity of 1.1 fps. The burst speeds shown in Table 5-4 indicate that all target species and life stages evaluated, with the exception of eggs, larvae, and juvenile Spottail Shiner, would be able to avoid entrainment at the Project given that estimated swim burst speeds are greater than approach velocities at the intake.

Table 5-4. Average Burst Swim Speeds and Fish Sizes

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Blacknose Dace[3]	*Rhinichthys atratulus*	Juvenile	1.69	2.54	Katopodis and Gervais 2016
Blacknose Dace[3]	*Rhinichthys atratulus*	Adult	1.60-1.74 (SL)	2.02-3.02	Nelson et al. 2003
Blacktail Shiner[3]	*Cyprinella venusta*	Adult	1.85	4.01	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Juvenile	1.97	2.66	Katopodis and Gervais 2016
Bluegill[4]	*Lepomis macrochirus*	Adult	3.94-5.91	2.44	Gardner et al. 2006
Bullhead Minnow[3]	*Pimephales vigilax*	Adult	1.97	2.60	Katopodis and Gervais 2016
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile/ Adult	1.42-4.33	1.84-3.52	Layher 1993
Central Stoneroller[3]	*Campostoma anomalum*	Juvenile	1.81	4.13	Katopodis and Gervais 2016
Channel Catfish x Blue Catfish[5]	*Ictalurus punctatus x I. furcatus*	Juvenile	6.30-9.06	7.88	Beecham et al. 2009
Darters[6]	*Etheostoma* spp.	Adult	1.42	2.62	Katopodis and Gervais 2016
Eastern Shiners[3]	*Notropis* spp.	Adult	1.65	3.38	Katopodis and Gervais 2016
Emerald Shiner[3]	*Notropis atherinoides*	Adult	2.5	4.00	Bell 1991
Fathead Minnow[3]	*Pimephales promelas*	Adult	1.85	2.16	Katopodis and Gervais 2016
Golden Shiner[3]	*Notemigonus crysoleucas*	Adult	1.54-4.33	2.02-4.68	Layher 1993
Greenside Darter[7]	*Etheostoma blennioides*	Adult	1.57-2.68	1.02-2.64	Layher 1993
Largemouth Bass	*Micropterus salmoides*	Juvenile	3.5-4.72 (FL)	2.32-3.28	Farlinger and Beamish 1977
Largemouth Bass	*Micropterus salmoides*	Juvenile	5.04	2.46	Katopodis and Gervais 2016
Longear Sunfish[4]	*Lepomis megalotis*	Juvenile/ Adult	2.20-5.35	1.24-2.56	Layher 1993
Longnose Sucker[7]	*Catostomus catostomus*	Juvenile/ Adult	3.9-16.0	4.0-8.0	Bell 1991
Mimic Shiner[3]	*Notropis volucellus*	Juvenile	1.38	2.86	Katopodis and Gervais 2016

Common Name	Scientific Name	Age	Length[1]	Burst Swim Speed (fps)[2]	Reference
Proserpine Shiner[3]	*Cyprinella proserpina*	Adult	1.57	3.99	Katopodis and Gervais 2016
Pumpkinseed[4]	*Lepomis gibbosus*	Adult	5	2.44	Brett and Sutherland 1965
Red Shiner[3]	*Cyprinella lutrensis*	Adult	1.69	4.67	Katopodis and Gervais 2016
Redbreast Sunfish[4]	*Lepomis auritus*	Juvenile	1.89	2.32	Katopodis and Gervais 2016
Redfin Shiner[3]	*Lythrurus umbratilis*	Adult	1.77	3.61	Katopodis and Gervais 2016
Ribbon Shiner[3]	*Lythrurus fumeus*	Juvenile	1.30	2.50	Katopodis and Gervais 2016
Robust Redhorse[7]	*Moxostoma robustum*	Larvae	0.51-0.8	0.46-0.76	Reutz and Jennings 2000
Satinfin Shiners[3]	*Cyprinella* spp.	Adult	2.09	4.44	Katopodis and Gervais 2016
Smallmouth Bass	*Micropterus dolomieu*	Larvae	0.55-0.98	1.2-1.74	Larimore and Deuver 1968
Smallmouth Bass	*Micropterus dolomieu*	Juvenile	3.58-3.66	2.6-3.6	Webb 1998
Smallmouth Bass	*Micropterus dolomieu*	Adult	10.3-14.9	3.2-7.8	Bunt et al. 1999
Smallmouth Bass	*Micropterus dolomieu*	Adult	11.81	5.77	Katopodis and Gervais 2016
Spottail Shiner[3]	*Notropis hudsonius*	Juvenile	2.01	1.44	Katopodis and Gervais 2016
Suckers[7]	*Catostomus* spp.	Adult	7.05	8.33	Katopodis and Gervais 2016
Sunfish Species[4]	*Lepomis* spp.	Adult	3.19	4.35	Katopodis and Gervais 2016
White Crappie[8]	*Pomoxis annularis*	Juvenile	3.03	0.36-1.04	Smiley and Parsons 1997
White Sucker[7]	*Catostomus commersonii*	Adult	6.69-14.57 (FL)	4.96	Hunter and Mayor 1986

[1] Lengths are Total Length (TL) unless otherwise noted (SL: standard length; FL: fork length)
[2] Burst swim speeds were calculated as 2x critical speed (Bell 1991), unless burst speed was provided in the literature.
[3] Used to represent the Shiners, Chubs, and Minnows group.
[4] Used to represent the *Lepomis* Sunfishes group.
[5] Used to represent the Catfishes group.
[6] Used to represent the Darters group.
[7] Used to represent the Suckers and Redhorse group.
[8] Used to represent Black Crappie.

5.2.3 Impingement Assessment

Proportional estimates of body width to length (scaling factor) were compiled by Smith (1985) for all the target and representative species in this study. The scaling factor multiplied by the maximum recorded length for the species (Jenkins and Burkhead 1993), or maximum recorded length from field data collected during the Preliminary Fish Community Study, resulted in a corresponding width which was then compared to the trash rack spacing at the Project (3.625 inch) (Table 5-5).

With the exception of Channel Catfish, all reported target and representative species would pass through the trash racks at the Project. The minimum size of channel catfish to be excluded by the trash racks would be 24 inches total length.

Table 5-5. Estimated Minimum Lengths (inches) of Target and Representative Species Excluded by Trash Racks at Niagara Hydroelectric Project

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (inch)[2]	Corresponding Body Width (inch)	Minimum Size (in) Excluded by Trash Racks at Niagara (3.625 inch)
River Chub	0.127	8.9	1.1	Not Excluded
Black Crappie	0.099	15.6	1.5	Not Excluded
Blacknose Dace*	0.132	1.8	0.2	Not Excluded
Blacknose Dace	0.132	2.8	0.4	Not Excluded
Bluegill*	0.132	6.5	0.9	Not Excluded
Bluegill	0.132	8.7	1.1	Not Excluded
Bluntnose Minnow*	0.119	2.6	0.3	Not Excluded
Central Stoneroller*	0.126	7.5	0.9	Not Excluded
Central Stoneroller	0.126	5.9	0.7	Not Excluded
Channel Catfish	0.156	27.6	4.3	24
Golden Redhorse	0.127	14.8	1.9	Not Excluded
Golden Shiner	0.105	7.9	0.8	Not Excluded
Green Sunfish*	0.154	4.8	0.7	Not Excluded
Green Sunfish	0.154	7.1	1.1	Not Excluded
Greenside Darter	0.122	3.5	0.4	Not Excluded
Johnny Darter*	0.118	2.1	0.2	Not Excluded
Johnny Darter	0.118	1.6	0.2	Not Excluded
Largemouth Bass*	0.134	6.1	0.8	Not Excluded
Largemouth Bass	0.134	25.6	3.4	Not Excluded
Logperch	0.104	4.7	0.5	Not Excluded
Longear Sunfish	0.153	5.9	0.9	Not Excluded
Longnose Dace	0.139	3.3	0.5	Not Excluded
Mimic Shiner*	0.101	2.4	0.2	Not Excluded
Mimic Shiner	0.101	2.2	0.2	Not Excluded
Northern Hog Sucker*	0.146	4.6	0.7	Not Excluded
Northern Hog Sucker	0.146	11.8	1.7	Not Excluded

Common Name	Scaling Factor for Body Width[1]	Maximum Reported Length (inch)[2]	Corresponding Body Width (inch)	Minimum Size (in) Excluded by Trash Racks at Niagara (3.625 inch)
Pumpkinseed	0.124	6.3	0.8	Not Excluded
Rainbow Darter	0.134	2.0	0.3	Not Excluded
Redbreast Sunfish*	0.150	6.7	1.0	Not Excluded
Redbreast Sunfish	0.150	7.3	1.1	Not Excluded
Rock Bass*	0.155	7.0	1.1	Not Excluded
Rock Bass	0.155	7.9	1.2	Not Excluded
Smallmouth Bass*	0.128	6.7	0.9	Not Excluded
Smallmouth Bass	0.128	16.9	2.2	Not Excluded
Spotfin Shiner*	0.110	2.7	0.3	Not Excluded
Spotfin Shiner	0.110	2.8	0.3	Not Excluded
Spottail Shiner*	0.140	3.7	0.5	Not Excluded
Spottail Shiner	0.140	3.5	0.5	Not Excluded
Spotted Bass	0.128	15.0	1.9	Not Excluded
Warmouth	0.140	7.9	1.1	Not Excluded
White Crappie	0.085	15.7	1.3	Not Excluded
White Sucker*	0.146	10.9	1.6	Not Excluded
White Sucker	0.146	15.7	2.3	Not Excluded
Yellow Bullhead	0.172	11.8	2.0	Not Excluded

[1] Scaling factor (Smith 1985) expresses body width as a proportion of length based on proportional measurements.

[2] Maximum length reported by Jenkins and Burkhead (1993).

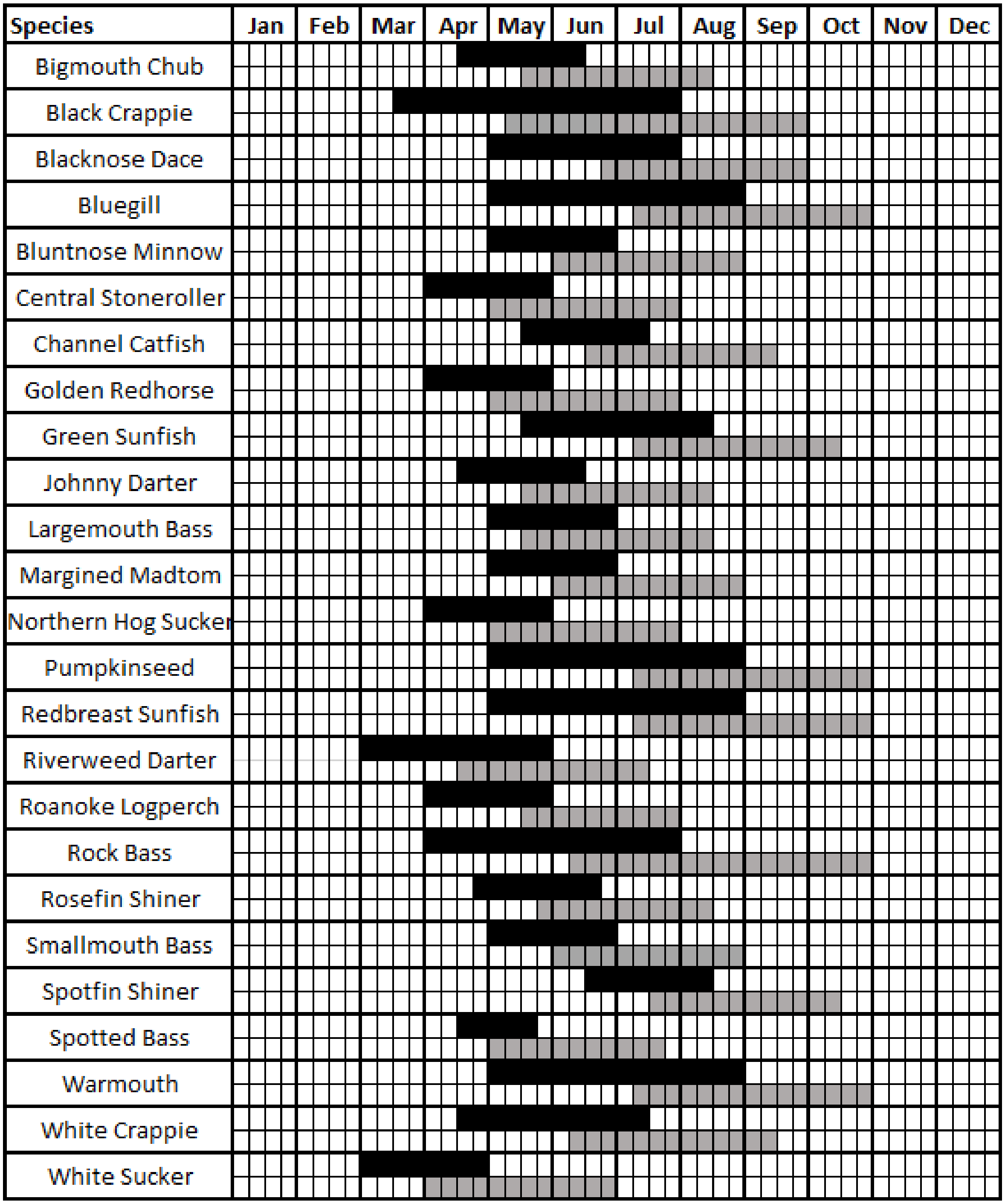
*Species and maximum length collected in the 2020 Fish Community Study

in=inch

5.2.4 Early Life Stage Entrainment Susceptibility

The early life stages of fish (eggs and larvae) cannot move independently (eggs) or have limited swimming ability (larvae), and therefore are unable to overcome currents, thus leaving them susceptible to entrainment at the Project. An assessment of target and representative species shows that the majority of species present in the Roanoke River in the Project area have spawning periods around May and June, with eggs developing into larvae from June to August (Table 5-6). Some species or groups, such as *Lepomis* sunfish, have prolonged spawning periods followed by prolonged egg and larval development periods, thus increasing risk of entrainment. However, members of the genus *Lepomis*, like others in the Centrarchidae family, create nests along shorelines with preference for cover such as vegetation and woody debris; therefore, entrainment risk for these early life stages is low.

Table 5-6. Spawning and Early Life Stage Periodicities for Target and Representative Fish Species in the Vicinity of Niagara Hydroelectric Project



Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bigmouth Chub	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□■■ □□□□	■■■■ □□▨▨	■■□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Black Crappie	□□□□ □□□□	□□□□ □□□□	□□■■ □□□□	■■■■ □□□□	■■■■ □▨▨▨	■■■■ ▨▨▨▨	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Blacknose Dace	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ □□□▨	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Bluegill	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ □□□□	■■■■ □▨▨▨	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□
Bluntnose Minnow	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Central Stoneroller	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Channel Catfish	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□■■ □□□□	■■■■ □□▨▨	■■□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Golden Redhorse	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Green Sunfish	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□■■ □□□□	■■■■ □□□□	■■■■ □▨▨▨	■■□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨□□	□□□□ □□□□	□□□□ □□□□
Johnny Darter	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□■■ □□□□	■■■■ □□▨▨	■■□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Largemouth Bass	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□▨▨	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
Margined Madtom	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□
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Pumpkinseed	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	□□□□ □□□□	■■■■ □□□□	■■■■ □□□□	■■■■ □▨▨▨	■■■■ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ ▨▨▨▨	□□□□ □□□□	□□□□ □□□□
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■ Spawning Period (Stauffer et al. 1995; Jenkins and Burkhead 1993, USFWS 1992, USFWS 2007)
▨ Eggs and larvae (estimated to begin two-thirds of the way through the spawning period and lasting 60 days post spawn)

Additionally, most freshwater fish species have demersal and/or adhesive eggs and larvae that remain close to areas with protective cover, which also lowers risk of entrainment (Cada 1991). Additional life history information for target and representative species is included in Appendix B.

Although some early life stage organisms may be swept from nesting areas during high flow events or from reservoir level fluctuations (which does not exceed 1 ft at the Project), it is expected that ichthyoplankton mortality resulting from turbine passage is low, at two to five percent (Cada 1991). Other sources of injury or mortality to early life stages such as pressure changes, cavitation, turbulence, and shear stress are limited at the facility based on the prior entrainment study (Appalachian 1991). As no significant changes have occurred at the facility since the last relicensing, impacts from these factors are also considered minimal.

5.2.5 Fish Entrainment Rates

Findings from FERC (1995) and Winchell et al. (2000) suggest that the majority of fish size classes entrained at hydroelectric projects is much smaller than the minimum length of fish physically excluded by a certain clear spacing, and that length frequencies of entrainment compositions are similar among sites with differing trash rack spacing. This indicates that the lack of larger fish may be related to their increased swimming performance and ability to avoid intake velocities as they approach the intake.

According to the EPRI (1997) database selections used for this study, fish measuring less than six inches in length were the majority (88 percent) of entrained fish (Figure 5-3), and fish less than eight inches exhibit the highest entrainment rates throughout the year (Table 5-7). Of the fish less than eight inches in length, entrainment rates in summer and fall were greatest, suggesting these are the species likely spawned the prior spring and recently recruited to sizes large enough to be captured in the sampling nets.

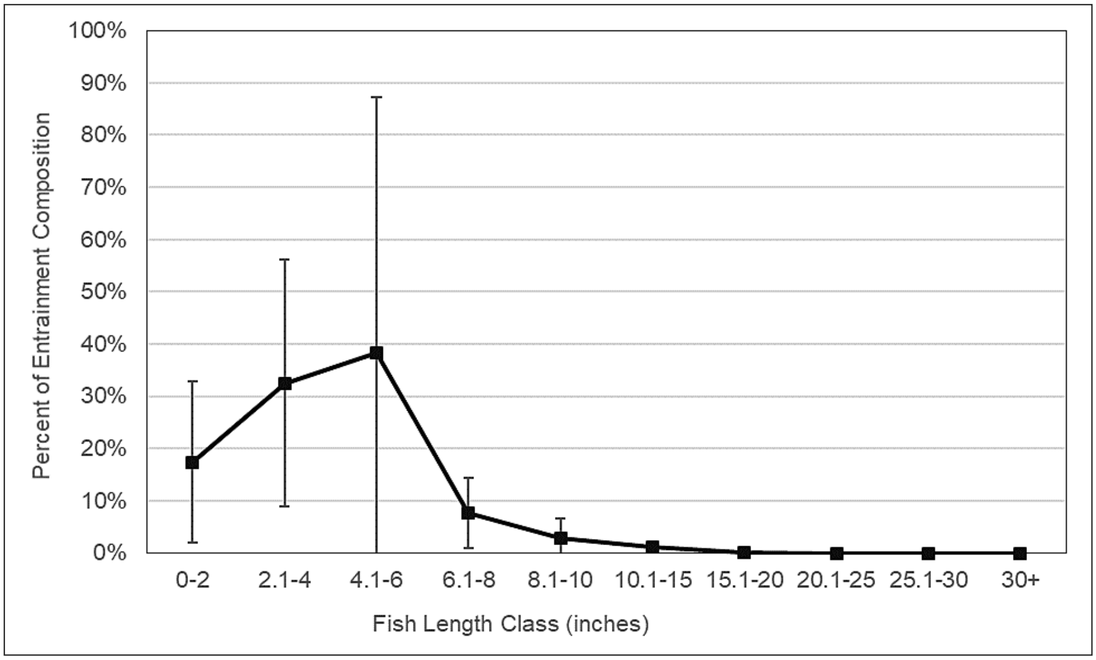

Figure 5-3. Mean Percent (standard deviation) of Entrainment Composition by Fish Size Class According to Target Species from 33 Hydroelectric Developments (EPRI 1997)

Table 5-7. Annual and Seasonal Entrainment Rates of Target Species and Species Groups by Fish Size Class

Fish Size (total length)	Average Monthly Entrainment Rate by Season (fish/hr)				
	Winter	Spring	Summer	Fall	Annual
Entrainment Rate (fish/hr) at Maximum Turbine Discharge (684 cfs)					
<4 inch	0.04	0.11	0.12	0.07	**0.34**
4-8 inch	0.04	0.04	0.06	0.17	**0.31**
8-15 inch	0.01	0.01	0.01	0.01	**0.03**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.09**	**0.16**	**0.19**	**0.25**	**0.68**
Entrainment Rate (fish/hr) at Optimal Turbine Discharge (606 cfs)					
<4 inch	0.03	0.12	0.10	0.05	**0.30**
4-8 inch	0.03	0.04	0.09	0.12	**0.27**
8-15 inch	0.01	0.01	0.00	0.01	**0.03**
>15 inch	0.00	0.00	0.00	0.00	**0.00**
Total	**0.06**	**0.17**	**0.20**	**0.18**	**0.60**
Note: Values represent average fish/hr entrainment from 33 sites selected from the EPRI database and adjusted for maximum and optimal turbine discharge (cfs) at the Project.					

Seasonal entrainment rates from the EPRI (1997) database by target species and species groups is presented in Table 5-8 for maximum turbine discharge and Table 5-9 for optimal turbine discharge. These include all fish size classes combined for each species. Mean monthly seasonal target species entrainment rates for each of these size groups is provided in Appendix C.

Table 5-8. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Maximum Turbine Discharge (684 cfs)

Target Species/Species Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Catfishes	0.07	1.18	1.89	0.12	**3.26**
Rock Bass	0.55	0.71	0.52	1.48	**3.26**
Suckers and Redhorse	0.46	0.24	0.29	1.02	**2.01**
Lepomis Sunfishes	0.05	0.49	0.45	0.88	**1.88**
Black Crappie	0.12	0.12	0.78	0.51	**1.53**
Darters	0.02	0.64	0.07	0.03	**0.76**
Logperch	0.06	0.38	0.17	0.03	**0.65**
Shiners, Chubs, and Minnows	0.13	0.13	0.18	0.20	**0.64**
Largemouth Bass	0.03	0.03	0.42	0.16	**0.64**
Bullheads and Madtoms	0.02	0.12	0.23	0.05	**0.42**
Smallmouth Bass	0.01	0.02	0.17	0.13	**0.33**
Total	**1.51**	**4.07**	**5.19**	**4.61**	**15.39**

Table 5-9. Seasonal and Annual Entrainment Rates for Target Species and Species Groups at Optimal Turbine Discharge (606 cfs)

Target Species/Species Group	Average Monthly Entrainment Rate (fish/hr) by Season				
	Winter	Spring	Summer	Fall	Annual
Catfishes	0.06	1.04	1.68	0.11	**2.89**
Rock Bass	0.48	0.63	0.46	1.31	**2.89**
Suckers and Redhorse	0.41	0.21	0.26	0.91	**1.79**
Lepomis Sunfishes	0.04	0.44	0.40	0.78	**1.66**
Black Crappie	0.11	0.11	0.69	0.45	**1.36**
Darters	0.02	0.57	0.06	0.02	**0.67**
Logperch	0.05	0.34	0.15	0.03	**0.57**
Shiners, Chubs, and Minnows	0.11	0.12	0.16	0.18	**0.57**
Largemouth Bass	0.03	0.03	0.37	0.14	**0.57**
Bullheads and Madtoms	0.02	0.10	0.20	0.05	**0.37**
Smallmouth Bass	0.01	0.02	0.15	0.12	**0.30**
Total	**1.34**	**3.61**	**4.60**	**4.09**	**13.64**

Catfishes, Rock Bass, suckers and redhorses, *Lepomis* sunfishes, and Black Crappie have the highest entrainment rates of the target species and groups. Peaking months of entrainment for these species and species groups varied. Smallmouth and largemouth bass, species often sought after by anglers, have some of the lowest entrainment rates of the target species and groups.

Entrainment rates were highest from April to October, with peaks in April, July, and October (Figure 5-4). Peaking months may correspond to spawning movements (April), recruitment to catchable size (July or October), or large storm/flow events.

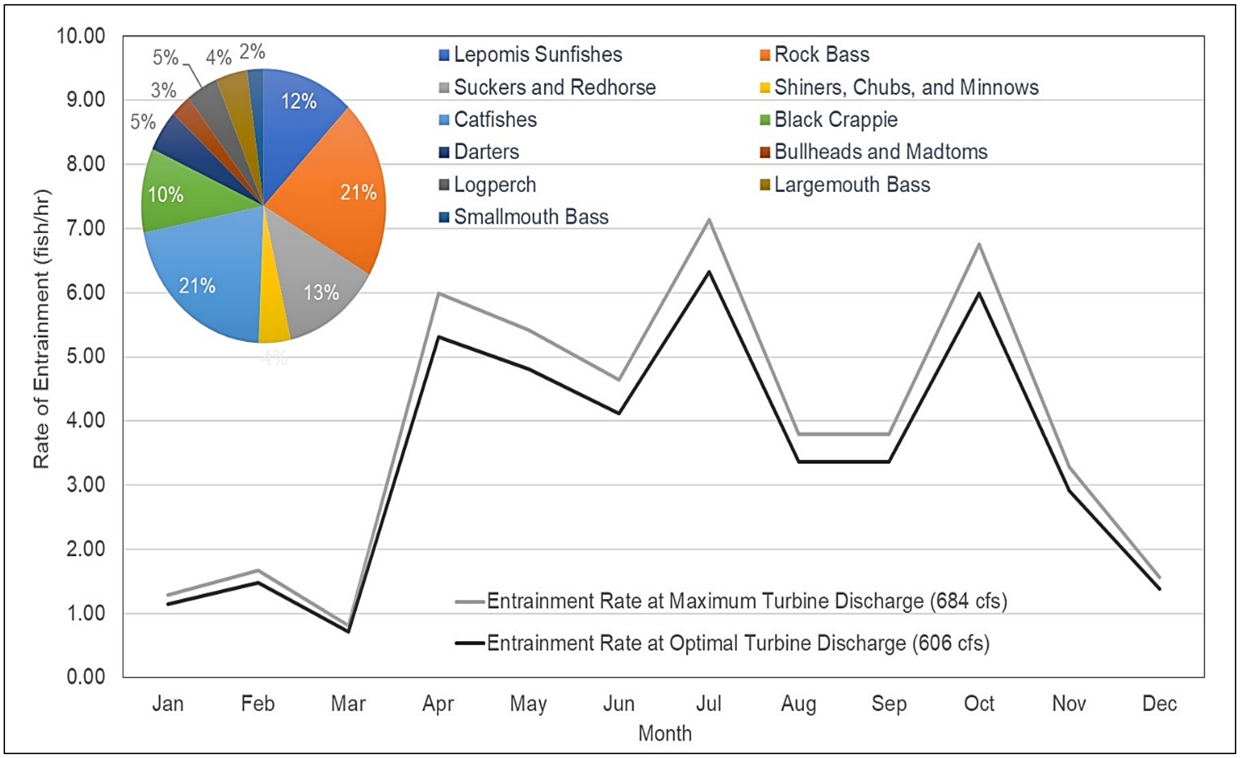

Figure 5-4. Average Monthly Entrainment Rate and Species Composition based on EPRI (1997) Entrainment Database Selections for the Niagara Hydroelectric Project

5.3 Qualitative Assessment of Turbine Entrainment Potential

Several factors were considered in providing a qualitative entrainment potential score to target species for the Project, including:

- Entrainment rates for each species and species group provided in the EPRI (1997) database;
- Maximum turbine discharge frequency (see Section 5.1.2);
- Comparison of burst swim speed versus intake velocity for likelihood of intake avoidance (see Section 5.2.2);
- Life history characteristics, such as migratory behavior, habitat preferences, spawning behavior/requirements, and early life stage periodicity (see Section 5.2.4); and
- Size exclusion (see Section 5.2.3);

Although few fish species in the vicinity of the Project would be excluded by the trash racks, almost all juvenile and adult fish species could avoid the intake entirely based on approach velocity and associated swim burst speeds. Therefore, most target species with elevated qualitative rankings were driven by increased entrainment rates based on the EPRI (1997) database, which has limited velocity data for comparison.

Some species have higher entrainment rates in the spring period, which may reflect increased activity associated with spawning (e.g., dispersal for nest site selection, increased feeding); none of the species evaluated for this study exhibit fall spawning behavior (see Section 5.2.1 and Appendix B). Although spring spawning is common for many species, some species migrate upstream and away from the intake (e.g., suckers and redhorse), create nests in protected areas (e.g., central stoneroller, crevice-spawning shiners), and/or require habitat not found in the vicinity of the intake (see Appendix B); therefore most species were given a low (L) ranking unless elevated entrainment rates were noted (Table 5-10).

Increased entrainment for certain species during the fall months (such as Rock Bass or suckers and redhorse group) may indicate increased activity in response to cooling summer water temperatures, triggering the need for increased foraging in preparation for the winter season, or possibly increased activity following late-summer egg hatch and swim up stage.

Roanoke Logperch, a federally endangered species, was given a low ranking throughout due to the habitat preferences of this species. As detailed in Appendix B, the Roanoke Logperch requires shallow riffles (males) and deep runs (females) over gravel and small cobble during the reproductive season (USFWS 1992). Outside of this period, habitat selection is dependent on life stage, where young and juvenile Roanoke logperch are found in slow runs and pools with clean bottoms. Adults are found primarily in runs, and deep fast habitats with exposed, silt-free gravel substrate, and occasionally in riffles. During winter, all life stages are found under boulders in deep pools. Generally, Roanoke Logperch have been found in a variety of habitats, but consistently in silt-free, loosely embedded substrate (Rosenberger 2002). None of these habitats are found in the vicinity of the intake, and therefore likelihood of entrainment of this species is considered low.

Since most species are not expected to spawn in the vicinity of the intake or where eggs and larvae would be susceptible to intake flows, rankings for potential entrainment of early life stages were not elevated.

Table 5-10. Qualitative* Monthly Turbine Entrainment Potential for Target Species and Species Groups at the Niagara Hydroelectric Project

Target Species	Qualitative Rating of Monthly Entrainment Potential*											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Largemouth Bass	L	L	L	L	L	L	L	L	L	L	L	L
Smallmouth Bass/Spotted Bass	L	L	L	L	L	L	L	L	L	L	L	L
Black Crappie	L	L	L	L	L	L	L-M	L-M	L	L	L	L
Rock Bass	L	L	L	L-M	L	L	L	L	L	M	L-M	L
Lepomis Sunfishes	L	L	L	L-M	L	L	L	L	L-M	L	L	L
Shiners, Chubs, and Minnows	L	L	L	L	L	L	L-M	L	L	L	L	L
Bullheads and Madtoms	L	L	L	L	L	L	L	L	L	L	L	L
Catfishes	L	L	L	L	M-H	M	M	L	L	L	L	L
Suckers and Redhorse	L	L	L	L	L	L	L	L	L	M	L	L
Darters	L	L	L	L	L-M	L	L	L	L	L	L	L
Roanoke Logperch	L	L	L	L	L	L	L	L	L	L	L	L
*L (low), L-M (low-moderate), M (moderate), M-H (moderate-high), H (high)												

5.4 Turbine Blade Strike Analysis

As stated previously, the historical entrainment study completed for the prior license (Appalachian 1991) concluded that impacts due to turbine passage on the fish population in the vicinity of the Project was negligible. A new turbine blade strike analysis will be performed for the Project in 2021 when the final results are available from the Fish Community Study. The evaluation will be performed using the most recent version available of the Turbine Blade Strike model, mean and standard deviation of fish lengths based on fish data collected during the 2020-2021 Fish Community Study, and site-specific inputs for required model parameters, as summarized in Table 5-11.

Table 5-11. Unit Turbine Characteristics at Niagara Hydroelectric Project

Term	Units	Description	Niagara*	
			Unit 1	Unit 2
Blades	*(#)*	Number of blades on the turbine runner	14	15
Type	*(-)*	Francis, Kaplan, propeller, or bypass	Vertical shaft Francis	Vertical shaft Francis
Net Head	*(ft)*	Net head on the turbine; HW to TW, less head loss through system	58.12	55.08
Runner Dia. at Discharge	*(ft)*	Diameter at the outlet of the runner (typ. before the draft tube; see Figure 4.3.2-3 in Franke et al., 1997)	4.17	4.76
Runner Dia. at Inlet	*(ft)*	Diameter at the intake of the runner (typ. beyond the guide vanes; see Figure 4.3.2-3 in Franke et al., 1997)	4.09	4.667
Runner Diameter	*(ft)*	Nominal diameter of runner; maximum radius is assumed to be 1/2 of diameter	3.36	3
Runner Height	*(ft)*	Runner height at inlet (see Figure 4.3.2-3 in Franke et al., 1997 for clarification)	1.75	1.803
Speed	*(rpm)*	Runner revolutions per minute (model automatically converts to radians per second)	277	277
Swirl Coefficient	*(-)*	Ratio between Q with no exit swirl and Q_{OPT} (recommended x=1.1 for Francis turbines)	1.1	1.1
Turbine Discharge	*(cfs)*	Turbine discharge	379	305
Turbine Efficiency	*(-)*	Ratio of output shaft power to input fluid power; typ. from vendor curves or index testing	86%	85%
Turbine Discharge	*(cfs)*	Turbine discharge at optimal efficiency	326	280
Discharge at Opt. Efficiency	%	Ration of turbine discharge at best efficiency to hydraulic capacity	86.02	91.80
Model Routes		Unit 1, Unit 2, bypass channel, main spillway		
Bypass/Spillway Mortality		Estimated as 20%		

*Niagara Units 1 and 2 operate in run-of-river mode.

6 Summary

In summary, the primary findings of the Preliminary Fish Impingement and Entrainment Study include:

- The findings of this study concur with the historical entrainment study completed for the prior relicensing in that effects to the fish community in the Project vicinity are expected to be minimal.
- Most fish would not be excluded by the intake trash racks, however velocities in front of the intake are comparable to normal flow conditions of the Roanoke River and would therefore likely be navigable by most juvenile and adult fish in the area.
- Entrainment of early life stage fishes (eggs and larvae) is likely minimal given the life history characteristics of species in the vicinity of the Project.
- Susceptibility to entrainment is variable depending on species and time period, however most target species and species groups have low entrainment potential for most of the year.
- A blade strike analysis will be performed in 2021 with results to be provided with the Updated Study Report.

7 Variances from FERC-Approved Study Plan

The Preliminary Fish Impingement and Entrainment Study was conducted in full accordance with the methods described in the RSP. In accordance with the RSP, the Turbine Blade Strike Analysis will be completed using the USFWS model described in Section 4.2.3 in 2021 following completion of the Fish Community Study field sampling.

As detailed in Section 4.1, per the Project RSP and Commission's SPD, intake velocities were to be measured using an ADCP along the upstream face of the angled trash racks to determine the approximate approach velocity immediately upstream of the intake structure. During the 2020 field season, a combination of high flow events and inoperable units prevented field data collection efforts. As a result, approach velocity was calculated using the intake structure and trash rack dimensions along with the design maximum flow capacity of the two generating units.

Using this approach, the calculated velocity in front of the intake is approximately 1.1 fps, which is similar to the intake velocities presented in the historical entrainment report (Appalachian 1991). Further, a desktop evaluation using Roanoke River morphometrics and flow data from the nearest upstream gage (USGS 02055000 Roanoke River at Roanoke, Virginia) suggests that the velocity of the river in the vicinity of the Project is comparable to that estimated in front of the intake. Given this information, and since the design and the general operation of the facility have not changed since the prior license application, the calculated approach velocity is representative of actual conditions at the Niagara intake structure and is used to support evaluations of impingement and entrainment at Niagara.

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Appendix A

Appendix A – Site Characteristics of Hydropower Facilities from the EPRI (1997) Database

Table 1. Electric Power Research Institute Entrainment Database[1] Sites Used for the Niagara Hydroelectric Project Fish Impingement and Entrainment Study

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (ft/sec)	Trash Rack Spacing (inch)
1	Belding	MI	Flat	-	-	-	-	-	-	416	2	-	-	2
2	Bond Falls	MI	W.B. Ontonagon	-	-	-	-	-	-	900	2	PK	-	3
3	Brule	WI	Brule	545	8880	530	1	5.2	340	1377	3	PK-partial	1	1.62
4	Caldron Falls	WI	Peshtigo	1180	-	-	-	-	-	1300	2	PK	-	2
5	Centralia	WI	Wisconsin	250	-	-	0	2	1400	3640	6	ROR	2.3	3.5
6	Colton	NY	Raquette	195	620	103	0.5	-	-	1503	3	PK	-	2
7	Crowley	WI	N.F. Flambeau	422	3539	-	1	-	-	2400	2	ROR	1.4	2.375
8	Feeder Dam	NY	Hudson	-	-	-	-	-	-	5000	5	PK	-	2.75
9	Four Mile Dam	MI	Thunder Bay	1112	2500		0.5	-	-	1500	3	ROR	-	2
10	Grand Rapids	MI/ WI	Menominee	250	-	-	0.5	-	-	3870	5	ROR	-	1.75
11	Herrings	NY	Black	140	-	-	-	-	-	3610	3	ROR	-	4.125
12	High Falls - Beaver River	NY	Beaver	145	1058	290	-	-	-	900	3	-	0.7	1.81
13	Higley	NY	Raquette	742	4446	-	1.5	-	-	2045	3	PK	-	3.63
14	Hillman Dam	MI	Thunder Bay	988	1600	-	-	-	-	270	1	ROR	-	3.25
15	Johnsonville	NY	Hoosic	450	6430	540	6.5	-	-	1288	2	PK	-	2
16	Kleber	MI	Black	270	3000	-	0	0.9	-	400	2	ROR	1.41	3
17	Lake Algonquin	NY	Sacandaga	-	-	-	-	-	-	750	1	-	-	1

No.	Site Name	State	River	Reservoir Area (ac)	Reservoir Volume (ac-ft)	Usable Storage (ac-ft)	Fluctuation Limits (ft)	Length (mi)	Width (ft)	Total Plant Capacity (cfs)	No. Units	Operating Mode[2]	Average Velocity at Trash Rack (ft/sec)	Trash Rack Spacing (inch)
18	Luray	VA	S.F. Shenandoah	-	-	-	-	-	-	1477	3	ROR	-	2.75
19	Minetto	NY	Oswego	350	4730	290	1.8	-	-	7500	5	PULSE	2.4	2.5
20	Moshier	NY	Beaver	365	7339	680	3	-	-	660	2	PK	-	1.5
21	Ninth Street Dam	MI	Thunder Bay	9884	2600	-	0.5	-	-	1650	3	ROR	-	1
22	Norway Point Dam	MI	Thunder Bay	10502	3800	-	0.5	-	-	1775	2	ROR	-	1.69
23	Potato Rapids	WI	Peshtigo	288	-	-	-	-	-	1380	3	ROR	-	1.75
24	Raymondville	NY	Raquette	50	264	-	1	-	-	1640	1	PK	-	2.25
25	Sandstone Rapids	WI	Peshtigo	150	-	-	-	-	-	1300	2	PK	-	1.75
26	Schaghticoke	NY	Hoosic	164	1150	120	6.5	-	-	1640	4	ROR	-	2.125
27	Sherman Island	NY	Hudson	305	6960	1060	3.7	-	-	6600	4	PK	-	3.125
28	Thornapple	WI	Flambeau	295	1000	295	1.5	4	600	1400	2	ROR-mod	1.22	1.69
29	Tower	MI	Black	102	620	-	0	0.9	-	404	2	ROR	0.82	1
30	Twin Branch	IN	St. Joseph	1065	-	-	-	8.75	-	3200	-	ROR	-	3
31	Warrensburg	NY	Schroon	-	-	-	-	-	-	1350	1	-	-	-
32	White Rapids	MI/ WI	Menominee	435	5155	415	1	2.3	580	3994	3	PK-partial	1.9	2.5
33	Wisconsin River Division	WI	Wisconsin	240	1120	-	0	2.5	1000	5150	10	ROR	1.4	2.19

[1] Electric Power Research Institute. 1997. Turbine Entrainment and Survival Database. TR-108630. Palo Alto, CA.

[2] Operating Mode: peaking (PK), pulse, or run-of-river (ROR)

Notes: ac=acre; ac-ft=acre-feet; mi=mile; cfs=cubic feet per second; ft/sec=feet per second

Appendix B

Appendix B – Life History Information for Target Fish Species and Species Groups

Largemouth Bass – *Micropterus salmoides*

Largemouth Bass are native to the Great Lakes-St. Lawrence and Mississippi basins and the Gulf and south Atlantic slopes but has been widely introduced elsewhere in North America (Jenkins and Burkhead 1993). They are found in marshes, swamps, ponds, lakes, reservoirs, creeks, and large rivers. They feed on a wide array of aquatic animals.

Largemouth Bass spawn in May and June (Jenkins and Burkhead 1993). Males fans a nest area over a variety of substrates, and guards it against intruders. They may be found in open areas or associated with various cover, such as vegetation, ledges, or woody debris.

Smallmouth Bass/Spotted Bass - *Micropterus dolomieu/M. punctulatus*

Smallmouth Bass are native to Virginia (VDWR 2017a) and they are now abundant in most large rivers and lakes throughout the State. Smallmouth bass prefer slow-to-moderate current and select areas of rocky shorelines. They are most active in 19°C to 22°C water and are intolerant of silty, warm, polluted water.

Spawning usually occurs from late April to early June as temperatures exceed 16°C, in water depths of 2 to 4 feet. Males build a nest in sand, gravel, or rubble where they will guard the nest and fry (VDWR 2017b). Eggs hatch between 7 and 21 days after fertilization, depending on the water temperature (Smith 1985).

Black Crappie - *Pomoxis nigromaculatus*

Black Crappie is native throughout the Great Lakes-St. Lawrence and Mississippi basins, Gulf slope, and Atlantic slope, and widely transplanted to other regions (Jenkins and Burkhead 1993). They are found in swamps, ponds, lakes, reservoirs, and slack water of low-to-moderate gradient, usually associated with vegetation or other structure such as woody debris and stumps. Young Black Crappie feed on microcrustaceans, insects, and larval fish; adults feed on fish, crustaceans, and insects.

Spawning occurs early, with nest construction beginning in March and continuing through July; however, most spawning occurs in April in Virginia (Jenkins and Burkhead 1993). Nests are excavated in shallow to moderately deep water associated with vegetation and may be crowded.

Lepomis Sunfishes - *Lepomis* spp.

Lepomis are the largest genus of the Centrarchidae. All *Lepomis* in Virginia are found in pools and backwater areas of warm, clear creeks, streams, and rivers of low to moderate gradient, as well as lakes and ponds (Jenkins and Burkhead 1993). They feed on small prey such as aquatic insects, small fish and crustaceans, and incidentally, plant material.

Spawning begins in May with nests constructed in colonially in open, shallow areas on sand and small gravel (Jenkins and Burkhead 1993). Nests are constructed in water 2 meters deep or shallower and are defended by males.

Rosefin Shiner – *Lythrurus ardens*

Rosefin Shiner was the most common shiner collected in the 2020 Fish Community Study. Rosefin Shiner is widespread on the Atlantic slope, as well as the Ohio basin (Jenkins and Burkhead 1993). It is found in warm, large creeks and rivers of moderate gradient with clear or turbid waters. It is a surface feeder, feeding in terrestrial insects, as well as benthic aquatic insects, algae, and detritus.

Spawning extends from late April to mid-or-late June. Males congregate over nests with females on the periphery, spawning as they swim over the nest.

Margined Madtom – *Noturus insignis.*

Margined Madtom are indigenous to the Atlantic slope drainages, and introduced to northern drainages in New York, New Hampshire, Maryland, and Pennsylvania (Jenkins and Burkhead 1993). It is found in low and moderate-gradient areas of large creeks to large rivers, over soft and hard bottoms of pools, runs, and riffles. It feeds on a variety of aquatic invertebrates, fish and terrestrial insects. Margined Madtom spawn in May and June. They create nests underneath flat rocks in gentle runs and slow water above and below riffles.

Channel Catfish - *Ictalurus punctatus*

Channel Catfish are found in lakes and larger rivers with relatively clean sand, gravel, or stone substrate, over mud flats, and seldom in dense weedy areas. They live in deep, slow pools of swift, clear-running streams. They are often found below dams in large reservoirs (VDWR 2017b).

Spawning occurs from late May through July when water temperatures reach the mid-70s. Channel Catfish often deposit their eggs on rocky ledges, undercut banks, hollow logs, and other underwater structures. Males guard the nest and the eggs hatch in 7 to 10 days. The fry travel in schools, which are often herded and guarded by the male (VDWR 2017b).

Golden Redhorse – *Moxostoma erythrurum*

Golden Redhorse is widespread in the southern Great Lakes basin, Mississippi basin, and Mobile drainage; it is also found in the Potomac, James, Chowan, and Roanoke drainages of the Atlantic slope (Jenkins and Burkhead 1993). They are found across a large range of habitat types of any redhorse species, including large rivers, natural lakes and impoundments, montane and lowland areas. They are invertivores, seeking out aquatic insects and other invertebrates, with incidental algae and detritus.

Spawning occurs in mid-to-late spring in Virginia (Jenkins and Burkhead 1993) at sites with gravel beds in shallow runs and riffles. Males aggressively defending spawning sites. Repeated spawning sometimes results in a substrate depression.

Riverweed Darter – *Etheostoma podostemone*

Riverweed Darter was the most common darter collected in the 2020 Fish Community Study. Its distribution is limited to the upper and middle Roanoke drainage and extends into the North Carolina Dan River system (Jenkins and Burkhead 1993). It is found in cool and warm, moderate-gradient creeks, streams, and rivers. They feed almost entirely on benthic aquatic insects, including midge and caddisfly larvae.

Spawning occurs from March to late May (Jenkins and Burkhead 1993). Pairs spawn inverted on the underside of stones where adhesive eggs are laid in single-tiered clusters and guarded by males.

Roanoke Logperch - *Percina rex*

The Roanoke Logperch is endemic to the Roanoke River basin within North Carolina and Virginia and the Chowan River basin in Virginia. The distribution in the upper Roanoke system extends roughly 1.8 miles downstream of the Niagara Dam upstream into the North Fork Roanoke River and to the South Fork Roanoke River (USFWS 1992). The species predominantly occurs in those portions of the drainage within the Piedmont and Ridge and Valley physiographic provinces. Populations are vulnerable due to limited range and low densities.

The Roanoke Logperch is a large darter, which reaches lengths of about 6 inches. According to USFWS (1992), during the different phases of its life history and season, the majority of the riverine habitat types are used. During the reproductive period, males are primarily associated with shallow riffles, while spawning females are common in deep runs over gravel and small cobble. Young and juveniles usually occur in slow runs and pools with clean bottoms. Winter habitat of all phases is believed to be under boulders in deep pools (USFWS 1992). Roanoke Logperch in the Roanoke River have been found primarily in runs, select deep, fast habitats with exposed, silt-free gravel substrate, occasionally in riffles, and rarely in pools. Roanoke Logperch have been found at a variety of depths and velocities, but consistently in silt-free, loosely embedded substrate (Rosenberger 2002).

Rock Bass - *Ambloplites rupestris*

Rock Bass are native only to the Tennessee and Big Sandy drainages, but has been introduced to the major Atlantic slope drainages (Jenkins and Burkhead 1993). They are found in clear, cool and warm creeks, streams, and rivers with moderate gradient, as well as pools and backwater areas. They are strongly associated with shelter and avoid areas with heavy siltation and turbidity. Rock bass are generalist feeders and will eat a variety of microcrustaceans, insects, and other invertebrates when young, shifting to larger prey as adults such as fish and crayfish.

Spawning occurs from April to July (Jenkins and Burkhead 1993). Males fan out circular nests in shallow areas with coarse sand and large gravel substrates and defend them against other males.

Appendix C

Appendix C – Monthly Mean Entrainment Rates (Average Number of Fish/Hour of Unit Capacity) by Length Class for Target Species at Maximum Turbine Discharge (684 cfs)

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Target Species/Group: Black Crappie

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.020	0.009	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.007	0.044	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.001	0.009	0.003	0.017	0.004	0.001	0.000	0.000	0.000	0.000
Apr	0.008	0.124	0.022	0.107	0.011	0.006	0.000	0.000	0.000	0.000
May	0.001	0.037	0.005	0.012	0.002	0.000	0.000	0.000	0.000	0.000
Jun	0.011	0.026	0.005	0.009	0.002	0.000	0.000	0.000	0.000	0.000
Jul	1.202	0.055	0.005	0.006	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.175	0.831	0.005	0.011	0.008	0.001	0.000	0.000	0.000	0.000
Sep	0.054	0.497	0.013	0.007	0.004	0.002	0.000	0.000	0.000	0.000
Oct	0.055	0.442	0.018	0.003	0.002	0.001	0.000	0.000	0.000	0.000
Nov	0.015	0.386	0.020	0.003	0.001	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.261	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.145**	**0.263**	**0.010**	**0.017**	**0.003**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Bullheads and Madtoms

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.004	0.005	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Feb	0.005	0.012	0.000	0.002	0.007	0.000	0.000	0.000	0.000	0.000
Mar	0.003	0.009	0.005	0.006	0.006	0.000	0.000	0.000	0.000	0.000
Apr	0.011	0.046	0.015	0.145	0.041	0.013	0.000	0.000	0.000	0.000
May	0.003	0.029	0.009	0.006	0.005	0.003	0.000	0.000	0.000	0.000
Jun	0.002	0.024	0.016	0.045	0.042	0.013	0.000	0.000	0.000	0.000
Jul	0.078	0.012	0.032	0.222	0.024	0.007	0.000	0.000	0.000	0.000
Aug	0.008	0.023	0.055	0.076	0.008	0.002	0.000	0.000	0.000	0.000
Sep	0.005	0.019	0.024	0.028	0.010	0.001	0.000	0.000	0.000	0.000
Oct	0.002	0.020	0.003	0.007	0.007	0.002	0.000	0.000	0.000	0.000
Nov	0.003	0.011	0.005	0.005	0.003	0.000	0.000	0.000	0.000	0.000
Dec	0.002	0.010	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.014**	**0.022**	**0.019**	**0.064**	**0.017**	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Catfishes

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.022	0.026	0.006	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Feb	0.066	0.048	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.023	0.030	0.005	0.026	0.001	0.000	0.000	0.000	0.000	0.000
Apr	0.006	0.072	0.038	0.009	0.005	0.002	0.000	0.000	0.000	0.000
May	0.007	2.739	0.139	0.084	0.279	0.066	0.000	0.000	0.000	0.000
Jun	0.021	1.192	0.135	0.310	0.507	0.045	0.001	0.001	0.000	0.000
Jul	1.603	0.833	0.043	0.083	0.059	0.006	0.000	0.000	0.001	0.001
Aug	0.531	0.158	0.060	0.030	0.038	0.029	0.000	0.000	0.000	0.000
Sep	0.079	0.077	0.016	0.018	0.035	0.009	0.000	0.000	0.000	0.000
Oct	0.027	0.029	0.004	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Nov	0.009	0.056	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.000	0.012	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.253**	**0.556**	**0.047**	**0.058**	**0.098**	**0.017**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Darters

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.030	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.013	0.006	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.191	0.686	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
May	0.905	0.126	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.105	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.037	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.005	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.004	0.026	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.000	0.018	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.002	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.248**	**0.185**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Largemouth Bass

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.039	0.010	0.000	0.000	0.000	0.002	0.000	0.000	0.000
Feb	0.000	0.011	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.002	0.011	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000
Apr	0.000	0.044	0.000	0.000	0.000	0.033	0.000	0.000	0.000	0.000
May	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.000	0.000	0.000
Jun	0.560	0.004	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000
Jul	0.402	0.184	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.005	0.056	0.013	0.011	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.002	0.056	0.019	0.010	0.002	0.001	0.000	0.000	0.000	0.000
Oct	0.001	0.126	0.036	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.000	0.116	0.064	0.015	0.003	0.016	0.000	0.000	0.000	0.000
Dec	0.001	0.029	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.108**	**0.074**	**0.015**	**0.006**	**0.001**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: *Lepomis* Sunfishes

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.036	0.013	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.014	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.007	0.005	0.051	0.005	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.026	0.473	0.542	0.007	0.000	0.000	0.000	0.000	0.000	0.000
May	0.013	0.257	0.081	0.013	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.063	0.088	0.147	0.028	0.001	0.000	0.000	0.000	0.000	0.000
Jul	0.115	0.038	0.219	0.017	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.026	0.032	0.563	0.025	0.001	0.000	0.000	0.000	0.000	0.000
Sep	0.060	0.045	1.369	0.024	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.089	0.116	0.726	0.001	0.000	0.004	0.001	0.000	0.000	0.000
Nov	0.097	0.082	0.027	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.053	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.054**	**0.123**	**0.433**	**0.014**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Logperch

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.000	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.000	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.001	0.859	0.015	0.000	0.000	0.001	0.000	0.000	0.000	0.000
May	0.018	0.118	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jun	0.009	0.135	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.274	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.008	0.012	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.001	0.022	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.001	0.021	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.001	0.008	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Dec	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.034**	**0.199**	**0.008**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Rock Bass

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.225	0.075	0.029	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Feb	0.403	0.164	0.094	0.012	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.043	0.004	0.048	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.071	1.138	0.553	0.014	0.007	0.000	0.000	0.000	0.000	0.000
May	0.018	0.064	0.083	0.069	0.013	0.000	0.000	0.000	0.000	0.000
Jun	0.017	0.133	0.250	0.107	0.007	0.000	0.000	0.000	0.000	0.000
Jul	0.117	0.034	0.180	0.046	0.006	0.000	0.000	0.000	0.000	0.000
Aug	0.020	0.034	0.467	0.140	0.013	0.000	0.000	0.000	0.000	0.000
Sep	0.042	0.027	0.287	0.318	0.003	0.000	0.000	0.000	0.000	0.000
Oct	0.040	0.101	2.296	0.034	0.001	0.000	0.000	0.000	0.000	0.000
Nov	0.021	0.038	1.177	0.056	0.001	0.000	0.000	0.000	0.000	0.000
Dec	0.047	0.137	0.413	0.037	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.054**	**0.184**	**0.585**	**0.095**	**0.006**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Shiners, Chubs, and Minnows

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.003	0.070	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.006	0.173	0.045	0.010	0.009	0.000	0.000	0.000	0.000	0.000
Mar	0.006	0.093	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.030	0.105	0.030	0.003	0.000	0.000	0.000	0.000	0.000	0.000
May	0.019	0.094	0.013	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Jun	0.038	0.075	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.113	0.167	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	0.030	0.106	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sep	0.031	0.209	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oct	0.011	0.151	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nov	0.007	0.165	0.009	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Dec	0.003	0.035	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.031**	**0.121**	**0.013**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Target Species/Group: Smallmouth Bass

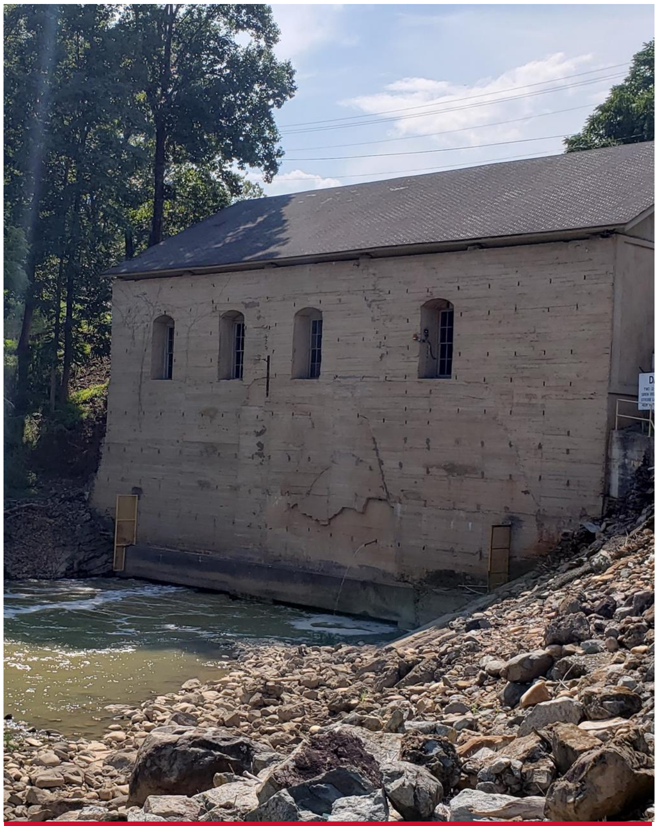
Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.012	0.001	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Feb	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mar	0.000	0.009	0.003	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Apr	0.000	0.005	0.000	0.000	0.000	0.008	0.001	0.000	0.000	0.000
May	0.000	0.001	0.001	0.001	0.003	0.015	0.003	0.000	0.000	0.000
Jun	0.047	0.027	0.002	0.003	0.004	0.008	0.001	0.000	0.000	0.000
Jul	0.270	0.028	0.005	0.004	0.002	0.003	0.000	0.000	0.000	0.000
Aug	0.028	0.040	0.016	0.010	0.006	0.008	0.000	0.000	0.000	0.000
Sep	0.004	0.139	0.083	0.033	0.008	0.003	0.000	0.000	0.000	0.000
Oct	0.006	0.064	0.021	0.005	0.002	0.004	0.000	0.000	0.000	0.000
Nov	0.000	0.011	0.008	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Dec	0.005	0.007	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grand Total	**0.047**	**0.041**	**0.018**	**0.008**	**0.003**	**0.006**	**0.001**	**0.000**	**0.000**	**0.000**

Target Species/Group: Suckers and Redhorse

Month	0-2 in	2-4 in	4-6 in	6-8 in	8-10 in	10-15 in	15-20 in	20-25 in	25-30 in	30+ in
Jan	0.005	0.102	0.181	0.138	0.087	0.061	0.000	0.000	0.000	0.000
Feb	0.005	0.064	0.163	0.114	0.013	0.000	0.002	0.000	0.000	0.000
Mar	0.005	0.024	0.088	0.074	0.007	0.007	0.000	0.000	0.000	0.000
Apr	0.022	0.119	0.053	0.036	0.047	0.142	0.042	0.000	0.000	0.000
May	0.003	0.017	0.005	0.003	0.007	0.016	0.003	0.000	0.000	0.000
Jun	0.277	0.041	0.006	0.003	0.001	0.006	0.001	0.000	0.000	0.000
Jul	0.430	0.050	0.008	0.002	0.001	0.005	0.001	0.000	0.000	0.000
Aug	0.032	0.010	0.002	0.001	0.002	0.001	0.001	0.000	0.000	0.000
Sep	0.004	0.018	0.006	0.007	0.004	0.010	0.000	0.000	0.000	0.000
Oct	0.002	0.035	1.917	0.096	0.124	0.029	0.009	0.000	0.000	0.000
Nov	0.001	0.026	0.050	0.432	0.276	0.025	0.000	0.000	0.000	0.000
Dec	0.006	0.010	0.056	0.287	0.078	0.001	0.000	0.000	0.000	0.000
Grand Total	**0.093**	**0.042**	**0.236**	**0.076**	**0.049**	**0.026**	**0.006**	**0.000**	**0.000**	**0.000**

Appendix D

Appendix D – Preliminary Benthic Aquatic Resources Study Report



Preliminary Benthic Aquatic Resources Study

Niagara Hydroelectric Project
(FERC No. 2466)

December 29, 2020

Prepared by:

Edge Engineering and Science, LLC

Prepared for:

Appalachian Power Company

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Niagara Hydroelectric Project
(FERC Project No. 2466)

Prepared for:

AMERICAN ELECTRIC POWER

BOUNDLESS ENERGY™

2020 Benthic Aquatic Resources Survey Results, Virginia

Niagara → HDR2020-0002

December 29, 2020

Prepared by:

EDGE ENGINEERING & SCIENCE further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

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AEP	American Electric Power – Client
Appalachian	Appalachian Power Company
CFS	Cubic feet per second
CPUE	Catch per unit effort
DO	Dissolved oxygen
EDGE	Edge Engineering and Science, LLC
FERC	Federal Energy Regulatory Commission
HDR	HDR, Inc. – Client
LDB	Left descending bank
RDB	Right descending bank
RSP	Revised Study Plan
SAV	Submerged aquatic vegetation
USFWS	U.S. Fish and Wildlife Service
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDWR	Virginia Department of Wildlife Resources (formerly VDGIF)
VISAC	Virginia Invasive Species Advisory Committee

1.0 INTRODUCTION

The Niagara Hydroelectric Project (Project) is a 2.4-megawatt hydroelectric generating facility located at river mile 355 of the Roanoke River in Roanoke County, Virginia. Appalachian Power Company (a unit of American Electric Power; AEP) is pursuing a new license from the Federal Energy Regulatory Commission (FERC) for the Project as their existing license (FERC Project No. 2466) expires in 2024. Aquatic biological studies were completed to support their existing FERC license and results of these studies are ultimately used as a record and reference for current relicensing efforts. The Roanoke River, along with the approximately 2-mile-long reservoir resulting from the Niagara Dam, harbors a diverse community of aquatic biota; thus, aquatic biological studies are required to survey and document the contemporary community of organisms present within the Project area (Figure 1). The Roanoke River and lower reaches of tributary streams are included in the Project area. The information gained from these studies will document the current conditions of macroinvertebrate and mussel abundance, diversity, and distribution in the vicinity of the Project.

Study scoping with state and federal agencies resulted in the development and approval of a project-specific Revised Study Plan (RSP) that identified four objectives for Project studies (AEP 2019) pertaining to benthic aquatic species.

Goals and Objectives

1) Collect a baseline of existing macroinvertebrate and crayfish communities in the vicinity of the Project
2) Confirm the presence or absence of mussels within the study area
3) Characterize the mussel community composition (if present), abundance, and distribution within the study area
4) Determine presence/probable absence of federally or state-listed species within the study area

In accordance with the RSP, field sampling efforts were necessary to satisfy each of the four objectives. Satisfaction of all objectives was not able to be accomplished during the 2020 calendar year; therefore, this report herein serves as an interim, progress report of findings. Additional field work is scheduled in 2021 and a comprehensive report of findings is planned for completion thereafter.

2.0 METHODS

The RSP provided guidance on the biological sampling framework for the Project that included macroinvertebrates, crayfish, and freshwater mussels. Macroinvertebrate and crayfish sampling employ a variety of methods to target representative habitat at 10 sites throughout the Project area. Mussel sampling targets representative habitat at 13 sites throughout the Project area. The methods, number and location of sample sites, and seasonality were developed to document a comprehensive representation of the Project area and to correlate with previous sampling efforts (Appalachian and AEP 1991) for comparison.

2.1 Macroinvertebrate and Crayfish Community

Macroinvertebrate and crayfish surveys include two temporally independent efforts (surveys in fall 2020 and spring 2021). Sampling methods were derived from National Rivers and Streams Assessment (NRSA)

Field Operations Manual and Virginia Department of Environmental Quality (VDEQ) Biological Monitoring Program Quality Assurance Project Plan, and include quantitative and qualitative sampling methods that target different habitats (USEPA 2019 and VDEQ 2008). Quantitative sampling targets riffle/run habitats and qualitative sampling targets available microhabitats in pools. Fall 2020 sampling efforts have concluded and spring 2021 sampling efforts are scheduled to be completed at the same sites during the sample index period defined by VDEQ (March 1 – May 31). Specific sampling dates within these timeframes are determined based on factors including (but not limited to) weather conditions, water temperatures, river flows and reservoir elevations, and safety of field staff and the public. A variety of sampling techniques were used to sample macroinvertebrates using quantitative, and qualitative methods as described in subsequent sections. Site naming conventions are as follows: Location-Seasonality-Method-Site Number. For example, NFQT1 = Niagara Fall Quantitative Site 1 and NFQL3 = Niagara Fall Qualitative Site 3.

The methods used to quantify macroinvertebrates only allows for the presence of crayfish to be concluded. To assess the crayfish community in the Project area, additional kick samples and seining efforts were performed following benthic macroinvertebrate sampling to ensure all crayfish habitat had been covered and that a broad representation of crayfish species available at each site was documented. The exact abundance of crayfish was not recorded because methods used are not crayfish specific and simply provide presence data. Additionally, crayfish collected during backpack electrofishing efforts (completed as part of relicensing study in fall 2020) were processed and added to crayfish data for inclusion as a qualitative data point at analogous sites.

2.1.1 Quantitative Sampling

Sampling benthic macroinvertebrates and crayfish occurred at five riffle/run sites (i.e., quantitative; NFQT site names) along 100-meter transects following guidelines defined by USEPA (2019) and VDEQ (2008). Upon arrival at riffle/run sites (Figures 1-6), transects were delineated in riffle/run habitat and the start and endpoint coordinates were recorded. Site photos were taken in four directions (upstream, downstream, left descending bank [LDB], and right descending bank [RDB]; all 90 degrees to one another) and substrate, and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). At each sample site, habitat characteristics (e.g., substrate, estimated water velocity, depth, and instream cover) and water quality parameters (e.g., pH, water temperature, dissolved oxygen [DO], and conductivity) were measured and recorded. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site. Sampling effort (e.g., time, number of samples) were also recorded during each sampling event.

Starting at the downstream end of the transect and moving upstream, all riffle/run habitats were candidates for sampling throughout the reach. Sampling was conducted holding the D-frame net on the bottom of the stream perpendicular to flow and kicking substrate to agitate and dislodge organisms, thus allowing dislodged organisms to flow into the net. A single kick consists of disturbing the substrate upstream of the net by kicking with the feet and/or by using the hands to dislodge the cobble/boulder for 30-90 seconds. For example, a single sample was a composite of six kick sets, each disturbing approximately 0.33 m^2 above the dip net for a duration of 30-90 seconds and totaled an area comprising 2 m^2. The composited sample was washed by running clean stream water through the net 2-3 times and then transferred to a sieve (500 µm) if needed. For QA/QC measures, replicate sampling was conducted at one quantitative site within close proximity (not in the same locations as the first set of samples) of the initial sampling area.

2.1.2 Qualitative Sampling

Benthic macroinvertebrates and crayfish were also sampled at five qualitative sites (i.e., multi-habitat) along 100-meter transects following guidelines defined by USEPA (2019) and VDEQ (2008). At pool sites (Figure 1 and Figures 7-11), transects were delineated in near-shore pool habitats and the start and endpoint coordinates were recorded. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as quantitative sites (see Section 2.1.1). In addition, a Secchi disk reading was taken at each sample site at the time of sampling to assess water transparency. Multiple points for habitat and water quality measurements were taken if there was large variation within a single site.

A canoe was necessary to collect qualitative samples along each of the transects starting at the downstream end and moving upstream. Sampling was conducted by performing 20 jabs with a D-frame net into suitable, stable habitats (snags, vegetation, banks, and substrate). A single jab consists of forcefully thrusting the net into a microhabitat for a linear distance of 1.0 meter, followed by 2-3 sweeps of the same area to collect dislodged organisms for 20-90 seconds per jab, sweep, or kick. Multiple types of habitat were sampled in rough proportion to their frequency within the reach. Unique habitat types (i.e., those consisting of less than 5 percent of stable habitat within the sampling reach) were not sampled. Sampling effort was proportionally allocated (20 jabs/sweeps/kicks) to shore-zone and bottom-zone, 20-90 seconds per jab, sweep, or kick. Samples were cleaned and transferred to the sieve bucket at least every five jabs; or more often as necessary. At one qualitative site, replicate sampling was conducted within the initial sampling area in close proximity (not in the same locations as the first set of samples). All samples were preserved and processed in the same manner as quantitative methods (see Section 2.1.1).

2.1.3 Laboratory Processing

All field samples were preserved in 95% ethanol, placed in labeled jars, and sent to Civil & Environmental Consultants, Inc. (CEC) for processing and identification to the lowest practicable taxonomic level. Laboratory processing was performed in accordance with the VDEQ standard operating procedures "Methods for Laboratory Sorting and Subsampling of Benthic Macroinvertebrate Samples" (VDEQ 2008). Photo vouchers will be taken of all unique or rare species collected. At this time laboratory processing is ongoing and will be completed in the summer of 2021, after completion of the spring 2021 sampling event. At the completion of the study, a summary of species and numbers collected will be provided to VDWR in compliance with the scientific collection permit specifications.

2.2 Mussel Habitat and Community

Mussel survey efforts include one season of sampling (fall 2020). Methods are habitat dependent (e.g., water depth, substrate, stream flow) and include snorkeling, viewscope, and/or Surface Supply Air. Methods follow the Draft Freshwater Mussel Guidelines for Virginia (USFWS and VDGIF 2018). Transect surveys occur in pool habitats and include searching all habitat along the entire length. Abbreviated surveys occurred at mixed habitat sites and include searching for mussels in suitable habitat throughout each site. Sampling dates were chosen within approved survey window and occurred during relatively low flow and high visibility. A variety of search techniques were used to survey for mussels at transect and abbreviated sites as described in subsequent sections. The site naming convention for transect sites is 'T' followed by site number and for abbreviated sites is 'UNIO' followed by site number/descriptor. For example, UNIO-WC is the abbreviated site in Wolf Creek.

2.2.1 Transects

Sampling for freshwater mussels involved surveying eight linear transects within the impounded area running perpendicular to stream flow bank to bank (varying from approximately 30 to 75 meters long). Due to safety concerns, transects were not placed or searched within 500 meters upstream of Niagara Dam. Transects were placed every 500 meters in the reservoir above Niagara Dam and the upstream/free-flowing reach near the upstream extent of the Project area. Upon arrival at sites T-1 through T-8 (Figure 1 and Figures 12-19), transects were delineated and the start and endpoint coordinates were recorded. Site photos were taken in four directions (90 degrees to one another) and substrate, and field conditions were recorded (e.g., time, date, temperature, precipitation, cloudy/overcast, etc.). At each sample site, habitat characteristics (e.g., substrate, estimated water velocity, depth, and instream cover) and water quality parameters (e.g., pH, water temperature, DO, and conductivity) were measured and recorded. A Secchi disk reading was taken at each reservoir sample site at the time of sampling. Transects were subdivided into 10-meter intervals and data (i.e., substrate composition, mussel occurrence) recorded per interval.

An EDGE mussel biologist, working under Virginia Scientific Collecting Permit No. 068630 (Appendix A), oversaw AEP- and HDR-approved commercial divers to conduct mussel surveys. Divers searched transects using Surface Supply Air methods at an approximate rate of one minute per square meter in heterogeneous substrates. All efforts were made to locate mussels including wafting substrates, searching through aquatic vegetation, and turning cobble, boulder, and woody debris. Additionally, divers wafted sediment and raked substrates with their fingertips to uncover buried mussels.

2.2.2 Abbreviated

Sampling for freshwater mussels also involved surveying five abbreviated sites outside the impounded area. (Figure 1 and Figures 20-24). Upon arrival, sites were delineated and the start and endpoint coordinates were recorded. Site photos, field conditions, habitat characteristics, and water quality parameters were recorded in the same manner as quantitative sites (see Section 2.2.1). Multiple points for habitat and water quality measurements were taken if there was large variation within a single site.

Abbreviated mussel surveys were completed throughout the assigned survey reach using viewscopes, snorkeling, and Surface Supply Air methods. Surveyors targeted habitat(s) suitable for the occurrence of freshwater mussels and searched those areas at an approximate rate of one minute per square meter in heterogeneous substrates. All efforts were made to locate mussels as in Section 2.2.1. Mussels were placed in mesh bags and retained in the water for subsequent processing that includes species identifications, enumerations, and length measurements. Photographs of representative taxa were taken. No live mussels were retained or injured during survey related activities. Fresh dead (empty valves) and weathered shells were retained as voucher specimens and will be deposited at malacological museums at 1) Marshall University in Huntington, West Virginia, 2) Ohio State University in Columbus, Ohio, 3) Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, or 4) will provided to the United States Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR) and/or appropriate state agency upon request.

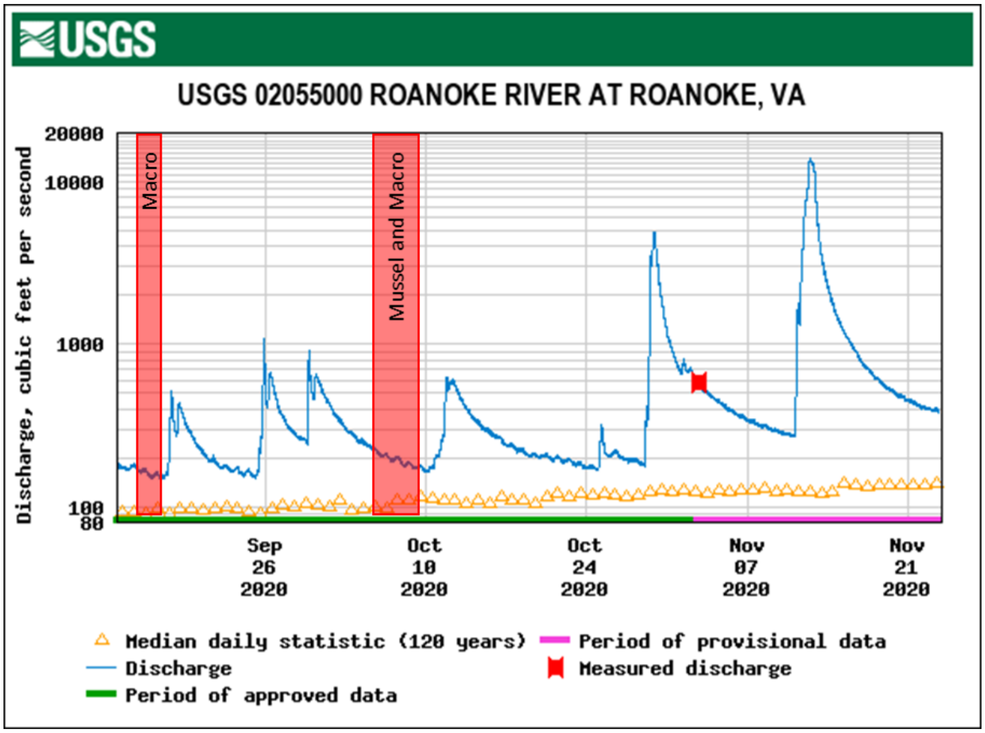
2.3 Deviations from Revised Study Plan

2.3.1 Covid-19 Delays

Initially, macroinvertebrates and crayfish surveys were proposed for completion in spring 2020; however, the Coronavirus pandemic, and subsequent restrictions on non-essential travel and safety considerations for field staff, prohibited spring 2020 field efforts. As a result, AEP requested and was granted an extension to accommodate the change in schedule as the USFWS, VDWR, VDEQ, and Virginia Department of Conservation and Recreation (VDCR) all concurred with adaptable schedule revisions. EDGE was contracted and given notice to proceed with fieldwork at the beginning of September 2020. For the purposes of this report, spring and fall macroinvertebrate and crayfish sampling were originally scheduled to occur in 2020, but spring sampling was not completed. Mussel surveys were scheduled for the 2020 field season and were successfully completed. Thus, as part of the benthic aquatic resource studies, only spring macroinvertebrate and crayfish sampling is scheduled for 2021.

2.3.2 Weather Delays

Periodic delays associated with weather and water conditions plagued the fall of 2020. Average annual rainfall for Roanoke, Virginia is approximately 105 centimeters (U.S. Climate Data 2021) and, as of December 1, 2020, Roanoke already accumulated over 157 centimeters of rain (National Weather Service 2020). Sampling efforts were completed at this year's assumed baseflow, which was likely around 150-200 cubic feet per second (CFS) during the sampling period. The 47 percent increase in average precipitation made it difficult to sustain contiguous field sampling efforts and did not allow the Roanoke River to reach average annual baseflow throughout the sampling period at the study location (see figure below).



3.0 RESULTS

All sample locations provided in the RSP were adhered to as closely as possible. Upon arrival at sample locations, biologists chose nearest locations that exhibited habitat required for sampling method efficacy, met target sampling habitats, and avoided exceptionally high flows. No notable or drastic changes were made to proposed sampling locations for macroinvertebrates, crayfish, or mussel survey efforts.

3.1 Macroinvertebrate and Crayfish Community

All ten macroinvertebrate sites were sampled between September 15 and 16 and October 5, 2020, during the fall sample index period defined by VDEQ (September 1 – November 30) (VDEQ 2008). Sampling was performed by EDGE's state and federally permitted astacologist under Virginia Scientific Collecting Permit No. 068630 (see Appendix A). The taxonomic results of macroinvertebrate collections are not yet available, but the crayfish results are detailed below. On-site observations of macroinvertebrates are however described and show potential for variability in abundance and community structure for benthic macroinvertebrates throughout the Project area. Five species of crayfish were collected and identified in the field during survey efforts at eight of the 10 sites sampled: the Appalachian Brook Crayfish (*Cambarus bartoni bartoni*), Atlantic Slope Crayfish (*Cambarus longulus*), Ozark Crayfish (*Faxonius ozarkae*), Virile Crayfish (*Faxonius virilis*), and the Red Swamp Crayfish (*Procambarus clarkii*). The Appalachian Brook Crayfish and Atlantic Slope Crayfish are native to the Roanoke River while the Ozark Crayfish, Virile Crayfish, and Red Swamp Crayfish are considered invasive species in the state of Virginia. Representative site and crayfish photos are provided in Appendix B. Site-specific information is provided below.

3.1.1 Quantitative Sampling

Five quantitative sites were sampled for benthic macroinvertebrate and crayfish including two sites upstream and three sites downstream of Niagara Dam. Benthic macroinvertebrate and crayfish habitat consisted primarily of bedrock, boulder, cobble, and gravel substrates (relatively good habitat at all five sites) (Figure 1; NFQT). Overall, a high abundance of aquatic snails was present at all sites with reduced numbers in Tinker Creek. Three species of invasive crayfish including Ozark crayfish, Virile Crayfish and Red Swamp Crayfish were collected at quantitative survey locations. Ozark Crayfish and Red Swamp crayfish were collected both above and below the Niagara Dam while Virile Crayfish were only collected at the most downstream site (NFQT10) from the Niagara Dam. Invasive crayfish always outnumbered native crayfish when found. Water parameters varied per site and ranged from 16.1 to 21.4 °C, pH 6.87 to 8.53, DO 75.4 to 105.7 percent saturation and 7.05 to 9.81 mg/L, and conductivity 390 to 444 µs/cm (Table 1).

Table 1: Macroinvertebrate and Crayfish Site Details

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Conductivity (us/cm)	Habitat
9/15/2020	NFQT1	18.5	6.9	7.05	75.4	416	Riffle/Run
9/15/2020	NFQT2	21.4	8.4	8.55	96.9	390	Riffle/Run
9/15/2020	NFQL3	21.2	7.1	7.05	79.2	418	Pool
9/16/2020	NFQL4	19.5	7.1	5.77	62.6	405	Pool
9/16/2020	NFQL5	20.4	7.1	6.77	75.1	413	Pool

9/16/2020	NFQT6	20.6	7.2	7.66	85.4	402	Riffle/Run
9/16/2020	NFQT7	20.8	8.5	7.28	80.4	444	Riffle/Run
10/5/2020	NFQL8	15.6	8.1	9.59	98.1	413	Run
10/5/2020	NFQL9	15.9	8.0	9.76	104.7	345	Run
10/5/2020	NFQT10	16.1	8.2	9.81	105.7	418	Riffle

Above/below dashed line represents above/below Niagara Dam

3.1.1.1 Tinker Creek – NFQT1

Substrates at NFQT1 consisted of sand (45%), gravel (35%), cobble (18%), and boulder (2%) (Figure 2). Habitat structure generally consisted of a sand/gravel/cobble mix with occasional boulders, rootwads and undercut banks were prevalent (particularly along the LDB), and the site is best classified as riffle/run habitat. Based on field notes, benthic macroinvertebrates appeared diverse and contained multiple EPT taxa (*Ephemeroptera* [mayflies], *Plecoptera* [stoneflies], and *Trichoptera* [caddisflies]). Crayfish species included Appalachian Brook Crayfish and the Ozark Crayfish (Table 2). The Appalachian Brook Crayfish was found at low abundance and along the margins of the stream while the Ozark Crayfish was abundant and found throughout the site.

Table 2: Crayfish Observations

Date	Site #	Appalachian Brook Crayfish	Atlantic Slope Crayfish	Ozark Crayfish	Virile Crayfish	Red Swamp Crayfish
9/15/2020	NFQT1	present		abundant		
9/15/2020	NFQT2		present	abundant		
9/15/2020	NFQL3			present		present
9/16/2020	NFQL4					
9/16/2020	NFQL5					
9/16/2020	NFQT6			present		present
9/16/2020	NFQT7			abundant		
10/5/2020	NFQL8			abundant		
10/5/2020	NFQL9			abundant		
10/5/2020	NFQT10		present	abundant	abundant	

Gray shading represents invasive species and above/below dashed line represents above/below Niagara Dam

3.1.1.2 Roanoke River – NFQT2

Substrates at NFQT2 consisted of bedrock (35%), boulder (20%), cobble (25%), gravel (10%), and sand (10%) (Figure 3). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop. The site is best classified as a riffle. Occasional patches of submerged aquatic vegetation (SAV) were present as well as filamentous algae. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa along with a great number of aquatic snails. Crayfish collected included Atlantic Slope Crayfish and Ozark Crayfish (Table 2). Atlantic Slope crayfish were present but not numerous and were found mid-channel under slab cobble or boulders while Ozark Crayfish were abundant and were found throughout the stream reach.

3.1.1.3 Roanoke River – NFQT6

Substrates at NFQT6 consisted of bedrock (50%), cobble (30%), boulder (10%), and gravel (10%) (Figure 4). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop. The site is best classified as a riffle. Patches of SAV and filamentous algae were thick and covered most of the cobble and boulders. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa along with a great number of aquatic snails. Crayfish collected included Ozark Crayfish and the Red Swamp Crayfish (Table 2). While both were collected in relatively low numbers at the site, numerous exuvia of freshly molted individuals of both species were present in isolated pools nearby. NFQT6 served as the quantitative replicate site for QA/QC purposes.

3.1.1.4 Roanoke River – NFQT7

Substrates at NFQT7 consisted of bedrock (50%), boulder (30%), and cobble (20%) (Figure 5). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop. The site is best classified as a riffle. Patches of SAV were present along the LDB. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa; however, the number of snails compared to previous sites was noticeably reduced. The Ozark Crayfish was abundant and was the only crayfish species collected at the site (Table 2).

3.1.1.5 Roanoke River – NFQT10

Substrates at NFQT10 consisted of bedrock (40%), slab boulder (20%), cobble (20%), and gravel (20%) (Figure 6). Habitat structure generally consisted of shallow sheets of bedrock riffles and glides with the other substrates lain overtop. The site is best classified as a riffle. Large slab boulders were common near the shore. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa. Crayfish collected included Atlantic Slope Crayfish, Virile Crayfish, and the Ozark Crayfish (Table 2). Atlantic Slope crayfish were present but not numerous and were found mid-channel under cobble. Virile crayfish were only collected from large boulders near the shore while Ozark Crayfish were abundant and were found throughout the stream reach.

3.1.2 Qualitative Sampling

Five qualitative sites were sampled for benthic macroinvertebrates and crayfish including three sites upstream and two sites downstream of Niagara Dam. The three sites located upstream of the Niagara Dam contained poor habitat as shown by apparent low benthic diversity while the two sites located downstream of the dam contained better habitat and apparently higher benthic diversity (Figure 1; NFQL). Two species of invasive crayfish including Ozark Crayfish and Red Swamp Crayfish were collected at qualitative survey locations. Ozark Crayfish and Red Swamp Crayfish were collected both above and below the Niagara Dam. No native crayfish were collected during qualitative sampling efforts. Water parameters varied per site and ranged from 15.6 to 21.2 °C, pH 7.05 to 8.14, DO 62.6 to 104.7 percent saturation and 5.77 to 9.76 mg/ L, and conductivity 345 to 418 µs/cm (Table 1).

3.1.2.1 Roanoke River – NFQL3

Substrates at NFQL3 consisted of bedrock (60%), cobble (30%), and silt (10%) with heavy amounts of leaf pack, rootwads, and snags along the shore. The water was relatively deep and quickly dropped off from shore, so sampling efforts were confined to shoreline habitat (Figure 7). The site is best classified as a pool. The site appeared unproductive as benthic macroinvertebrates appeared low in both density and diversity. Crayfish collected included Ozark Crayfish and Red Swamp Crayfish (Table 2). Both species were found at low abundance and in cobble substrate.

3.1.2.2 Roanoke River – NFQL4

Substrates at NFQL4 consisted of sand (60%) and silt (40%) with heavy amounts of leaf pack and snags along the shore. The water was relatively deep and quickly dropped off from the shore, so sampling efforts were confined to shoreline habitat (Figure 8). The site is best classified as a pool. The site appeared unproductive as benthic macroinvertebrates appeared low in both density and diversity; however, it did appear more productive than NFQL3. No crayfish were collected which was likely due to a lack of suitable habitat as no hard cover objects were available at the site (Table 2). NFQL4 served as the qualitative replicate site for QA/QC purposes.

3.1.2.3 Roanoke River – NFQL5

Substrates at NFQL5 consisted of sand (70%) and silt (30%) with moderate amounts of leaf pack, snags, SAV, and rootwads along the shore. The water was relatively deep and quickly dropped off from the shore, so sampling efforts were confined to shore habitat (Figure 9). The site is best classified as a pool. The site appeared unproductive as benthic macroinvertebrates appeared low in both density and diversity. No crayfish were collected which was likely due to a lack of suitable habitat as no hard cover objects were available at the site (Table 2).

3.1.2.4 Roanoke River – NFQL8

Substrates at NFQL8 consisted of cobble (60%), sand (20%), gravel (10%), and boulder (10%) with moderate amounts of SAV and rootwads along the shore. The water was knee deep allowing for sampling efforts throughout (Figure 10). The site is best classified as a run. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa along with many aquatic snails. The Ozark Crayfish was abundant and was the only crayfish species collected at the site (Table 2).

3.1.2.5 Roanoke River – NFQL9

Substrates at NFQL9 consisted of bedrock (40%), cobble (20%), gravel (20%), and sand (20%) with moderate amounts rootwads along the shore. The water was knee deep near shore while mid-channel approached chest deep (Figure 11). Sampling efforts were confined to approximately seven meters off the LDB. The site is best classified as a run habitat. Benthic macroinvertebrates appeared diverse and contained multiple EPT taxa along with many aquatic snails. The Ozark Crayfish was abundant and the only crayfish species collected at the site (Table 2).

3.2 Mussel Habitat and Community

Mussel survey efforts were completed during optimal weather and riverine conditions between October 6-8, 2020, following methods defined in the RSP and derived from the Draft Freshwater Mussel Guidelines for Virginia (USFWS and VDGIF 2018) and performed by EDGE's state permitted malacologist and a commercial dive team under Virginia Scientific Collecting Permit No. 068630 (see Appendix A). Unionids were mostly absent throughout all 13 survey reaches. Eight transect surveys in the Niagara Dam impoundment, totaling 430 square meters of search effort, resulted in the collection of zero live or deadshell specimens. Abbreviated surveys at five locations, with a cumulative search effort of 1,335 minutes, resulted in the collection four live unionids representing one species, Eastern Elliptio (*Elliptio complanata*). The Eastern Elliptio is native to the Roanoke River system and a common species in Atlantic Slope mussel assemblages. Additionally, a single Notched Rainbow (*Villosa constricta*) was observed as weathered deadshell material during quantitative macroinvertebrate and crayfish surveys near the Tinker Creek site. No live mussels or deadshell were collected downstream of Niagara Dam. The invasive Asiatic Clam (*Corbicula fluminea*) was noted at all sites in relatively even densities within the mainstem Roanoke River (above and below Niagara Dam) with slightly higher densities where suitable mollusk habitat was present. The highest density of Asiatic Clams in the Project area was noted in Tinker Creek. Asiatic Clams were noted at the mouth of Wolf Creek but did not persist upstream beyond the confluence with the Roanoke River. Representative site and mussel photos are provided in Appendix B. Site-specific information is provided below.

3.2.1 Transects

All mussel transect sites were placed within the impounded section of the Roanoke River and consequently categorized as pool habitats. Substrate composition varied from bedrock to silt, with a general longitudinal pattern observed in substrate sizes that decreased in the downstream direction towards Niagara Dam (Figure 1; T). Water parameters varied per site and ranged from 14.9 to 16.1 °C, pH 7.72 to 7.91, DO 60.2 to 96.9 percent saturation and 4.95 to 9.68 mg/L., and conductivity 336 to 406 µs/cm (Table 3). Transect sites had relatively similar habitat features and all resulted in zero live mussels; therefore, are discussed collectively and in generality.

Table 3: Mussel Site Details

Date	Site #	Water Temp. (C)	pH	DO (mg/L)	DO (%)	Conductivity (us/cm)	Habitat
10/6/2020	T-1	15.8	7.9	8.55	96.9	336	Pool
10/6/2020	T-2	16.1	7.7	10.02	96.8	390	Pool
10/6/2020	T-3	15.4	7.8	7.05	79.2	384	Pool
10/6/2020	T-4	15.0	7.9	9.63	94.6	406	Pool
10/6/2020	T-5	14.9	7.9	5.77	62.6	399	Pool
10/6/2020	T-6	15.0	7.9	7.72	75.0	400	Pool
10/6/2020	T-7	15.2	7.9	9.68	96.9	404	Pool
10/6/2020	T-8	15.5	7.9	4.95	60.2	402	Pool
10/8/2020	UNIO-1	16.4	8.4	8.55	96.9	352	Riffle/Run
10/8/2020	UNIO-2	16.4	8.6	12.02	130.3	466	Riffle/Run
10/6/2020	UNIO-WC	16.4	8.0	7.66	85.4	213	Riffle/Run
10/7/2020	UNIO-Bypass	16.8	8.4	9.53	102.1	409	Riffle/Run
10/7/2020	UNIO-Tailrace	16.7	8.1	9.64	103.3	404	Run

3.2.1.1 Roanoke River – Niagara Impoundment

The Niagara impoundment was surveyed with eight bank-to-bank transects spaced 500 meters apart totaling 430 square meters of search area (averaging approximately 54 meters per transect) (Figures 12-

19). Survey efforts yielded zero live freshwater mussels or deadshell specimens. Longitudinal variation in depth and substrate sizes were observed between the upper and lower portions of the impoundment. Transects in the upper portions (Transects 1-3) averaged approximately one meter deep across the channel, the lower transects (Transects 6-8) averaged approximately two meters deep, and middle transects averaged between the two. Substrate composition in the upper impoundment was dominated by coarse substrates such as gravel and bedrock and gradually transitioned to less coarse and homogenous substrates such as deep silt and sand deposits at downstream transects. The upper transects had high visibility, shallow stream banks, and a lack of fine sediments. The downstream transects had steep sloping banks, less visibility, and numerous woody debris deposits.

Although the thalweg was typically inundated with thick, mobile silt deposits, the riverine margins were characterized by stable, presumably suitable, unionid habitat. However, no live or deadshell freshwater mussels were encountered, including silt-tolerant species (e.g., Paper Pondshell [*Utterbackia imbecillis*]) which are common in the stable banks of impoundments throughout the Atlantic Slope.

3.2.2 Abbreviated

Five abbreviated sites were sampled and all were categorized as riffle and/or run habitats composed of varying substrates from bedrock to silt (Figure 1; UNIO). Water parameters varied per site and ranged from 16.4 to 16.8 °C, pH 8.1 to 8.6, DO 85.4 to 130.3 percent saturation and 7.66 to 12.02 mg/L, and conductivity at 213 to 466 µs/cm (Table 3). Four of the five abbreviated sites are approximately 500 meters in length and the bypass reach is approximately 315 meters in stream length. Although there was a limited number of mussels collected, catch per unit effort (CPUE), species richness, qualitative density, and relative abundance were calculated. No state or federally listed mussels were found.

3.2.2.1 Roanoke River – UNIO-1

The site consists of several riffle-run complexes and one long pool (Figure 20). During survey efforts, the stream was relatively low and clear with a maximum depth of approximately 1.5 meters and an average depth of 0.5 meter. The average stream width at this site was approximately 33 meters. Substrate composition was a heterogeneous mixture of sand (30%), gravel (30%), cobble (25%), and bedrock (10%) with some silt (5%) deposits along the stream margins. Survey efforts included 360 minutes of qualitative searches using snorkel and view scope methods and resulted in the collection of two live Eastern Elliptio (Table 4). This sampling location resulted in a CPUE of 0.33 individuals per hour with an approximate qualitative density of 0.000148 individuals per square meter. However, both individuals were collected within 3 meters of each other in sand/silt substrates near flow refugia along the LDB. With an abundance of two and a species richness of one, the UNIO-1 site likely supports a minimal population of highly localized freshwater mussels that persist in low densities.

Table 4: Mussel Collections

Date	Site #	Common Name	Species	Length (mm)	Dom. Substrate
10/8/2020	UNIO-1	Eastern Elliptio	*Elliptio complanata*	88.9	Course
10/8/2020	UNIO-1	Eastern Elliptio	*Elliptio complanata*	96.2	Course
10/8/2020	UNIO-2	Eastern Elliptio	*Elliptio complanata*	105.4	Sand
10/8/2020	UNIO-2	Eastern Elliptio	*Elliptio complanata*	73.5	Sand

3.2.2.2 Tinker Creek – UNIO-2

The Tinker Creek site consisted of riffle/run complexes (Figure 21). During the survey effort, the stream was low and clear with a maximum depth of approximately 1.5 meters and an average depth of 20 centimeters. The average stream width at this site was approximately 15 meters. The riffles and thalweg of Tinker Creek were dominated by unstable, mobile sand (65%), gravel (25%), and silt (10%). A small area (~25 square meters) around the Tinker Creek Canoe Launch provided the only coarse substrate (i.e., large, stable cobble) in the stream. Two hundred and forty (240) minutes of qualitative search effort was expended and yielded two live Eastern Elliptio individuals and approximately 12 weathered deadshell Eastern Elliptio specimens. CPUE was 0.5 individuals per hour with an approximate qualitative density of 0.0018 individuals per square meter. Both live individuals were old and all deadshell specimens were represented by older individuals, suggesting a lack of recruitment. Additionally, a Notched Rainbow was observed as weathered deadshell material during quantitative macroinvertebrate and crayfish surveys near this site in Tinker Creek.

The site was strongly influenced by anthropogenic impacts and featured heavy trash deposits, human feces, and combined sewer outfalls. During high flow events, the stream likely experiences elevated water velocities and unnatural sediment transport as it drains downtown Roanoke with a watershed dominated by impermeable surfaces. However, stable substrates suitable for mussel colonization were present in pockets behind woody debris and along the lateral stream margins. The Tinker Creek site likely supports a minimal population of freshwater mussels that may be greatly degraded due to anthropogenic impacts and a lack of recruitment.

3.2.2.3 Wolf Creek – UNIO-WC

Wolf Creek is a small tributary that empties into the impounded portion of the Roanoke River along the LDB and consisted of high-gradient riffle/run complexes (Figure 22). The maximum depth was approximately 1.0 meter with an average depth of 8 centimeters. The average stream width at this site was approximately five meters. Substrate composition was dominated by unconsolidated sand (70%) with small pea gravel (25%) and some cobble (5%) present. Survey efforts began at the Wolf Creek confluence with the Roanoke River and extended approximately 500 meters upstream. One hundred and thirty-five (135) minutes of qualitative search efforts yielded no live individuals or deadshell specimens. The stream featured excellent riparian zone coverage but was heavily impacted by unstable sand deposits; likely the result of upstream urban activity. The small stream size (approximately 13 square kilometer drainage area) and unstable substrates provided poor habitat for freshwater mussel colonization.

3.2.2.4 Roanoke River – UNIO-Bypass

The Bypass site occurs directly downstream of Niagara Dam and primarily consisted of heavily braided riffle/run habitats and plunge pools (Figure 23). The maximum depth was approximately 1.0 meter with an average depth of 15 centimeters at the time of surveys. The average stream width at this site was approximately 55 meters. The survey area was dominated by scoured bedrock (50%), cobble (40%), and gravel (10%) with very little suitable unionid habitat available. Survey efforts began at the Niagara Pumphouse and extended approximately 315 meters upstream to the base of the Niagara Dam (Figure 23). Three hundred and thirty (330) minutes of qualitative search efforts yielded no live individuals or deadshell specimens. The entire reach is heavily impacted by strong flows from the Niagara Dam and large portions of the reach may also go dry during periods of low flow. Although riverine conditions exhibited high DO and cool temperatures, this site was highly unsuitable for unionid colonization due to heavy scouring and periodic turbulent velocities.

3.2.2.5 Roanoke River – UNIO-Tailrace

The site occurs downstream of Niagara Pumphouse and primarily consisted of deep, swift bedrock runs (Figure 24). The maximum depth was approximately 2.5 meters with an average depth of 1.0 meter. The average stream width at this site was approximately 25 meters. The site was dominated by bedrock (90%) substrate in the thalweg with gravel (5%) and sand (5%) along the shorelines. Survey efforts began at the Blueridge Parkway Bridge and extended approximately 500 meters downstream. Two hundred and seventy (270) minutes of qualitative search effort yielded no live individuals or deadshell specimens. Although riverine conditions exhibited high DO and cool water temperatures, the entire reach is heavily impacted by strong flows from the Niagara Dam and deeply scoured into swift chutes of bedrock. A large riffle at the bottom of the site offered the first continuous area of stable gravel/cobble substrate and may represent the beginning of suitable mussel habitat.

4.0 DISCUSSION

4.1 Macroinvertebrate and Crayfish Community

Benthic macroinvertebrate and crayfish species diversity and abundance can be used as indicators of water quality, as these organisms serve as a food resource for fish and other fauna in the riverine community. A healthy stream generally includes habitat diversity and limited pollution, often indicated by a high EPT metric score, which indicates the presence of an abundance and diversity of pollution intolerant EPT taxa, and acceptable scores in other standard biological metrics. VDEQ (2017) conducted macroinvertebrate sampling in the Roanoke River downstream of Niagara Dam and demonstrated low diversity and presence of few sensitive taxa overall; despite presence of some optimal habitat. There is no site-specific reference information available for crayfish in the vicinity of the Project; however, Virginia is known to harbor approximately 33 species of crayfish. Several species currently found in Virginia include non-indigenous and/or invasive species such as the Red Swamp Crayfish, Rusty Crayfish (*Faxonius rusticus*), and Virile Crayfish (VDGIF 2018; VISAC 2018).

Macroinvertebrate taxonomic identification is currently in progress; therefore, only general observations have been presented and a full discussion is anticipated in forthcoming reports. Field observations suggest riffle/run sites (quantitative sampling) exhibited greater substrate heterogeneity and (anecdotally) more diverse macroinvertebrate communities than multi-habitat sites (qualitative sampling). These differences are likely attributed to the targeted habitats for each survey method. For example, quantitative surveys target riffle and run habitats that typically harbor coarser, complex substrates; thereby providing more stable conditions for macroinvertebrate colonization. Filamentous algae (and accompanying aquatic snails) were observed throughout most of the stream reaches within the Project area. Analysis of macroinvertebrates will include various methods (e.g., Hilsenhoff Biotic Index, percent intolerant species, percent EPT, etc.) once macroinvertebrate taxonomic data is available. Various metrics (e.g., taxonomic, ecological guilds) will also be used to compare macroinvertebrate community parameters and habitats above and below Niagara Dam.

Quantitative sampling methods accounted for all five of the crayfish species captured; whereas qualitative sampling methods accounted for only two, neither of which were native. Although the species composition varied, four species were collected both above and below the dam. Above the dam there were two native and two invasive species and below the dam there was one native species and three invasive species. The Appalachian Brook Crayfish (i.e., native) was only collected in Tinker Creek. The invasive Ozark Crayfish and Red Swamp crayfish were collected both above and below the dam, whereas the Virile Crayfish was only collected below the dam (however there are records of Virile Crayfish above the Project in the Roanoke River [Foltz, unpublished data]). Native species were collected at three of the 10 sampled sites while invasive species were collected at eight of the 10 sampled sites. The invasive Ozark Crayfish was collected at all sites where crayfish were present, as two of five sites above the dam resulted in zero crayfish. Overall, the crayfish community composition above the dam (two native species and two invasive) appears heathier than below the dam (one native species and three invasive).

The status of Objective One, “Collect a baseline of existing macroinvertebrate and crayfish communities in the vicinity of the Project”, is partially fulfilled until macroinvertebrate taxonomic identification and spring 2021 sampling events are complete.

4.2 Mussel Habitat and Community

Presence of freshwater mussels can also serve as a biological indicator of a healthy stream because of their typical intolerance to fine sediments and water pollution. The presence of certain invasive mollusks (i.e., Asiatic Clam) can also indicate potentially degraded stream health. Asiatic clams have not been previously identified in the Project area; however, little to no recent mussel surveys have been completed in the vicinity of the Project. A geographic search on VDWR’s Fish and Wildlife Information Service and communications with USFWS identified potential occurrence of seven mussels species that may occur in the Project vicinity, including the Atlantic Pigtoe (*Fusconaia masoni*, proposed for federal listing), the Green Floater (*Lasmigona subviridis*, state threatened) and James Spinymussel (*Parvaspina collina*, federally and state endangered). No evidence of these aforementioned species were encountered during 2020 mussel surveys.

Site-specific survey results were presented for abbreviated mussel surveys in Section 3.2.2. Two Eastern Elliptio mussels were collected near one another at the most upstream site in the Roanoke River project area (UNIO-1). Two live Eastern Elliptio mussels and approximately 12 deadshell specimens, were collected in Tinker Creek (UNIO-2). Although these two sites offer minimal suitable mussel habitat, they are likely the most productive within the Project area. Although water conditions appear suitable (Table 3) with high DO and cool temperatures, the habitat at many sites was unsuitable for unionid colonization due to heavy scouring and bedrock substrates. Anthropogenic impacts to the Roanoke River within the Project area, along with a dearth of suitable habitat, appear to support marginal populations exhibiting a lack of recruitment and strong presence of invasive Asiatic Clams throughout. The lack of suitable habitat and depauperate unionid community suggests the probable absence of federally or state-listed species within the study area.

The status of Objective Two, “Confirm the presence or absence of mussels within the study area”, Objective Three, “Characterize the mussel community composition (if present), abundance, and distribution within the study area”, and Objective Four, “Determine presence/probable absence of federally or state-listed species within the study area” have been completed. These findings add to the currently scarce body of knowledge involving mussel communities in this portion of the Roanoke River and confirm that native mussels are patchy in distribution and support depauperate densities.

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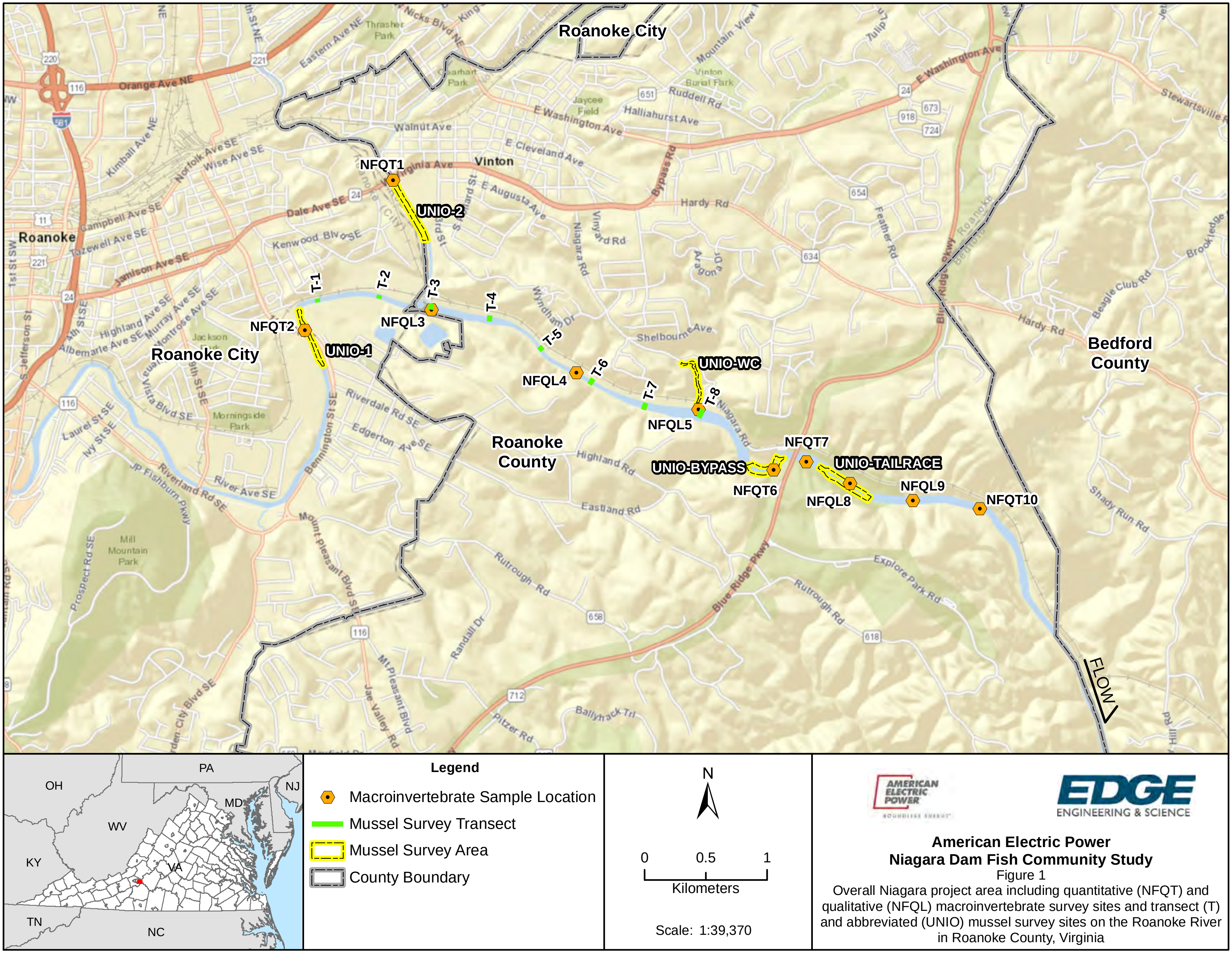
Figures



Legend

- ● Macroinvertebrate Sample Location
- 🟩 Mussel Survey Transect
- ▨ Mussel Survey Area
- ▨ County Boundary

AMERICAN ELECTRIC POWER

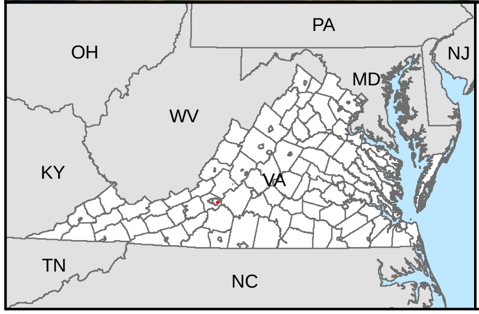
EDGE ENGINEERING & SCIENCE

American Electric Power
Niagara Dam Fish Community Study
Figure 1
Overall Niagara project area including quantitative (NFQT) and qualitative (NFQL) macroinvertebrate survey sites and transect (T) and abbreviated (UNIO) mussel survey sites on the Roanoke River in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig1_20201124.mxd

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 2
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

⬢	Macroinvertebrate Sample Location
—	Macroinvertebrate Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

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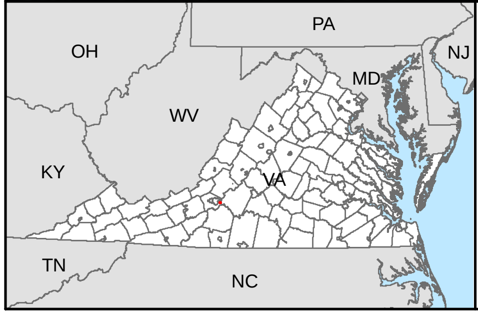
Niagara Dam Benthic Aquatic Resource Study
Figure 3
Quantitative macroinvertebrate and crayfish 100-meter survey
extent in riffle/run habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

⬢ Macroinvertebrate Sample Location

— Macroinvertebrate Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

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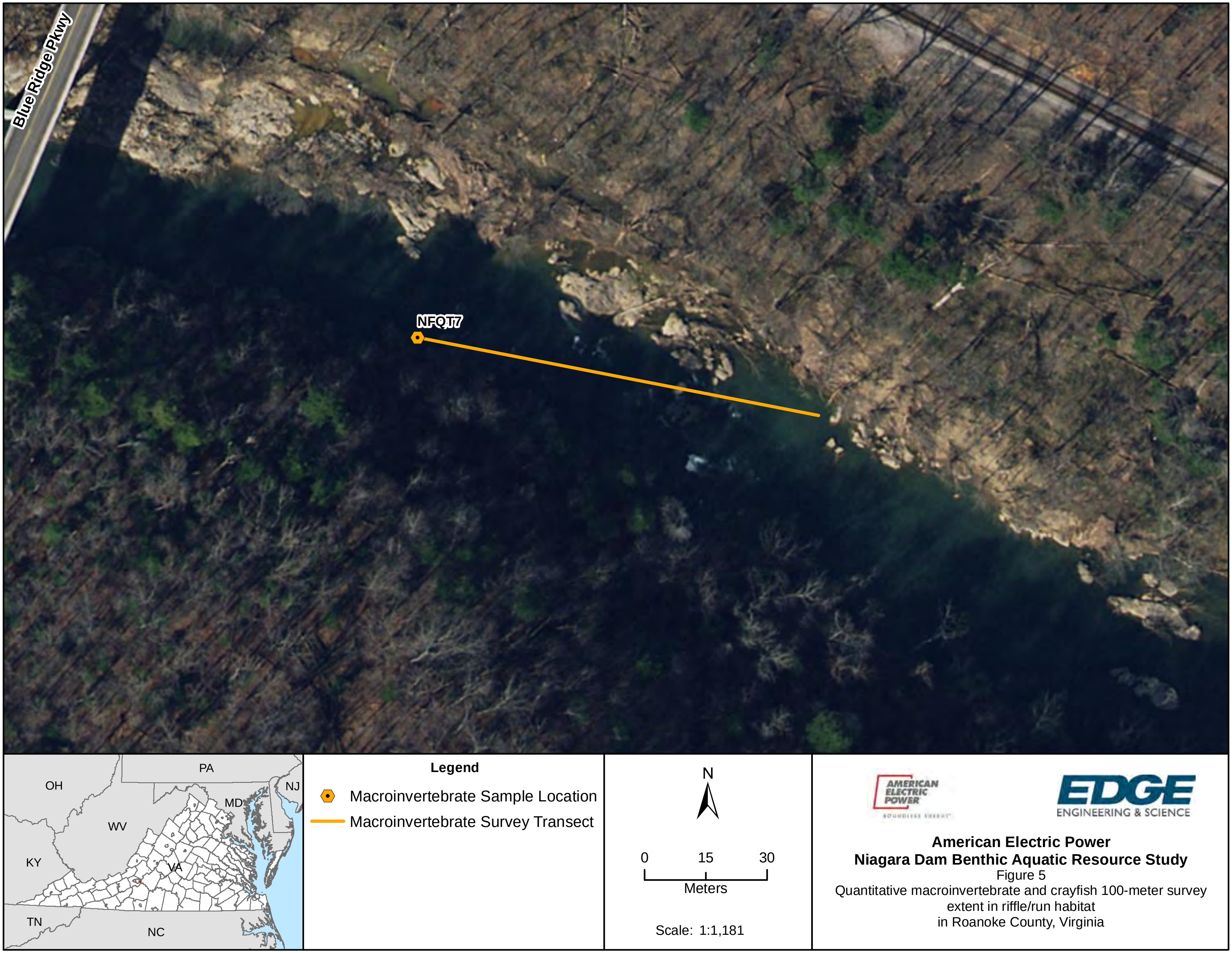
American Electric Power

Niagara Dam Benthic Aquatic Resource Study

Figure 4

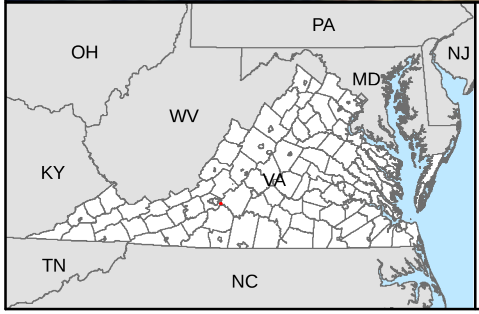
Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 5
Quantitative macroinvertebrate and crayfish 100-meter survey
extent in riffle/run habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

⬢ Macroinvertebrate Sample Location

— Macroinvertebrate Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

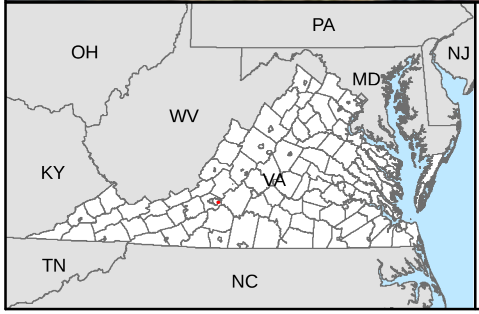
American Electric Power

Niagara Dam Benthic Aquatic Resource Study

Figure 6

Quantitative macroinvertebrate and crayfish 100-meter survey extent in riffle/run habitat in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

⬢ Macroinvertebrate Sample Location

— Macroinvertebrate Survey Transect

Scale: 1:1,181

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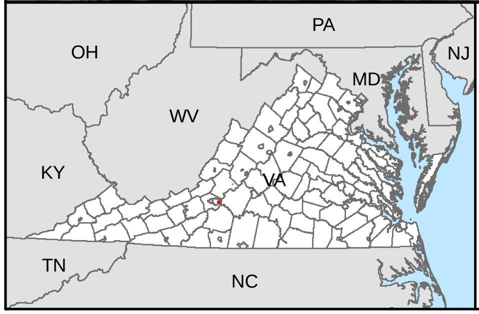
American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 7
Qualitative macroinvertebrate and crayfish 100-meter survey extent
in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

●	Macroinvertebrate Sample Location
—	Macroinvertebrate Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

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Niagara Dam Benthic Aquatic Resource Study
Figure 8
Qualitative macroinvertebrate and crayfish 100-meter survey extent
in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 9
Qualitative macroinvertebrate and crayfish 100-meter survey extent
in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd

Legend

- ⬢ Macroinvertebrate Sample Location
- ▬ Macroinvertebrate Survey Transect

Scale: 1:1,181

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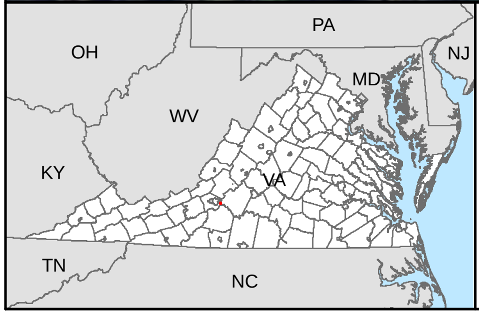
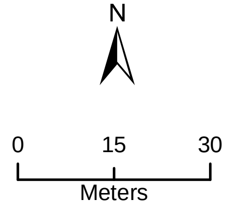
Niagara Dam Benthic Aquatic Resource Study
Figure 10
Qualitative macroinvertebrate and crayfish 100-meter survey extent
in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

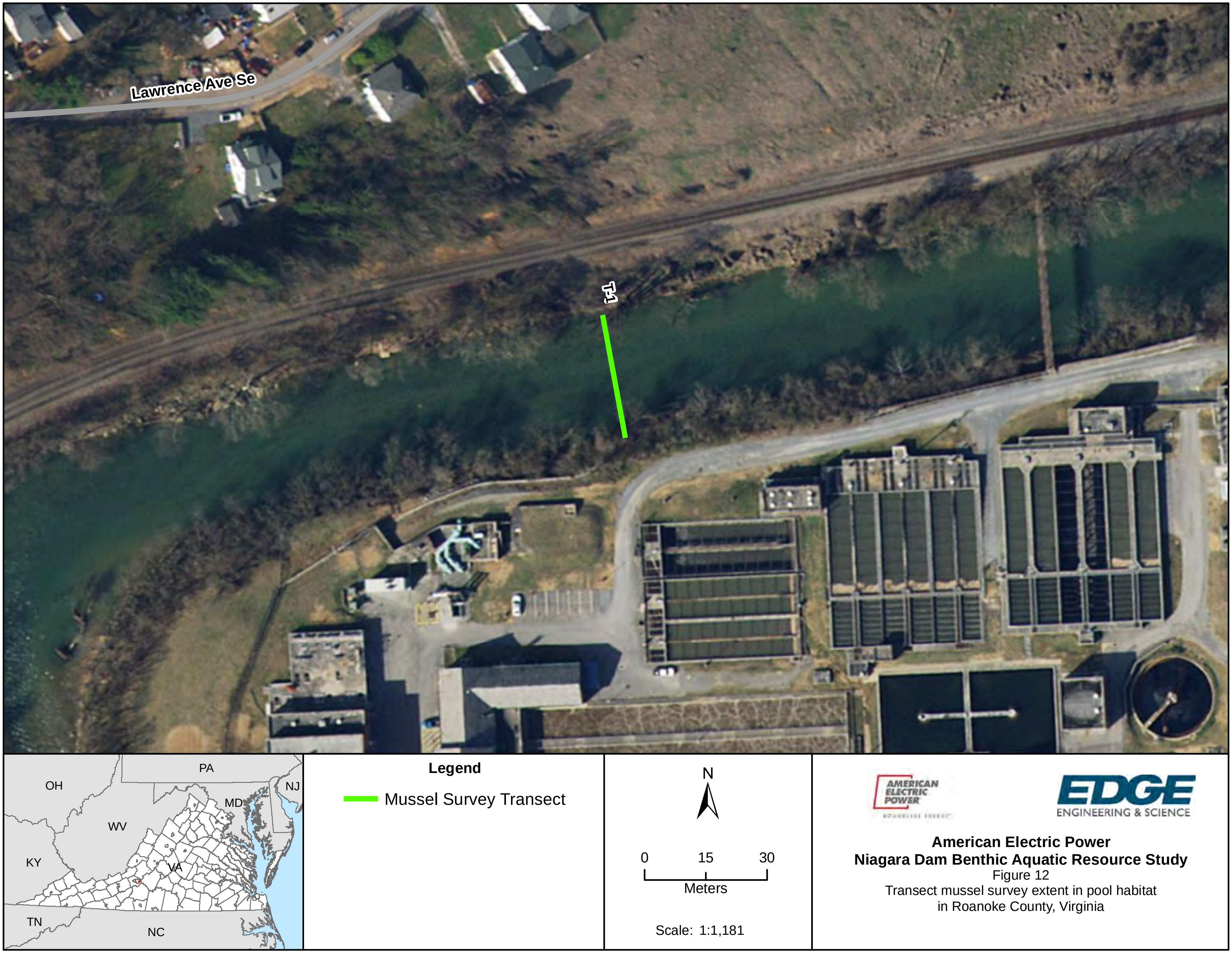
⬢	Macroinvertebrate Sample Location
▬	Macroinvertebrate Survey Transect



Scale: 1:1,181

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 11
Qualitative macroinvertebrate and crayfish 100-meter survey extent
in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 12
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd

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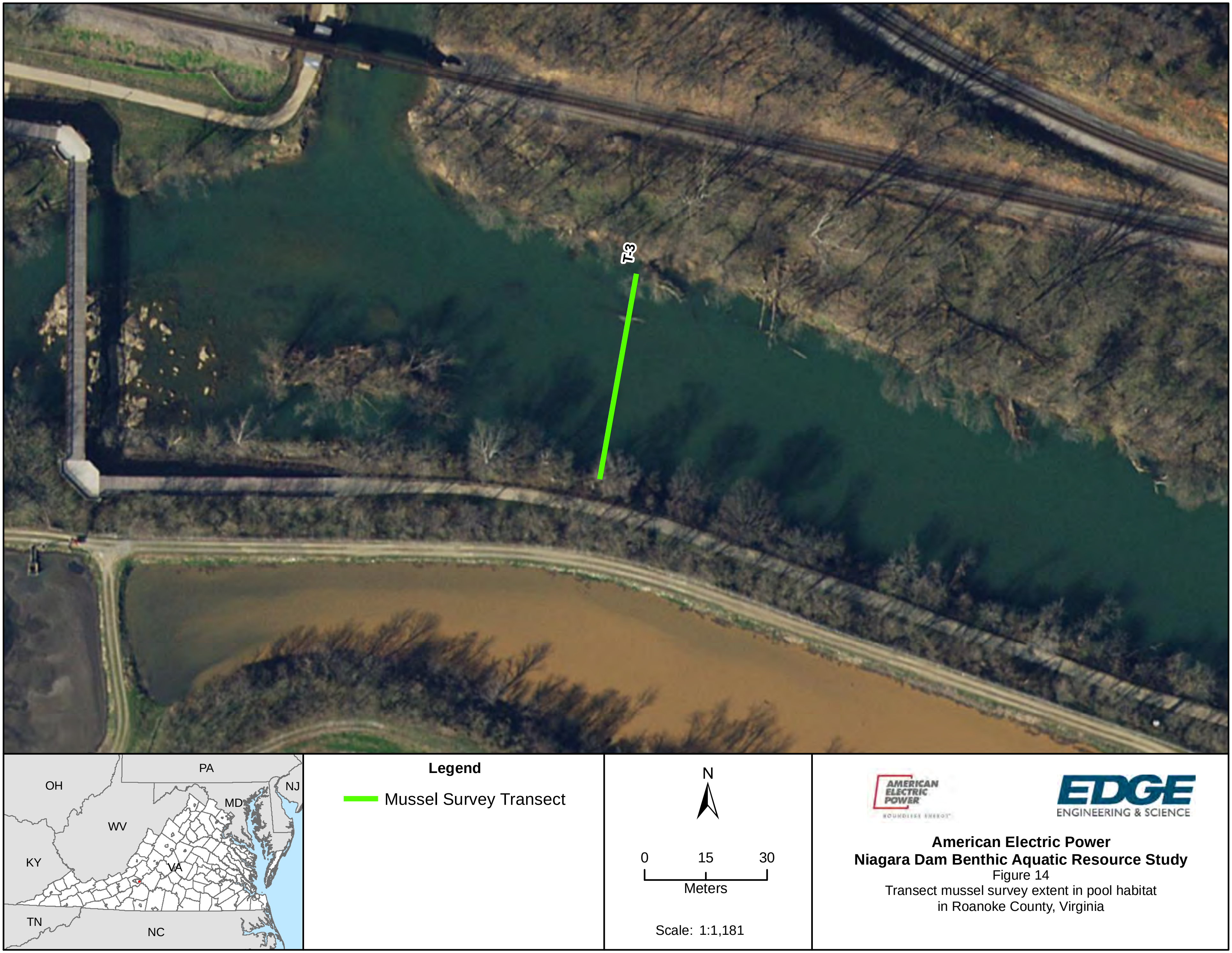
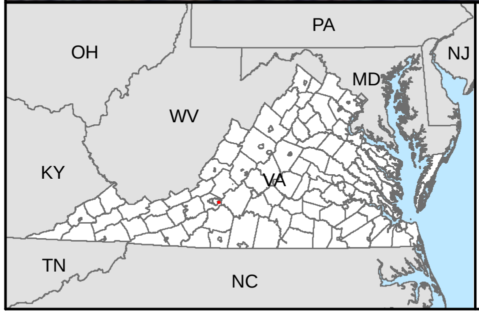
Niagara Dam Benthic Aquatic Resource Study
Figure 13
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 14
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

🟩 Mussel Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

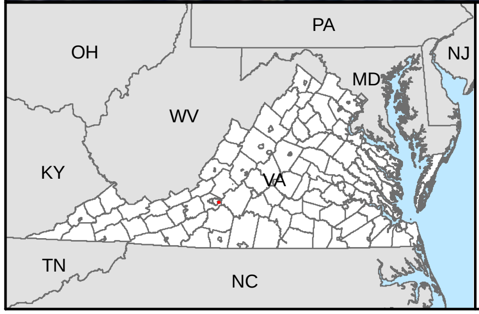
American Electric Power

Niagara Dam Benthic Aquatic Resource Study

Figure 15

Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

🟩 Mussel Survey Transect

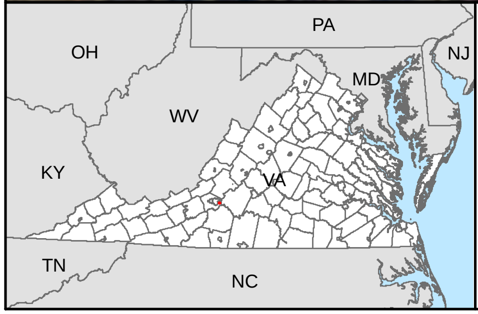
N

0 15 30
Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 16
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

Mussel Survey Transect

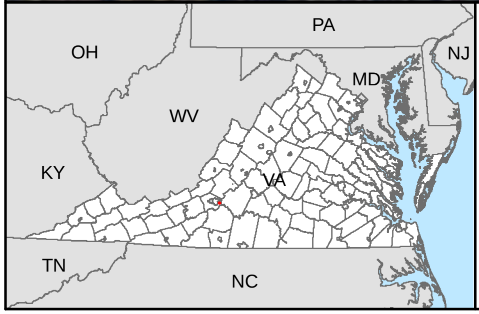
N

0 15 30
Meters

Scale: 1:1,181

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 17
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

🟩 Mussel Survey Transect

N

0 15 30

Meters

Scale: 1:1,181

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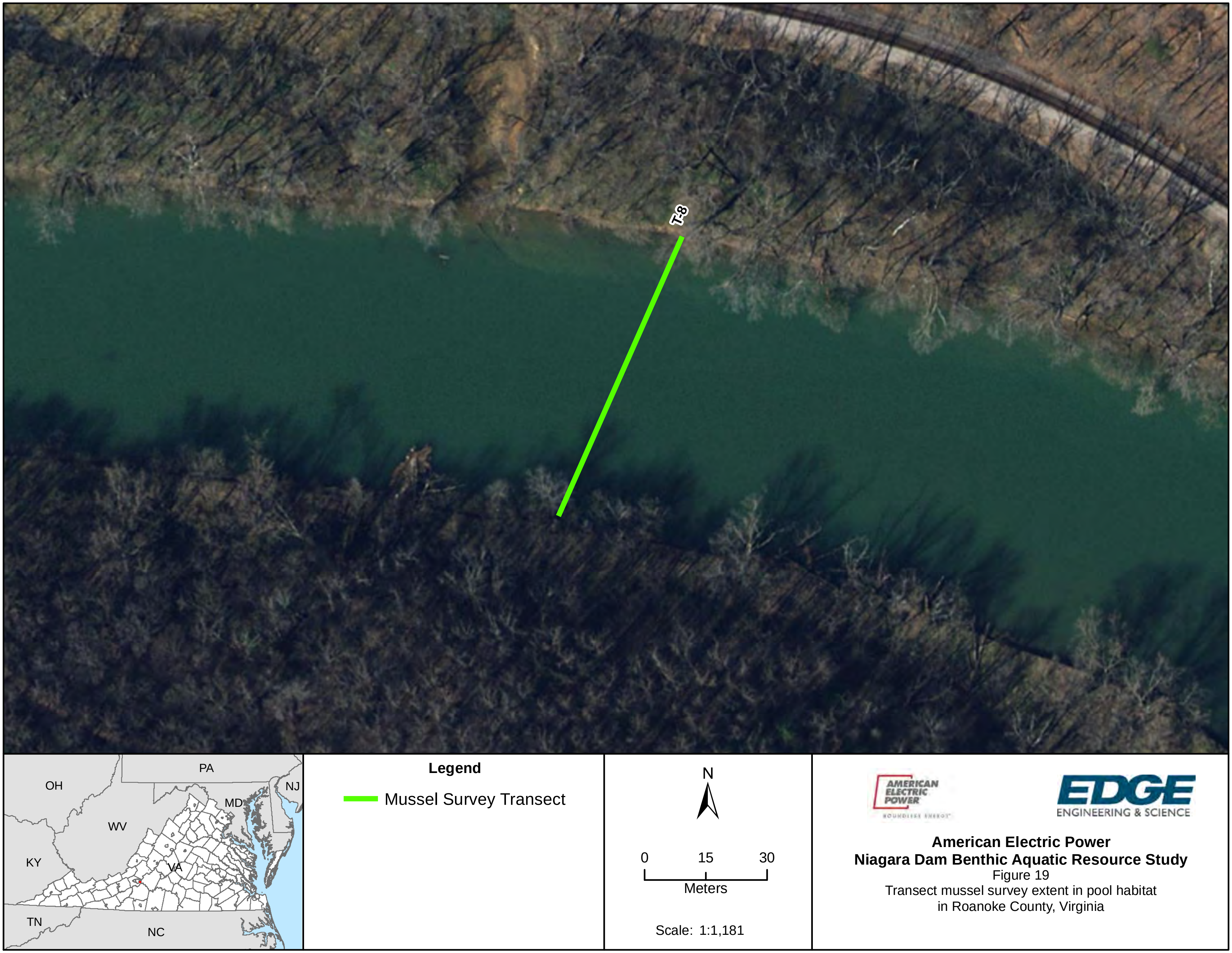
Niagara Dam Benthic Aquatic Resource Study

Figure 18

Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



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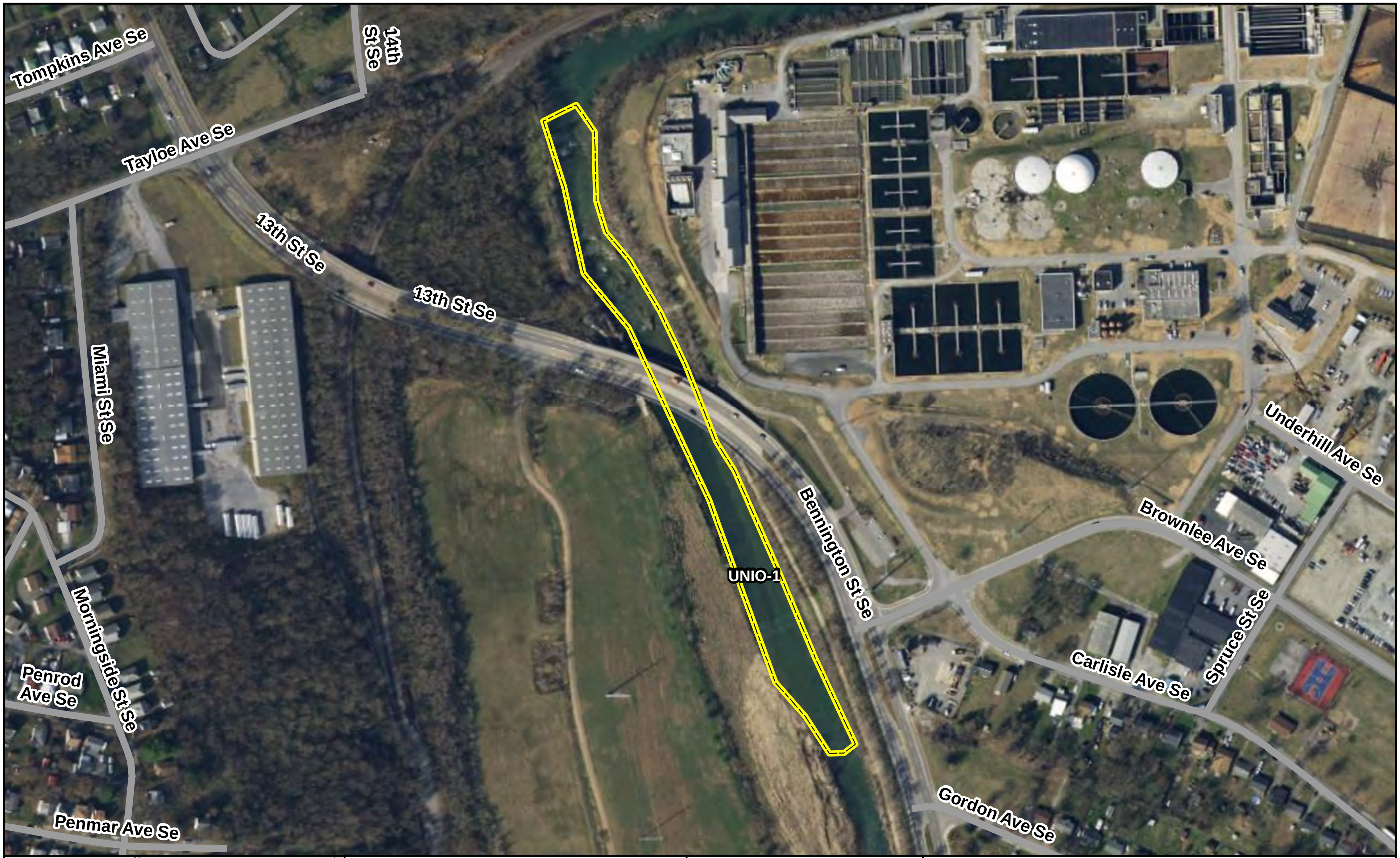
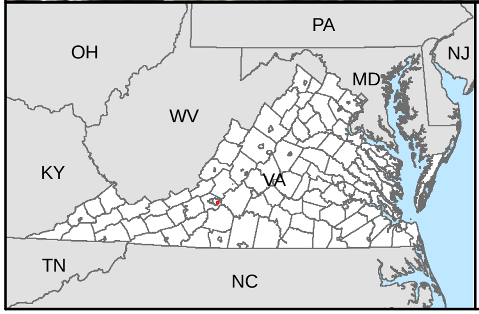
Niagara Dam Benthic Aquatic Resource Study
Figure 19
Transect mussel survey extent in pool habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd





Legend

▭ Mussel Survey Area

N

0 50 100

Meters

Scale: 1:3,937

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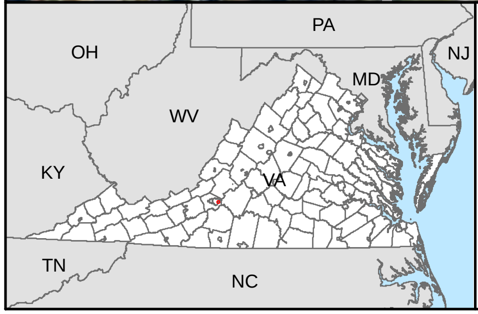
Niagara Dam Benthic Aquatic Resource Study

Figure 20

Abbreviated mussel survey extent in mixed habitat in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

▭ Mussel Survey Area

N

0 50 100
Meters

Scale: 1:3,937

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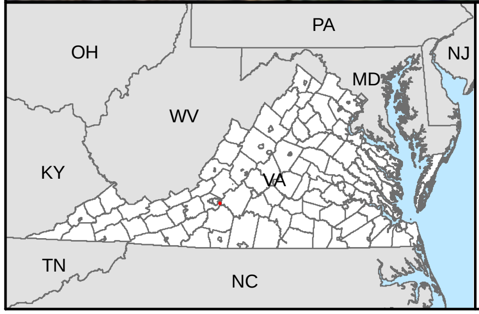
American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 21
Abbreviated mussel survey extent in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd

American Electric Power
Niagara Dam Benthic Aquatic Resource Study
Figure 22
Abbreviated mussel survey extent in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

▨ Mussel Survey Area

N

0 50 100

Meters

Scale: 1:3,937

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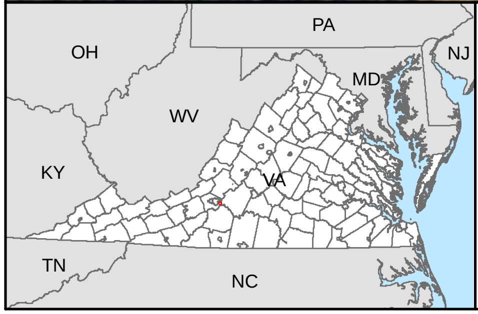
Niagara Dam Benthic Aquatic Resource Study
Figure 23
Abbreviated mussel survey extent in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd



Legend

▭ Mussel Survey Area

N

0 50 100
Meters

Scale: 1:3,937

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Niagara Dam Benthic Aquatic Resource Study
Figure 24
Abbreviated mussel survey extent in mixed habitat
in Roanoke County, Virginia

D:\PROJECTS\HDR\HDR2020-0002 Niagara Dam Relicensing\GIS\MXD\MacroInvtbrts\Report_Figs\20201124_Sbmtl\HDR2020-0002_McroInvbrts_Fig2_24_20201124.mxd

Appendix A

SCIENTIFIC COLLECTION PERMITS

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Permittee: **Casey D Swecker**
Address: **4005 Ponder Drive**
Cincinnati, OH 45245
Email: **cdswecker@edge-es.com**

Home:
Office: **(304) 633-5808**
City/County: **Out of State**

Business: **Edge Engineering and Science, LLC**
4005 Ponder Drive
Cincinnati, OH 45245
City/County: **Out of State**

Contract Species Surveys/Research/Relocation

Authorized Collection Methods: By Hand/Dip Nets/Electrofishing/Gill Nets-Trawl Nets/Seine Nets/Snorkel/View Scope/Aquatic Kick Samples/Scuba/Nets-Traps (Fyke/Hoop/D-Frame)/Hooka (Third Lung)
All methods which are part of the project(s) outlined in the submitted and approved proposal.
Authorized Waterbodies: Blackwater River/New River/Banister River/Sandy River/North Fork Roanoke River/Little Creek/Crooked Creek/Roanoke River/Sinking Creek/North Fork Holston River/Mill Creek
Authorized Marking Techniques: N/A

SPECIAL CONDITIONS: It is recommended that the fish relocation best management practices be utilized while collecting fish for this project.
Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

PERMIT AMENDMENT 9/1/2020: The amendment changes the following:
Principal Permittee & Authorized Subpermittees Affiliation FROM: ESI to Edge Engineering and Science, LLC
This amendment deletes the following:
Authorized Subpermittees: Kyle McGill/Greg Anderson/Robert Paul/Brandon Yates/Keith Gibbs/Kyle Price/Brandon Bassinger/Tyler Slagle
This amendment adds the following: Permittee is exempt from standard condition #11 (game fish creek limit) during gillnet sampling on the New River above Byllesby Dam.

Permittee MUST notify VDGIF a minimum of 7 days prior to each sampling event. Notification must be made via email to: collectionpermits@dgif.virginia.gov

Report Due: 31 January 2021, 31 January 2022

ANNUAL REPORTS MUST BE SUBMITTED VIA: https://vafwis.dgif.virginia.gov/collection_permits/

STANDARD CONDITIONS ATTACHED APPLY TO THIS PERMIT.

Authorized Counties / Cities:

Augusta
Bath
Brunswick
Buckingham
Carroll
Cumberland
Dinwiddie
Franklin
Giles
Greensville
Highland
Montgomery
Nelson
Nottoway
Pittsylvania
Prince Edward
Pulaski
Roanoke
Scott
Southampton
Radford
Statewide

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)
Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** Fee Paid: **$40.00** VADGIF Permit No. **068630**

Authorized Species:

Description	**ID Number**	**Scientific Name**
Aquatic Insects		
Aquatic Invertebrates (excluding aquatic mollusks)		
Crayfish		
Freshwater Fish		
Freshwater Mussels		
Spiny Riversnail		***Io fluvialis***

Annual Report Due End of Each Year

Authorized Sub-Permittees:
See Attached Sheet

Approved by: Randall T Francis

Applicants may appeal permit decisions within 30 days of issuance. The appeal must be in writing to the Director, Department of Game and Inland Fisheries.

Title: **Randall T. Francis - Permits Manager**

Date: **4/21/2020**

20 Permit Effective **4/21/2020** through **12/31/2021** **21**

Virginia Department of Game and Inland Fisheries

7870 Villa Park Drive, P.O. Box 90778, Henrico, VA 23228-0778
(804) 367-1000 (V/TDD)

Under Authority of § 29.1-412, § 29.1-417, & § 29.1-418 of the Code of Virginia

Scientific Collection Permit

Permit Type: **Renewal** FeePaid: **$40.00** VADGIF Permit No. **068630**

Authorized Sub-Permittees:

Dr. Tom Jones, Edge Engineering & Science, LLC
John Spaeth, Edge Engineering & Science, LLC
Aaron Prewitt, Edge Engineering & Science, LLC
Nancy Scott, Three Oaks Engineering
Adam Benshoff, Edge Engineering & Science, LLC
Dr. Art Bogan, NC Museum of Natural Sciences
Tom Dickinson, Three Oaks Engineering
Nathan Howell, Three Oaks Engineering
David Foltz, Edge Engineering & Science, LLC
Jonathan Studio, Edge Engineering & Science, LLC
Doug Locy, Edge Engineering & Science, LLC
Alyssa Brady, Edge Engineering & Science, LLC
Cody Parks, Three Oaks Engineering
Lizzy Stokes, Three Oaks Engineering
Tim Savage, Three Oaks Engineering
Mitchell Kriege, Edge Engineering & Science, LLC

Appendix B

REPRESENTATIVE PHOTOGRAPHS

Appendix B: Representative Photographs

NFQT1 - Downstream
Quantitative Macroinvertebrate Sample Site

NFQT2 - Downstream
Quantitative Macroinvertebrate Sample Site

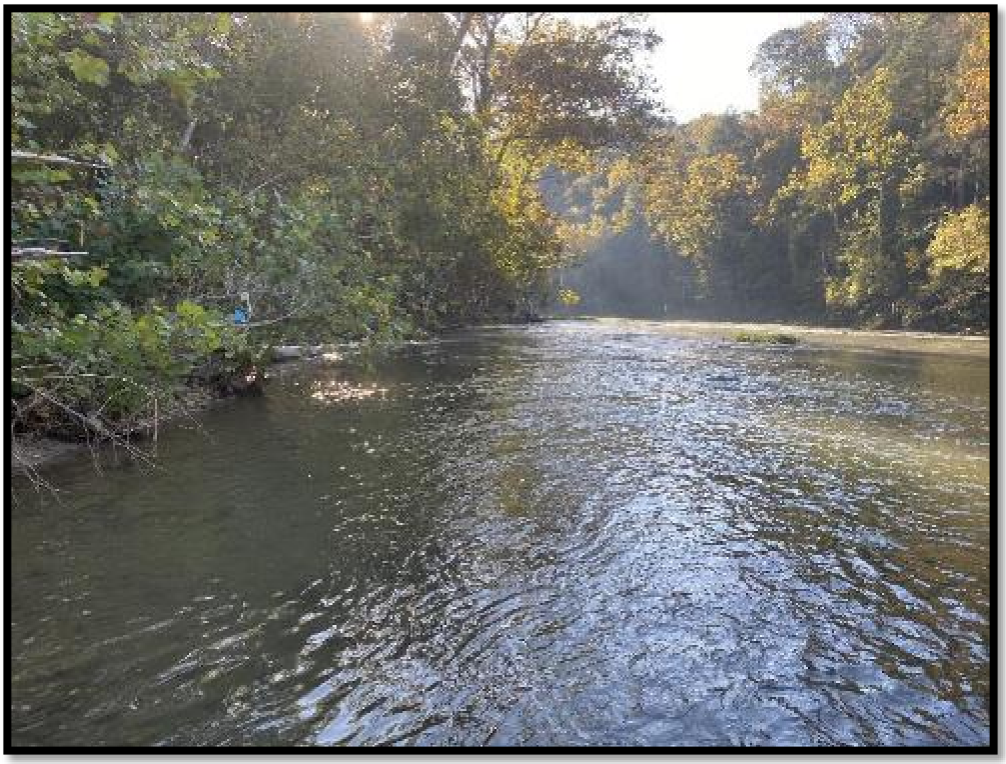
NFQL3 - Upstream
Qualitative Macroinvertebrate Sample Site

NFQL4 - Upstream
Qualitative Macroinvertebrate Sample Site

NFQL5 - Upstream
Qualitative Macroinvertebrate Sample Site

NFQT6 - Upstream
Quantitative Macroinvertebrate Sample Site

NFQT7 - Upstream
Quantitative Macroinvertebrate Sample Site



NFQL8 - Downstream
Qualitative Macroinvertebrate Sample Site

NFQL9 - Upstream
Qualitative Macroinvertebrate Sample Site

NFQT10 - Upstream
Quantitative Macroinvertebrate Sample Site

The single specimen collected was too small for detailed voucher photo.

Appalachian Brook Crayfish
(*Cambarus bartoni bartoni*)

Atlantic Slope Crayfish
(*Cambarus longulus*)

Ozark Crayfish
(*Faxonius ozarkae*)

Virile Crayfish
(*Faxonius virilis*)

Red Swamp Crayfish
(*Procambarus clarkii*)

T-1 - Upstream
Mussel Transect Sample Site

T-2 - Downstream
Mussel Transect Sample Site

T-3 - Downstream
Mussel Transect Sample Site

T-4 - Downstream
Mussel Transect Sample Site

T-5 - Downstream
Mussel Transect Sample Site

T-6 - Downstream
Mussel Transect Sample Site

T-7 - Downstream
Mussel Transect Sample Site

T-8 - Downstream
Mussel Transect Sample Site

UNIO-1 - Downstream
Mussel Abbreviated Sample Site

UNIO-2 - Upstream
Mussel Abbreviated Sample Site

UNIO-WC - Upstream
Mussel Abbreviated Sample Site

UNIO-Bypass - Upstream
Mussel Abbreviated Sample Site

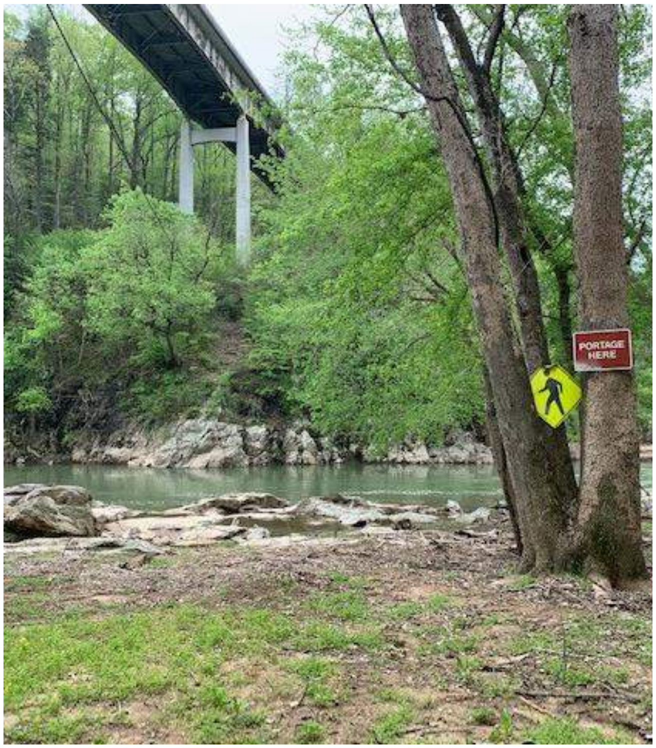
UNIO-Tailrace - Upstream
Mussel Abbreviated Sample Site

Eastern Elliptio
(*Elliptio Complanata*)

Notched Rainbow
(*Villosa constricta*)

Appendix E

Appendix E – Preliminary Recreation Study Report



Preliminary Recreation Study Report

Niagara Hydroelectric Project (FERC No. 2466)

January 11, 2021

Prepared by:

Prepared for:

Appalachian Power Company

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Acronyms and Abbreviations

ADA	Americans with Disabilities Act
AEP	American Electric Power
Appalachian or Licensee	Appalachian Power Company
CFR	Code of Federal Regulations
Cfs	cubic feet per second
FERC or Commission	Federal Energy Regulatory Commission
FORVA	Friends of the Rivers of Virginia
Ft	feet/foot
HDR	HDR Engineering, Inc.
ILP	Integrated Licensing Process
ISR	Initial Study Report
KOP	Key Observation Point
NGVD	National Geodetic Vertical Datum of 1929
NPS	National Park Service
PM&E	protection, mitigation, and enhancement
Project	Niagara Hydroelectric Project
Q	quarter
RRBC	Roanoke River Blueway Committee
RSP	Revised Study Plan
RVGC	Roanoke Valley Greenway Commission
SPD	Study Plan Determination
USGS	U.S. Geological Survey
YES	Young Energy Services

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1 Project Introduction and Background

Appalachian Power Company (Appalachian or Licensee), a unit of American Electric Power (AEP), is the Licensee, owner, and operator of the run-of-river, 2.4-megawatt Niagara Hydroelectric Project (Project) (Project No. 2466), located on the Roanoke River in Roanoke County, Virginia.

The Project is currently licensed by the Federal Energy Regulatory Commission (FERC or Commission). The Project underwent relicensing in the early 1990s, and the current operating license for the Project expires on February 29, 2024. Accordingly, Appalachian is pursuing a subsequent license for the Project pursuant to the Commission’s Integrated Licensing Process (ILP), as described at 18 Code of Federal Regulations (CFR) Part 5.

In accordance with 18 CFR §5.11, Appalachian developed a Revised Study Plan (RSP) for the Project that was filed with the Commission and made available to stakeholders on November 6, 2019. On December 6, 2019 FERC issued the Study Plan Determination (SPD).

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the Initial Study Report (ISR) to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021.

Appalachian has conducted studies in accordance with 18 CFR §5.15, as provided in the RSP and as subsequently modified by FERC. This report describes the methods and results of the Recreation Study conducted in support of preparing an application for new license for the Project.

2 Study Goals and Objectives

The goal of the Preliminary Recreation Study is to determine the need for enhancement to existing recreation facilities and for additional recreational facilities to support the current and future demand for public recreation in the study area. The objectives of this study are to:

- Gather information on the condition of the one FERC-approved public recreation facility at the Project and identify any need for improvement;
- Gather information on the condition and facilities provided at non-Project recreation sites;
- Characterize current recreational use of the study area;
- Estimate future demand for public recreation at the Project;
- Evaluate opportunities, processes, and constraints related to short-term or temporary modifications to Project operation to facilitate downstream boating flows;
- Solicit comments from stakeholders on potential enhancements to existing facilities or adding new facilities; and
- Analyze the effects of Project operation on Project-related recreation facilities.

3 Study Area

The general study area for the Preliminary Recreation Study includes Project and non-Project facilities and is shown on Figure 3-1. This is an appropriate study area as it includes the recreation facility managed by Appalachian under the license and other recreational opportunities within or near the Project boundary of interest to the stakeholders.

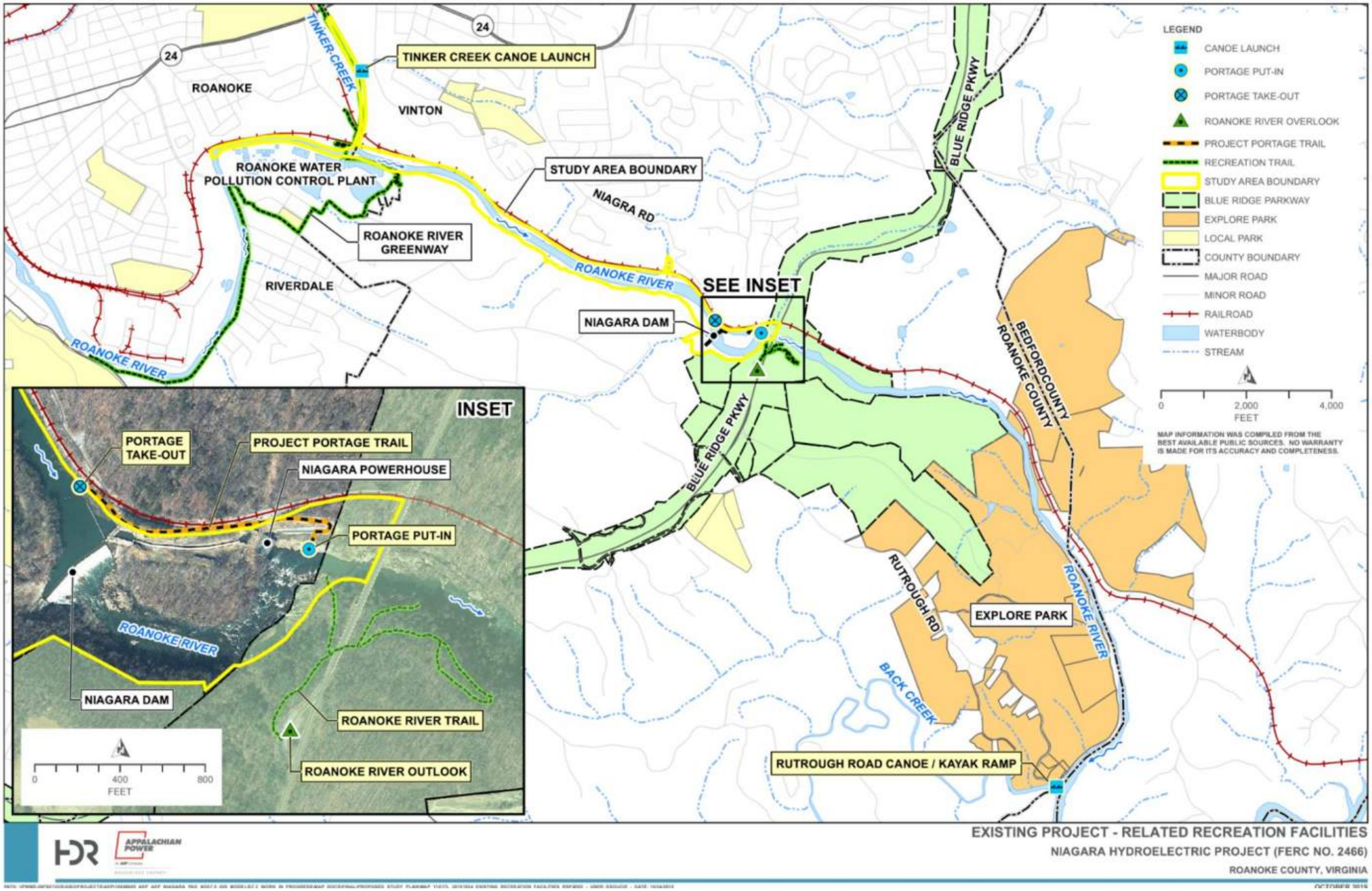

Figure 3-1. Recreational Facilities Within and Adjacent to the Project Boundary

4 Background and Existing Information

The Roanoke River is a significant recreation amenity and natural resource, providing opportunities to canoe, kayak, tube, wade, view wildlife, fish, hike, bike and explore nearby trails, just outside of the city of Roanoke. The Roanoke River Blueway Committee (RRBC) was established in 2013 by the Roanoke Valley-Alleghany Regional Commission to facilitate the planning, development, and marketing of the Roanoke River Blueway. (A blueway is water path made up of launch points to encourage recreation, ecological education, and preservation of wildlife resources.) The Roanoke River Blueway offers a unique combination of urban, front country, and back country recreation opportunities in the upper Roanoke River watershed. Maps, trip planning, water level, and rental information are available online on the Roanoke River Blueway website (Roanoke River Blueway undated). Additionally, the Roanoke Valley Greenway Commission (RVGC) was established in 1997 to establish a greenway plan for the Roanoke Valley, advise and assist participating governmental agencies, and facilitate cooperation among stakeholders, among other administrative and planning functions.

The Blue Ridge Parkway, which is a National Parkway, crosses directly below the Project’s boundary, below the tailrace. The Blue Ridge Parkway is a 469-mile-long roadway connecting the Great Smoky Mountains National Park in North Carolina to the Shenandoah National Park in Virginia. The National Park Service (NPS) maintains two Blue Ridge Parkway and Roanoke River overlooks on the south side of the river, one on each side of the Parkway about 1,000 ft (ft) downstream of the Project powerhouse. The NPS maintains a footpath, the Roanoke River Trail, from a roadside pull-off on the Project-facing side of the Blue Ridge Parkway. The Roanoke River Trail is a 0.5-mile gravel hiking loop along rocky cliffs above the river gorge. The trail provides views of the Roanoke River from a pedestrian overlook and continues down into the gorge, providing river and fishing access (National Park Planner 2017).

The Project is set within the geographic context of the Blueway and Greenway and the Blue Ridge Parkway; however, recreational opportunities at the Project are limited due to limited land ownership by Appalachian, steep terrain, and the CSX Railroad tracks traversing the northern riverbank. The major recreational activities at the Project are boating, fishing, and sightseeing. Section 5.8 of the Pre-Application Document provides additional existing information about federal, state, and local recreation facilities and opportunities in or near the study area.

The only FERC-approved (i.e., “Project”) public recreation facility is the Project Canoe Portage Trail, which includes a take-out and put-in point into the Roanoke River. The Canoe Portage Trail was constructed at the Project in 1996 by the Virginia Department of Wildlife Resources (previously known as the Virginia Department of Game and Inland Fisheries) as part of the Partners in River Access program, a cooperative effort among Virginia Department of Wildlife Resources, Virginia Department of Conservation and Recreation, and Appalachian to develop various recreation sites on the Roanoke, New, and James rivers in the vicinity of hydroelectric projects. The trail provides safe passage around the dam to a put-in point below the powerhouse for those wishing to paddle the short reach downstream to the Rutrough Road access or Smith Mountain Lake. The 1,600-foot-long canoe portage trail also includes a take-out point (upstream of the boat barrier) consisting of steps installed by Appalachian in 2014, a crushed stone surface, and a gravel maintenance road connecting to a put-in point near the Blue Ridge Parkway Bridge. A portage sign is located at the take-out and at the beginning of the pathway leading to the downstream put-in point. The canoe portage is maintained by Appalachian and is only accessibly by water.

Additional (i.e., “Non-Project”) public recreation facilities nearby that provide recreational opportunities on the Roanoke River and are at least in part covered by this study include:

1) A canoe launch located on Tinker Creek (Tinker Creek Canoe Launch), upstream of Niagara dam, which is maintained by the Town of Vinton. The launch provides a concrete boat ramp, canoe rack, informational kiosk, paved parking lot with handicapped spaces, and a picnic area.

2) The Roanoke River Trail, which begins at the NPS Roanoke River Outlook and traverses into the Niagara bypass reach. It provides a short-inclined walk, bird watching, view of the dam and bypass, and access to fishing in the bypass reach.

3) A canoe/kayak launch/take-out located at the terminus of Rutrough Road (i.e. Rutrough Road Canoe/Kayak Ramp), approximately three miles downstream of the Project powerhouse.

Opportunities for recreational paddling exist both upstream and downstream of the Project, and relicensing stakeholders (e.g., Friends of the Rivers of Virginia [FORVA]) have expressed interest in exploring the potential for Project operations to support a provision of enhanced and/or steady flow conditions for boating downstream of the Project and potentially in the bypass reach. As noted in comments filed by FORVA on the Proposed Study Plan, Appalachian has in the past cooperated with Roanoke Valley jurisdictions to provide short-term increased releases from the Project powerhouse (within the limits of authorized operating restrictions). Section 6.6of this study report discusses the potential for future recreation flow releases below the Project powerhouse.

5 Methodology

In support of the first year of the FERC-approved Recreation Study, Appalachian and their consultants utilized a range of data collection techniques, including a Recreation Facility Inventory and Condition Assessment, a Recreation Visitor Use Online Survey, and an Aesthetic Flow Survey. Data gathered from these methods collectively illustrate general recreational trends of the Project. The prevailing conditions of the COVID-19 pandemic throughout most of the study period and the primary recreation season (ranging from periods of lockdown and relatively little non-essential travel to more typical summer recreation periods) delayed some of the recreation tasks (as outlined in the RSP) into 2021. Variances from the RSP and 2021 activities are discussed in Section 8. The status of each study task is summarized in Table 5-1.

Table 5-1. Recreation Study Task Status as of Q4 2020

Task	Status
Recreation Facility Inventory and Condition Assessment	Completed in January 2020.
Existing and Future Recreational Opportunities	Postponed until Q1 2021.
Recreation Visitor Use Online Survey	Preliminary data provided. Survey has been extended through October 2021.
Recreational Use Documentation	Postponed until May 2021.
Aesthetic Flow Documentation	Completed (potential for one more visit to capture bypass reach minimum flow conditions in 2021).
Recreational Flow Release Desktop Evaluation	Completed in November 2020.

Note: Q = quarter

5.1 Recreation Facility Inventory and Condition Assessment

Appalachian’s sub-consultant (Young Energy Services [YES]), provided an analysis of the Recreation Facility Inventory and Condition Assessment of the four facilities identified in Section 4. YES staff conducted the field inventory for Tinker Creek Canoe Launch (Non-Project facility) on October 18, 2019. The Project Canoe and Portage Trail (Project facility) was assessed on October 24, 2019. The Roanoke River Trail (Non-Project facility) and Rutrough Road Canoe and Kayak Ramp (Non-Project facility) assessment took place on October 28, 2019. YES staff recorded the following information for each recreational facility as follows:

- A description of the type and location of existing facility;
- The type of recreation provided (e.g., boat access, angler access, picnicking, etc.);
- Length and footing materials of any assessed trails;
- Existing facilities, signage, and sanitation;
- The type of vehicular access and parking (if any);

- Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e., compliance with current Americans with Disabilities Act (ADA) standards for accessible design); and
- Photographic documentation of recreation facilities and GPS location data.

Additionally, a qualitative assessment of the condition of the recreation facilities was performed using a Recreation Facility Inventory and Condition Assessment Form. Using the Facility Inventory and Condition Assessment Form, YES rated the recreation amenities available at each recreation facility using the following criteria: (N) Needs replacement (broken or missing components, or non-functional); (R) Needs repair (structural damage or otherwise in obvious disrepair); (M) Needs maintenance (ongoing maintenance issue, primarily cleaning); and (G) Good condition (functional and well-maintained). If a facility is given a rating of “N”, “R”, or “M”, an explanation for the rating was provided.

5.2 Existing and Future Recreational Opportunities

Appalachian proposed in the RSP to convene a meeting with interested relicensing participants (e.g., RRBC, RVGC, FORVA, and relevant state and federal agencies) for a focused discussion of existing and future recreational opportunities at or associated with the Project. However, due to COVID-19 travel and meeting restrictions, in combination with the delay of other study activities as noted in Table 5-1, the meeting and discussion was postponed and is tentatively rescheduled for Q1 2021 and/or in combination with the Initial Study Report meeting.

As part of this discussion, Appalachian will seek input from primary relicensing participants to discuss potential conceptual level recreation enhancements and improvements to the canoe portage trail and other areas of the Project where enhancements may be feasible. Appalachian will notify interested relicensing participants at least three weeks in advance.

Based on the results of the other tasks of this Preliminary Recreation Study and discussions at the ISR meeting, Appalachian will evaluate the need for additional meetings or other stakeholder coordination and outreach to evaluate potential recreational enhancements.

5.3 Recreation Visitor Use Online Survey

Appalachians consultant (HDR Engineering, Inc. [HDR]) developed an online survey from general concepts and guidance from the National Visitor Use Monitoring Handbook (USFS 2007) as well as from other FERC-approved relicensing studies for recreation visitor use surveys. On April 21, 2020, the online survey was administered through the Project’s relicensing website and offered respondents the opportunity to provide survey responses electronically. The online survey results included in this Study Report include responses through October 31, 2020. The online survey will continue through October 2021 in parallel with the Recreation Use Documentation task.

Appalachian posted signs including a brief description of the purpose and intent of the survey and website address on Appalachian-owned and/or operated facilities (Canoe Portage Trail and Tinker Creek Canoe Launch). Roanoke County posted signs at the Rutrough Road Canoe/Kayak Ramp and at two kiosks within the Explore Project, a nearby park maintained by Roanoke County. Additionally, notice of the survey continues to be posted on the Project’s relicensing website. Appalachian also provided an update and website address to local outfitters and regional organizations (e.g., RRBC, RVGC, FORVA), so they would have the opportunity to distribute notice of the survey to their members or clients. Appalachian notified relicensing participants that the online survey was available through the second quarterly ILP study progress report. This allowed respondents to complete a survey on-site, or later upon returning home from their visit, or without visiting the Project if the link was identified through other (electronic) communications.

The online questionnaire was designed to collect information about:

- General user information;
- Resident/visitor;
- Purpose and duration of visit;
- Distance traveled;
- Day use/overnight lodging;
- History of visiting the site or area;
- Types of recreational activities respondents participated in during their visit, including primary and secondary recreation activities;
- General satisfaction with recreational opportunities, facility, and the respondents overall visit and/or areas that need improvement;
- Effects of Project operations on recreation use and access; and
- Accessibility of facilities.

5.4 Recreational Use Documentation

Appalachian or their consultant will collect visitor use data at the Non-Project recreation facilities through a combination of in-person surveys, interviews, field reconnaissance, and photo documentation during the second field season. The 2021 schedule will still tentatively adhere to the Recreation Study schedule in the RSP.

- May – One weekend day (Memorial Day Weekend) and one randomly selected weekday.
- June – One randomly selected weekend day and one randomly selected weekday.
- July – One weekend day (July 4th Weekend) and one randomly selected weekday.
- August – One randomly selected weekend day and one randomly selected weekday.
- September – One weekend day (Labor Day Weekend) and one randomly selected weekday.
- October – One randomly selected weekend day and one randomly selected weekday.

5.5 Aesthetic Flow Documentation

The Project is located adjacent to the Blue Ridge Parkway and is visible from the Roanoke River Overlook and from the trail that extends down to the base of the dam area, making the Project an important aesthetic resource.

To characterize and capture the appearance of the dam and bypass reach under a range of flows,[1] YES collected photo and video documentation from three key observation points (KOP), including 1) the NPS Roanoke River Outlook adjacent to the Blue Ridge parking lot, 2) a bench midway down the stairs to the bypass, and 3) the bank fishing area located at the end of the trail steps at the Roanoke River (see Figure 5-1). The selection of the KOPs was based on professional judgment of YES staff who are familiar with the Project and nearby recreation resources, as well as areas that could be practically and safely accessed for this data collection.

YES took photos and videos at these three KOPs on ten different occasions to gather comparable data for all four seasons under a range of flow conditions (including periods of spill over the spillway crest). YES staff was on-site in support of the aesthetic study on the following days:

- November 15, 2019
- January 1, 2020
- January 30, 2020
- February 7, 2020
- March 2, 2020
- March 25, 2020
- May 1, 2020
- July 11, 2020
- September 5, 2020
- September 26, 2020

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[1] Article 403 of the current license requires a minimum flow of 8.0 cubic ft per second (cfs) into the bypass reach, which is provided via the trash sluice gate. The trash sluice gate hoist operator system was not operational in 2020; as a result, bypass reach flows during 2020 were higher than the license requirement. The gate has been repaired and a new gate and operating system installed, which is expected to be operational by early 2021.

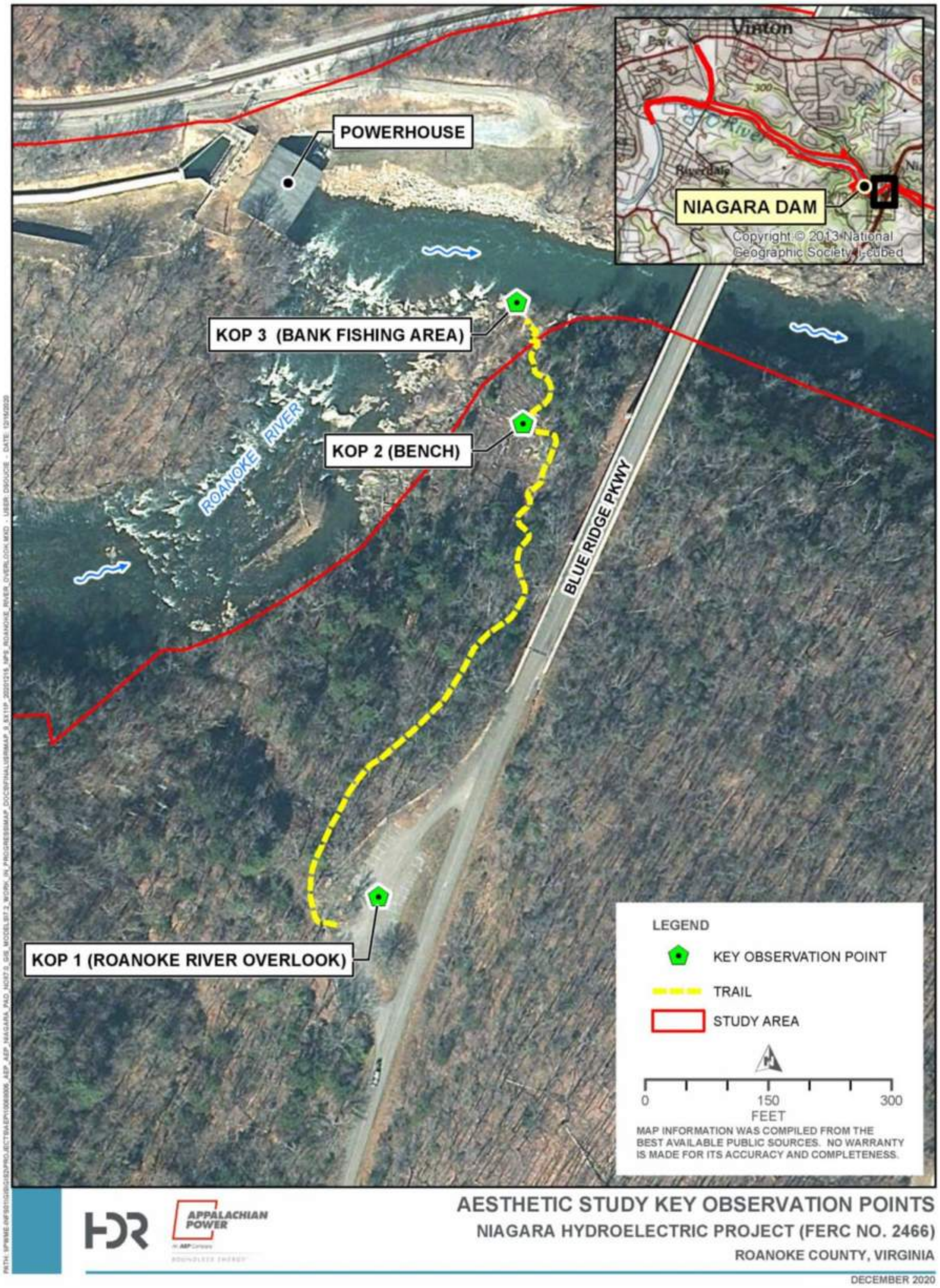

Figure 5-1. Key Observations Points Niagara Hydroelectric Project Aesthetic Study

5.6 Recreational Flow Release Desktop Evaluation

The objective of the Recreational Flow Release Desktop Evaluation is to evaluate the potential for controlled flow releases from the Project to support short-term enhancement of downstream flow conditions for recreational boating (i.e., primarily canoeing, kayaking, and other paddling activities).

Under normal operating conditions, the Project uses available flows for powerhouse generation, maintaining the Niagara reservoir elevation between 884.4 ft[2] and 883.4 ft. The volume of water contained in this 1-ft authorized operating band is approximately 56.5 acre-ft, which equates to approximately one hour of run-time with the powerhouse at maximum discharge capacity (684 ft cfs), assuming no Project inflow. The crest of the spillway is at elevation 885 ft, allowing 0.6 ft of freeboard between the upper end of the normal operating band and the spillway crest. The additional volume of water that could be stored in the freeboard is approximately 34.3 acre-ft, which would provide an additional 36 minutes of run-time at maximum powerhouse capacity, assuming no Project inflow.

To address stakeholders’ interests while recognizing Project constraints related to enhancement of downstream flow conditions, HDR conducted a desktop evaluation to assess the potential for Project operations to support short-term enhancement of flow conditions for downstream boating. Results of the desktop study are included in Section 6.6.

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[2] All elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

6 Study Results

6.1 Recreation Facility Inventory and Condition Assessment

As described in Section 5.1, YES performed a Recreation Facility Inventory and Condition Assessment to document one Project and three Non-Project public recreation facilities**.** YES observed several common themes among the recreation facilities and concluded that, overall, the facilities are in good condition. Each facility is well maintained with no trash or vandalism observed during the assessment. In general, signage is adequate and in good shape at the facilities, except for the Project-related Canoe Portage Trail, where some improvements could be made. ADA designated parking spots are provided only at the Tinker Creek Canoe Launch. Toilet facilities are not provided at any of the facilities.

The existing amenities and condition for each recreation facility is summarized below. The Recreation Facility Inventory and Condition Assessment Report is included in Attachment 1.

6.1.1 Niagara Project Canoe Portage (Project Facility)

Existing recreation amenities of the Niagara Canoe Portage include timber steps at the take-out, boat barrier upstream of spillway, portage trail that shares the Project access road (not publicly accessible otherwise), rock outcrop at the put-in, and signage at take-out, put-in, and along the trail. Condition of the amenities at the facility are summarized below:

- Good condition portage path, 10 ft. to 12 ft. wide. Slope up to 10 percent. Primarily gravel surface.
- Take-out poorly signed and difficult to use. Debris and silt on steps.
- Put-in along rocks somewhat difficult to use.
- Number of signs adequate. Some signs are worn and faded and should be replaced.
- No sanitary facilities or trash receptacles.

6.1.2 Tinker Creek Canoe Launch (Non-Project Facility)

Existing amenities of the Tinker Creek Canoe Launch include parking for 23 vehicles (5 are for boaters; 1 is ADA), concrete ramp to Tinker Creek that is 10 ft wide with 10 percent maximum grade, timber storage rack that can accommodate six canoes or kayaks, and signage and postings. Condition of the amenities at the facility are summarized below:

- Parking area paved and in good condition.
- Ramp in good condition. Put-in at end of ramp at Tinker Creek is rocky and shallow.
- Storage rack in good condition with good access.
- Signage is adequate and kept in good condition.
- No sanitary facilities or trash receptacles.

6.1.3 Roanoke River Trail (Non-Project Facility)

Existing amenities of the Roanoke River Trail include asphalt-paved parking spaces for 35 vehicles. The upper 200 ft of the trail is paved with asphalt (3 ft wide), the mid-section is gravel (4 ft wide), and the lower section has 200 timber steps with gravel fill (4 ft wide, 0.5 ft high, 20 inches deep). Additional amenities include a rock outcropping providing bank fishing at the end of the steps, trash receptable at the parking area, and informational sign and benches provided at observation sites along the steps. Additionally, the U.S. Geological Survey (USGS) gage (USGS 02056000 Roanoke River at Niagara, Virginia) is located just downstream from the stair access to the river, Condition of the amenities at the facility are summarized below:

- Parking area in good condition. No ADA space identified.
- Trail in good condition. Maintenance needed along paved upper portion of trail and at steps.
- Signs and benches in good condition.

6.1.4 Rutrough Road Canoe and Kayak Ramp (Non-Project Facility)

Existing amenities of the Rutrough Road Canoe and Kayak Ramp include 12 timber steps (8 ft wide, 1.0 ft high, 1.25 ft deep) at the put-in and take-out. There is a gravel surface parking lot for 12 vehicles and a gravel surface trail (75 ft long and 2.5 ft wide) from the parking area to the put-in and take-out. Additional amenities include bank fishing, access from parking area to Explore Park (Figure 3-1) trails, picnic table, trash receptacles and numerous informational and directional signage. Condition of the amenities at the facility are summarized below:

- Put-in/take-out in good condition. Some accumulated debris and sediment on steps.
- Parking area in good condition. No designated ADA parking space.
- Trail from parking area to put-in/take-out in decent condition. Needs to be resurfaced.
- Bank fishing area well used.
- Access from parking area to Explore Park trails in good condition with adequate directional signs.
- Picnic table in poor condition.
- Very good signage providing direction and information. No signage directing vehicles along Rutrough Road to parking area.

6.2 Existing and Future Recreational Opportunities

Changes to the relicensing schedule due to COVID-19 restrictions have postponed the stakeholder meeting which will tentatively take place in Q1 of 2021. Interested relicensing participants will be notified at least three weeks in advance.

6.3 Recreation Visitor Use Online Survey

The Recreation Visitor Use Online Survey provided a method for existing and potential recreation visitors to the Study Area to respond and provide feedback on recreation opportunities at the Project, as well as at Non-Project facilities. From April 21, 2020 to October 31, 2020, Appalachian received 120 responses to the online survey. The online survey is still active and will continue until October 2021 in parallel with the Recreation Use Documentation task. A high-level summary of all the recreation facility responses (from April 21 – October 31, 2020) is provided below:

- Eight-six percent of the responses primarily pertained to three recreation facilities: Niagara Portage Trail (owned by Appalachian), Roanoke River Trail/Overlook (owned by NPS), and Rutrough Road Canoe/Kayak Ramp (owned by Roanoke County), indicating these sites were the most frequently utilized by online survey respondents.
- Forty-five percent of the survey respondents came from four zip code locations, averaging 9 miles from the Project. Eighty-eight percent considered themselves to be regular visitors to the area (i.e., at least 3 or more times a year) and stayed at the Project an average length of 3.5 hours per visit. Ninety-seven percent of respondents did not stay overnight at the Project.
- Seventy-six percent of respondents were male; 45 percent were in their 30’s and 40’s.
- The most frequent months visited were April to September; April and June were the peak months (Figure 6-1).
- As shown in Table 6-1, canoe/kayaking and fishing were the most popular activities at the Project documented in the online survey.
- Visitors rated each recreational visit at the Project for its accessibility, parking, crowding, safety, condition, availability, and overall experience. The sliding scale rating system indicated that visitors generally found the individual metrics and overall experience “acceptable.” The only metric that was not rated highest in the acceptable category was the Available Facilities metric, which was rated neutral.

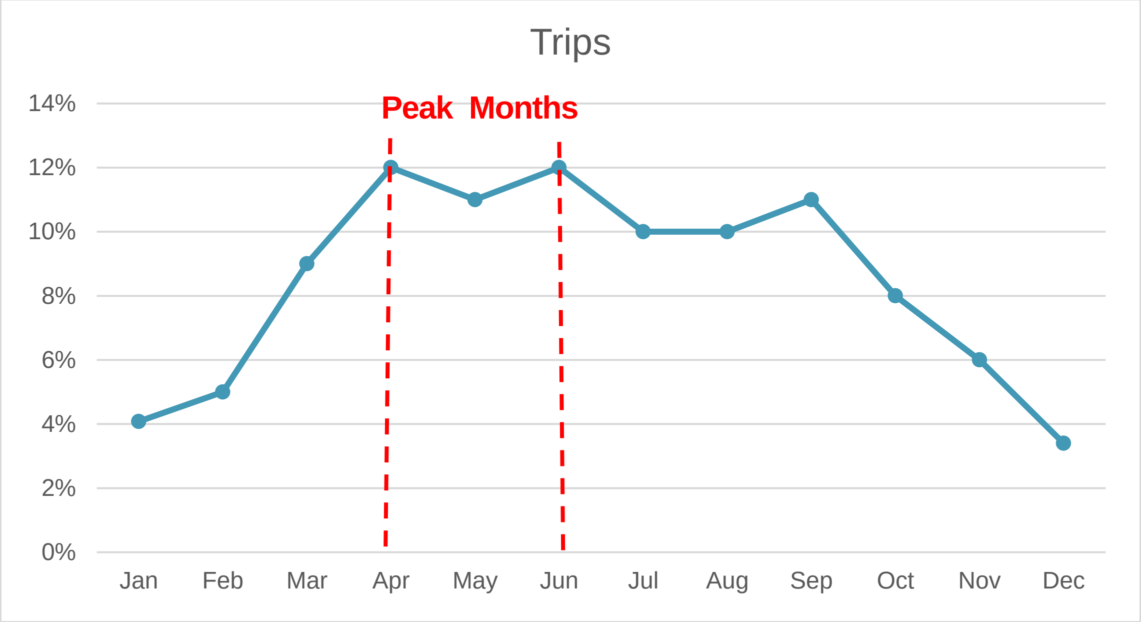

Figure 6-1. Monthly Recreation Activity for Project and Non-Project Facilities

Table 6-1. Online Survey Summary for Primary Recreation Activities at all Project and Non-Project Facilities

Primary Activity	Percent (%)
Canoeing/kayaking	67
Fishing	17
Hiking	6
Sight-seeing	3
Picnicking	1
Pleasure boating	1
Running	1
Swimming	1
Tubing	1
Wildlife viewing	1

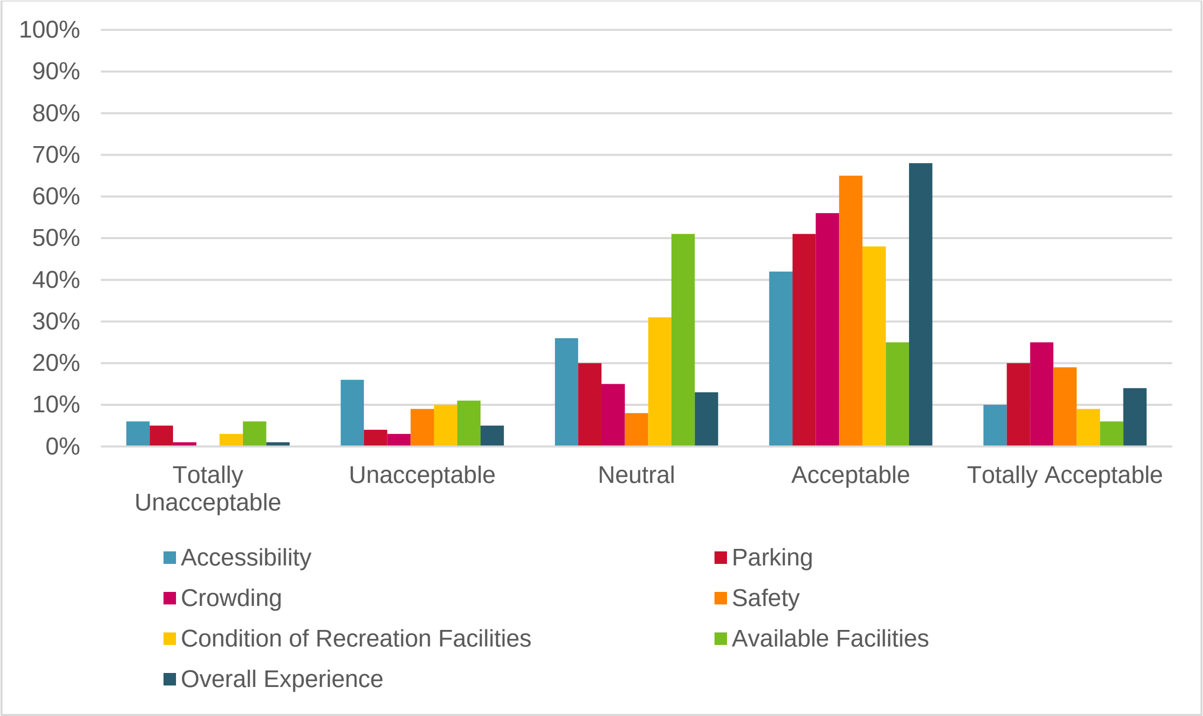

Figure 6-2. Online Survey Summary for Overall Rating on All Visits at Project and Non-Project Facilities

The online survey resulted in 25 percent of respondents expressing enthusiasm for having the Niagara Project and Non-Project facilities studied. Several comments included requests or recommendations for flow releases, which was analyzed as part of this study and the results are described in Section 6.6. There were also comments including requests for trash removal and the construction of a waterpark and play waves. The top two suggestions for improvement included better and more public access and improvements to portages.

Facility-specific summaries and verbatim user comments from the online survey are included in Attachment 2.

6.4 Recreational Use Documentation

Changes to the relicensing schedule due to COVID-19 restrictions have postponed the recreational use documentation task for the Recreation Study to 2021; however, during the holiday weekends in 2020, YES made field observations of usage for each of the recreation facilities. The intent was to establish a general level of activity during what would typically be considered higher usage periods. Results of these efforts indicated that activities observed at the facilities during the 2020 holidays were limited.

Memorial Day Holiday. Just prior to the Memorial Day holiday, rainfall in the Roanoke Valley was at historic levels causing closure of the Tinker Creek Canoe Launch and the Blue Ridge Parkway segments providing access to the Roanoke River Trail. Subsequently, no activity was observed at either facility. The higher than normal river flows at the Rutrough Road Canoe and Kayak Ramp limited canoeing and kayaking downstream of the Niagara Project. Between 11:15 am and 11:35 am on May 25th, five vehicles (42% of parking capacity) were observed. Recreation activity was related primarily to bank fishing and hiking. The weather at the time of the observations was cloudy with temperatures in the mid-60s.

Independence Day Holiday. On July 3rd, the Roanoke River Trail remained closed, as the Blue Ridge Parkway access continued to be closed due to road hazards caused by heavy rainfall. At the Tinker Creek Canoe Launch, three vehicles (12% of parking capacity) were noted. Between 9:45 am and 10:00 am, six vehicles (50% of parking capacity) were counted at the Rutrough Road Canoe and Kayak Ramp. Recreation activities observed included launching of kayaks and bank fishing. Weather on July 3rd was sunny with temperatures at or near 80 degrees.

Labor Day Holiday. All the recreation facilities were open on Labor Day 2020. Between 11:45 am and 12:15 pm, four vehicles (11% of parking capacity) were observed at the Roanoke River Trail. Bank fishing, hiking, and viewing of the Project spillway from the parking area were the primary activities observed. At the Tinker Creek Canoe Launch, no vehicles or activities were observed between 12:30 pm and 12:45 pm. Between 11:15 am and 11:30 am, the Rutrough Road Canoe and Kayak Ramp had four vehicles (33% of parking capacity). Recreation activities observed were kayak launching and bank fishing. The weather was sunny with temperatures in the mid-70s.

In general, for the 2020 holidays (i.e. Memorial Day, Fourth of July, and Labor Day), facility use was low, which could have been the result of weather conditions (particularly in May), closures of the Blue Ridge Parkway, and concerns related to COVID-19. License plates observed were all in-state. The recreational use data collected in 2020 will provide a reference point for assessing Recreation Use Documentation during holiday weekends in 2021.

6.5 Aesthetic Flow Documentation

As described in Section 5.5, the Project was evaluated as an aesthetic resource by recording photographs and videos of flows to the bypass reach, including (but not limited to) flows over the Project spillway. YES recorded photographs and videos from three KOP’s and documented flow and operational data for the select days[3] (Figure 5-1).

In leaf-off months (approximately October to April), aesthetically pleasing views of the spillway, dam, and bypass reach are available from the Roanoke River Trail. In leaf-on months (approximately May to September) when recreation typically increases, the spillway is not easily viewed from KOP 2 due to vegetation. The bypass can be seen year-round from KOP 1 and 3. In order to allow for views of the Project spillway and bypass, the NPS trimmed vegetation to allow unobstructed views from the parking area (KOP 1). Vegetation is also trimmed in the early spring months at KOP 2, but as vegetation grows into the summer, views become obstructed in the late spring, summer, and fall months. Overall, the optimal time for viewing the Project spillway and bypass reach appears to be late October and early November when leaves are changing colors and falling (see Figure 6-3). The fall colors, along with the open views created by the leaf-fall, create optimal aesthetic conditions.

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[3] Flow information is estimated utilizing operations information provided by Appalachian along with data obtained from the USGS 02056000 streamflow gage located on the Roanoke River immediately downstream from the Project powerhouse.

Figure 6-3. KOP 1 Viewpoint on November 15, 2019, estimated 24 cfs

In high flow conditions, the spillway may be aesthetically appealing, but the high flows can cause turbidity in the bypass and cover the unique geological features, making the bypass less aesthetically pleasing. Generally, aesthetically pleasing views occur under low to mid flows ranging from the estimated 50 cfs passed through the trash sluice gate at the spillway during periods of no generation at the powerhouse to approximately 200 cfs over the Project spillway. The aesthetic view of 8 cfs (licensed minimum flow requirement when the powerhouse is generating) through the sluice gate was not recorded in 2020, but is not expected to provide a better or worse aesthetic view of the Project than the estimated 24 cfs shown above. YES plans to collect an additional aesthetic flow observation of the bypass reach from the three KOPs during a period of approximately 8 cfs bypass reach flow conditions in 2021 to confirm this assumption and address specific objectives of the Recreation Study.

The photograph provided above (Figure 6-3) was taken when flow was solely through the existing sluice gate (no spillway flow). The photograph provided below (Figure 6-4) represents flows over the spillway (over 200 cfs) in conjunction with approximate 50 cfs through the sluice gate.

Figure 6-4. KOP 1 Viewpoint on January 1, 2020, estimated 332 cfs

When evaluating aesthetics, sound should also be considered. From the observations made in the field by YES, flows of 50 to 200 cfs resulted in similar acoustics. Sound from flows through the bypass are more pronounced above 200 cfs, but do not necessarily contribute to a more pleasant experience to those observing flows from the Roanoke River Trail.

From the observations made, existing Project operations provide an appropriate aesthetic experience.

Attachment 3 provides a photolog of views from the KOPs over the course of the study period. Documented aesthetic videos will be shown during the ISR meeting.

6.6 Recreational Flow Release Desktop Evaluation Results

In an effort to provide short-term flow releases for recreational purposes, powerhouse generation could be reduced to either Unit 1 (maximum capacity of 379 cfs) or Unit 2 (maximum capacity of 305 cfs). For example, operating Unit 2 (only) at maximum capacity would result in a run-time of 2 hours and 12 minutes using the volume of water contained in the 1-ft operating band and an additional 1 hour and 21 minutes including the freeboard volume (for a total of 3 hours and 33 minutes).

Project flow releases, either via the bypass reach and/or powerhouse generation affect river depths and flow travel time downstream of the Project. River stage is recorded at the USGS 02056000 Roanoke River at Niagara, Virginia flow gaging station, which is immediately downstream of the

Project tailwater and bypass reach confluence. Table 6-2 provides three powerhouse generation scenarios, associated run-times (assuming no Project inflow), and corresponding river stage recorded at the USGS 02056000 flow gaging station.[4]

Table 6-2. Niagara Desktop Recreation Flow Study – Potential Generating Scenarios

Parameter	Minimum Downstream Flow Requirement (Project) 50 cfs	Powerhouse Generation		
		Unit 1 379 cfs (hr:min)	Unit 2 305 cfs (hr:min)	Unit 1 & 2 684 cfs (hr:min)
Current Operating Band Volume (56.5 acre-ft) (i.e., under impoundment elevation and fluctuation limits of the existing license)	--	1:46	2:12	1:00
Additional Freeboard Volume (34.3 acre-ft)	--	1:05	1:21	0:36
Total Available Volume (90.8 acre-ft)	--	2:51	3:33	1:36
Roanoke River at Niagara USGS stage	0.99 ft	2.75 ft	2.49 ft	3.61 ft

Due to the relatively narrow (i.e., 1-ft) authorized reservoir operating band, the Project normally operates in a run-of-river mode whereby Project inflows are released downstream either via the powerhouse or bypass reach. The monthly average and minimum discharge recorded at the USGS 02056000 flow gaging station from 1926 through 2020 (i.e., a 95-year period of record) is provided in Table 6-3. On a monthly average basis, there appears to be enough Project inflow to support operation of at least one unit year-round. However, during drier/drought years, there are periods when Project inflows are too low to operate a unit. During these periods, Project flow releases would be made via the trash sluice gate into the bypass reach to maintain reservoir levels.

HDR concluded that the potential for the short-term enhancement of downstream flow conditions to support recreation activities would be most advantageous during the typically lower flow late-summer/early-fall months (i.e., July through October).

Table 6-3. Monthly Average and Minimum Discharge Recorded at USGS 02056000 (Period of Record: 1926 to 2020)

Month	Average Discharge (cfs)	Minimum Discharge (cfs)
January	623	110
February	774	117
March	876	210
April	830	158
May	619	193
June	457	135
July	315	109

---

[4] River stage increases resulting from a short-term pulse of powerhouse generation flow will attenuate (i.e., flatten) as the flow pulse travels downstream. As a result, the stage increase recorded at the USGS 02056000 flow gaging station will diminish as the flow travels downstream.

Month	Average Discharge (cfs)	Minimum Discharge (cfs)
August	327	92
September	339	84
October	359	86
November	382	101
December	503	115

Source: USGS 02056000 Roanoke River at Niagara Current/Historical Observations. Accessed 12/16/2020 [URL]: https://waterdata.usgs.gov/va/nwis/uv/?site_no=02056000

The distance between the Project's portage put-in and the downstream Explore Park/Rutrough Point canoe/kayak access area (shown on Figure 3-1) is approximately three river miles. Paddlers using this stretch of river may benefit the most from a potential short-term recreation flow release as a flow pulse between one hour and approximately 3.5 hours could be maintained depending on the number of units generating and the available reservoir storage volume. This run-time would likely allow paddlers enough time to navigate this stretch of river. Attempting to enhance flows below the Explore Park/Rutrough Point access area would not provide much benefit as the headwaters of Smith Mountain Lake extend up to this area and would significantly dampen the effect. Any short-term operational modification to provide flow enhancement downstream of the Project would be subject to sufficient inflow, availability of Project facilities, and availability of operating personnel. Appalachian also notes that operating the reservoir with more fluctuation than is typical (i.e., utilizing the full authorized operating band) to provide what would amount to a very minor "bump" in downstream flow may have unintended effects on reservoir littoral habitat.

7 Summary and Discussion

Findings of this Recreation Study based on this first year of data collection are summarized as follows:

- Current usage of the Project facility appears to be limited and will be studied further during the second field season in 2021.
- Recreation along the Roanoke River is of significant interest to agencies, local stakeholders (i.e. FORVA, RRBC, RVGC) and residents.
- Usage generally favors canoeing/kayaking and bank fishing, as noted in the online survey and observations from YES in 2020.
- Online survey respondents generally noted the Project and Non-Project facilities are acceptable from an overall experience, condition of facilities, safety, crowding, parking and accessibility. However, respondents' top two suggestions are better public access and portage improvements.
- The Roanoke River Trail (Non-Project Facility) provides aesthetically pleasing views of the dam, especially in the fall when the leaves are changing and falling.
- While opportunities to provide controlled recreation flow releases are limited by the Project's run-of-river operating mode and associated limited impoundment fluctuation, within the limits of the existing license minor, short-term recreation flow releases below the Project can be provided by utilizing available impoundment storage and powerhouse discharge capabilities. These releases would have the most significant impact (i.e., benefit for floating or paddling) on river stage and flows during the late summer or early fall. The flow releases would benefit a short reach of the river (up to the Rutrough Road Canoe and Kayak Ramp [Non-Project Facility]).

The second season of the Recreation Study will focus on identifying potential improvements to existing usages, especially for paddling and boating. Key improvements and recommendations will be discussed with stakeholders and will be evaluated further by Appalachian in 2021.

8 Variances from FERC-Approved Study Plan

The following are variances from the FERC-Approved Revised Study Plan:

- The Existing and Future Recreational Opportunities task is postponed. The meeting and discussion are tentatively rescheduled for Q1 2021 and/or in combination with the Initial Study Report meeting The Recreation Visitor Use Online Survey is extended through October 2021.
- The Recreational Use Documentation survey was postponed and is presently scheduled to begin May 2021 through October 2021.

9 Germane Consultation and Correspondence

On July 27, 2020, Appalachian filed an updated ILP study schedule and a request for extension of time to file the ISR to account for Project delays resulting from the COVID-19 pandemic. The request was approved by FERC on August 10, 2020, and the filing deadline for the ISR for the Project was extended from November 17, 2020 to January 11, 2021. These delays pushed the start of the 2020 field season into late July 2020. FERC letters of correspondence are included in Attachment 1 of the ISR.

10 References

National Park Planner. 2017. Blue Ridge Parkway. Accessed October 17, 2017. [URL]: http://npplan.com/parks-by-state/north-carolina-national-parks/blue-ridge-parkway-park-at-a-glance/blue-ridge-parkway-hiking-trails/blue-ridge-parkway-roanoke-river-overlook-114-9/.

Roanoke River Blueway. Undated. Roanoke River Blueway. Accessed 10/17/2019. [URL]: http://www.roanokeriverblueway.org/.

U.S. Forest Service (USFS). 2007. National Visitor Use Monitoring Handbook. National Visitor Use Monitoring Program, U.S. Forest Service, Washington, D.C

Attachment 1

Attachment 1 – Recreation Facility Inventory and Condition Assessment Report

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Appalachian Power Company

Niagara Hydroelectric Project (P-2466)

Recreation Facilities Inventory and Condition Assessments

Prepared for:

Appalachian Power Company

Prepared by:

YOUNG ENERGY SERVICES

2112 Talmage Drive Leland, NC 28451-9340

youngenergyservices.com

January 2020

Table of Contents

1.0 Scope of Work

Appalachian Power Company (Appalachian), a unit of American Electric Power (AEP), is the licensee, owner, and operator of the Niagara Hydroelectric Project (Project) located on the Roanoke River in Roanoke County, Virginia. Appalachian is conducting a Recreation Study as part of the relicensing of the Project. The goal of this study is to determine the need for enhancement to the existing recreation facility, or the need for additional recreation facilities, to support the current and future demand for public recreation in the study area. The Scope of Work for the Recreation Study is described in the Revised Study Plan (RSP) filed by Appalachian on November 6, 2019.

Under Task 1 of the Recreation Study, Appalachian is to perform a field inventory to document existing Project and non-Project recreation facilities located within or adjacent to the Project boundary including Tinker Creek Canoe Launch, Niagara Project Canoe Portage Trail, Roanoke River Trail, and Rutrough Road Canoe and Kayak Access. The information to be recorded includes:

- A description of the type and location of the existing facilities;
- The type of recreation provided (boat access, angler access, picnicking, etc.);
- Length and footing materials of any trails;
- Existing facilities, signage, and sanitation;
- Type of vehicle access and parking (if any);
- Suitability of facilities to provide recreational opportunities and access for persons with disabilities (i.e. compliance with current Americans with Disabilities Act (ADA) standards for accessible design); and
- Photographic documentation of the recreation facilities and GPS location.

In addition, a qualitative assessment of the condition of the recreation facilities is to be performed using the Facilities Inventory and Condition Form developed by Appalachian. A copy of the form is included in Section 3.0 of this Recreation Facility Inventory and Condition Assessments.

The existing formal Project recreation facilities described by the RSP to be inventoried and assessed include the following:

- Niagara Canoe Portage Trail.

The existing formal Non-Project recreation facilities described by RSP to be inventoried and assessed include the following:

- Tinker Creek Boat Launch located at The Town of Vinton, Virginia along Tinker Creek.
- Roanoke River Trail leading from the parking area along the National Park Service (NPS) Blue Ridge Parkway at Milepost 115 to the Roanoke River downstream of the powerhouse for the Niagara Project.

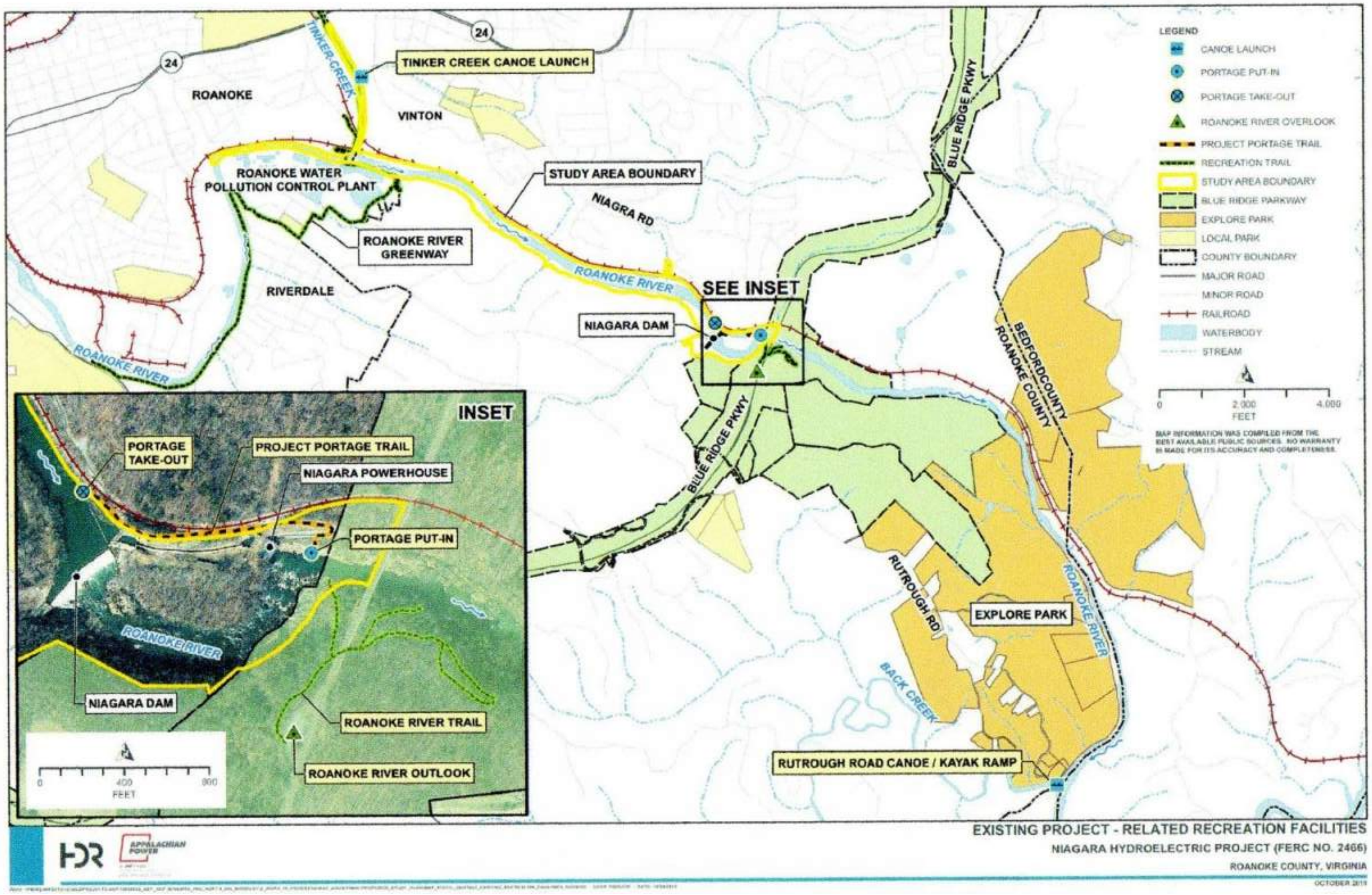
2.0 Inventories and Condition Assessments

The inventory and assessment information for the described locations is included as part of this report. This information for each facility includes the Inventory Assessment Forms, photographs, and notes from the field surveys. Coordinates noted for each site represent the connecting points to the Roanoke River and Tinker Creek as appropriate. The locations for which inventory and condition assessments were made are shown on the figure attached presenting recreational facilities within and adjacent to the Project Boundary.

The field inventory for the Tinker Creek Boat Launch occurred on October 18, 2019 while those for the Niagara Project Canoe Portage Trail and the Roanoke River Trail took place on October 24 and October 28 respectively.

In addition to the formal Project and Non-Project recreation facilities listed above, the canoe/kayak take-out and put-in located at the terminus of Rutrough Road at the Roanoke River was similarly inventoried and assessed. The Rutrough Road Canoe and Kayak Access is located approximately three miles downstream of the Project Powerhouse and provides a location for canoeists and kayakers to exit and enter the Roanoke River. The field inventory and condition assessment for that facility was performed on October 28, 2019.

Figure 10-1. Recreational Facilities Within and Adjacent to the Project Boundary



Note: Figure from Niagara Hydroelectric Project Revised Study Plan dated November 6, 2019.

3.0 RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT BLANK FORM

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT

Niagara Hydroelectric Project (FERC No.2466)

Location:

Date: **Surveyor:**

Photo Number(s):

Type of Amenity	#	ADA	Condition	Notes
Boat Launch Ramp/Lane			N / R / M / G	
Fishing Platform			N / R / M / G	
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Picnic Table			N / R / M / G	
Restroom			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____	**Condition**
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:___________*	N / R / M /

Signs	#	Size	Material	Condition	Comments
FERC Project			wood / metal / other	N / R / M / G	
Facility ID			wood / metal / other	N / R / M / G	
Regulations			wood / metal / other	N / R / M / G	
Directional			wood / metal / other	N / R / M / G	
Interpretive			wood / metal / other	N / R / M / G	

Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of “N”, “R”, or “M”, provide specific details.

ADDITIONAL COMMENTS/NOTES:
Note the age of the facilities (if known) as well as any signs of overuse.

4.0 RECREATION FACILITY INVENTORIES AND CONDITION ASSESSMENTS FORMS, NOTES, AND PHOTOGRAPHS

- **Niagara Project Canoe Portage Trail (Project Facility)**
- **Tinker Creek Boat Launch – Vinton, Virginia (Non-Project Facility)**
- **Roanoke River Trail (Non-Project Facility)**
- **Rutrough Road Canoe and Kayak Access (Non-Project Facility)**

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Niagara Hydroelectric Project (FERC No. 2466)

Location:	**Niagara Project Canoe Portage Trail (37.2677; -80.0263)**		
Date:	**10/24/2019**	**Surveyor:**	**F. Simms/K. Simms**
Photo Number(s):	**Photos Attached**		

Type of Amenity	#	ADA	Condition	Notes
Portage (put-in/take-out)	1 Ea.	**No**	N / [✓ R] / M / G	Three timber with earth fill steps at Take-Out. Each Step 48"W x 20"D x 6"H. Take-Out at Roanoke River downstream of powerhouse very rocky. Difficult to access river.
Portage Trail/Walking Trail (include length and footing materials)	1	**No**	N / R / M / [✓ G]	Portage trail utilizes existing plant access road for most of its length. Surface is gravel. Width is 10 to 12 ft. Length of portage approximately 1,550 ft. Slopes along portage range from flat to 10 to 12 percent.
Trash Receptacles			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING: (See Notes)	Total Spaces: _____ Standard: _____ ADA: _____ Double (trailer): _____ Other: _____	**Condition**
	Surface Type: *Asphalt* *Concrete* *Gravel* *Other:*___________	N / R / M /

Signs	#	Size	Material	Condition	Comments
FERC Project	1		wood / [✓ metal] / other	N / R / M / [✓ G]	Provides Project No. No information on recreation
Facility ID	2	30" x 20"	wood / [✓ metal] / other	N / R / M / [✓ G]	Take-Out and Put-In location signs with plastic facing.
Regulations			wood / metal / other	N / R / M / G	
Directional	5	24"x 24"	wood / [✓ metal] / other	[✓ N] / R / M / G	Plastic facing coming loose.
Interpretive			wood / metal / other	N / R / M / G	

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:
Note the age of the facilities (if known) as well as any signs of overuse.

- Access to Roanoke River at Put-In difficult due to rocky conditions.
- Take-Out at reservoir very steep below first step. Water is very deep. Difficult to access steps.
- No public access to road to powerhouse. Parking is gravel but only for employees and individuals granted permission to access powerhouse area.
- No ADA accommodations.
- Estimated age of portage 20+ years. No sign of excessive use.
- No one was observed utilizing the facility during the field inventory.

Notes from Niagara Project Canoe Portage Trail Inventory and Condition Assessment – October 24, 2019

- Entrance road to powerhouse and spillway is closed to public use by locked gate.
- The canoe/kayak take-out at the reservoir is not well marked. Accessing the take-out steps is difficult. The depth of water at the end of the steps is very deep and the side slope is steep.
- The boat barrier adjacent to the portage take-out consists of barrels connected by cable. During the inventory, debris accumulation in excess of what could be contained in a dumpster along the barrier was noted.
- Directional signs for the portage need to be replaced due to plastic covering coming off.
- The portage trail shares the access road for employees and contractors.
- There is an active railroad track paralleling the portage trail. No barrier between the trail and track exists.
- Gravel surfaced parking for employees and contractors is provided near to the Project powerhouse. Access to the public is restricted.
- The last section of the portage trail (approximately 150’ long) is not defined and traverses a grassed and muddy area. Some accumulated debris likely due to high water noticed in this area as well as at the put-in point.
- Although a sign designates the existence of the portage at the put-in, the put-in itself is not clearly delineated.
- The portage put-in area is very rocky and very difficult to cross to get to the Roanoke River. Due to the rocky nature of the put-in, placing a canoe or kayak in the water can be difficult.
- Bank fishing opportunities at take-out and put-in limited due to access limitations.
- There are no restroom facilities or trash receptacles provided.
- In general, the portions of the portage trail sharing the plant access road and surrounding plant grounds are well maintained and in good condition.
- There is a sign identifying the Project number. However, there is no information provided denoting other recreation opportunities in the area.
- Weather at time of field inventory: Sunny, mild breezes, temperature 65° F.

Steps at Portage Take-Out

Sign at Portage Take-Out

Portage Trail from Take-Out

Boat Barrier Adjacent to Take-Out

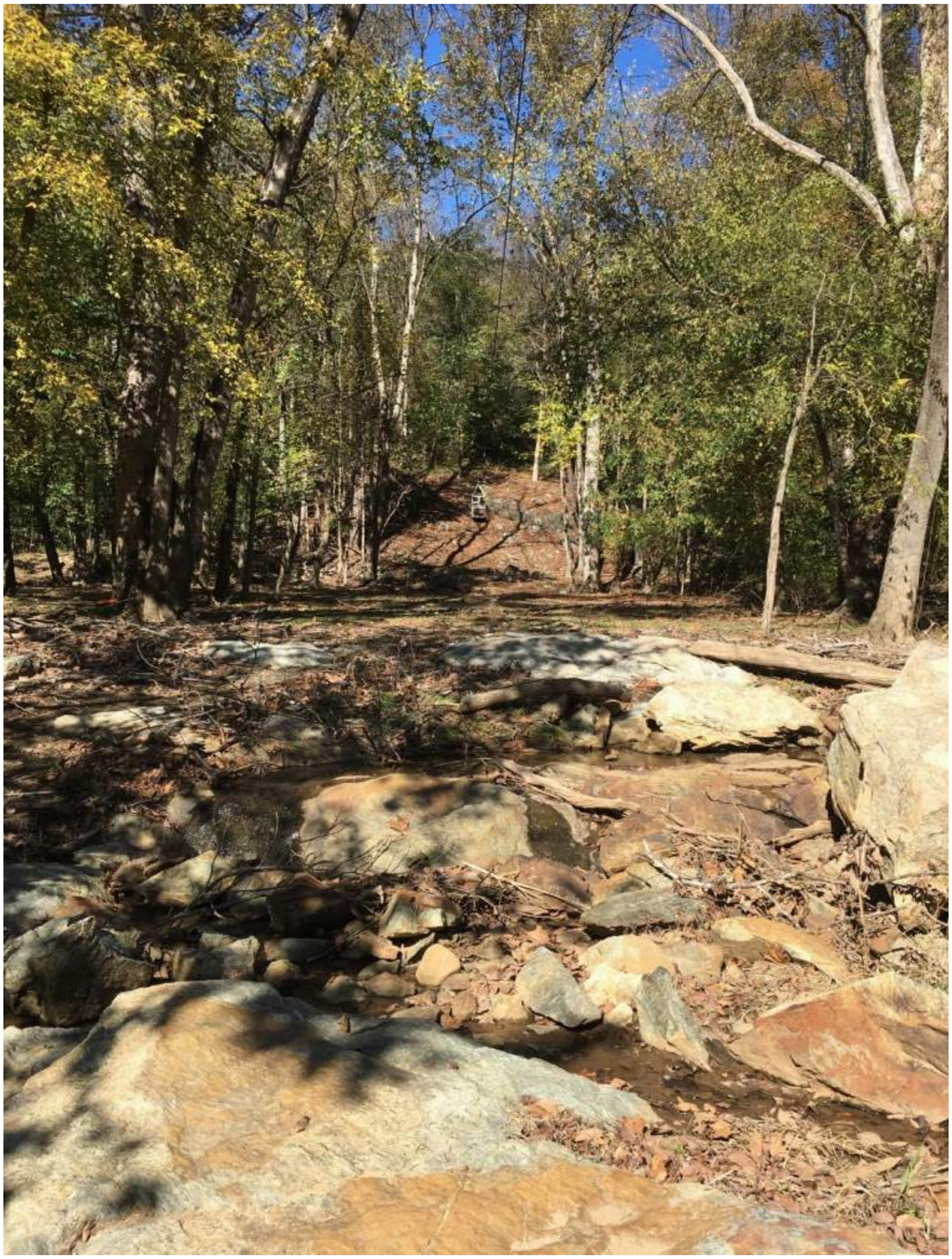
Portage/Access Road at Railroad Tracks

Portage/Access Road Near Powerhouse

View of Spillway Bypass Below Powerhouse from Portage Trail

Portage Trail/Access Road Near to Blue Ridge Parkway Bridge

Portage Trail at Put-In to Roanoke River



View of Roanoke River Trail Steps and USGS Gage (No. 02056000) Across Roanoke River from Put-In

Portage Put-In at Roanoke River Downstream of Powerhouse

View of Powerhouse from Portage/Access Road

Signs at Put-In at Roanoke River

Roanoke River Downstream of Put-In

Roanoke River Upstream of Put-In

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Niagara Hydroelectric Project (FERC No. 2466)

Location: **Tinker Creek Boat Launch – Vinton, Virginia (37.2636; -79.9149)**

Date: **10/18/2019** **Surveyor:** **F. Simms/K. Simms**

Photo Number(s): **Photos Attached**

Type of Amenity	#	ADA	Condition	Notes
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)			N / R / M / G	
Trash Receptacles			N / R / M / G	
Other: Boat Launch	1	**No**	N / R / M / [✓ G]	Curved Concrete Ramp. Width = 10 ft.; Length = 75 ft.; Slope = 20% (Avg.)
Other: Canoe/Kayak Storage Rack	1	**No**	N / R / M / [✓ G]	Located at upper end of concrete ramp. Holds 6 canoes and/or kayaks.
Other			N / R / M / G	

PARKING	Total Spaces: _23____ Standard: _22____ ADA: __1___ Double (trailer): _____ Other: _____	**Condition**
	Surface Type: [✓ *Asphalt*] *Concrete* [✓ *Gravel*] *Other:___________*	N / R / M /

Signs	#	Size	Material	Condition	Comments
FERC Project	N/A		wood / metal / other	N / R / M / G	Non-Project Facility
Facility ID	1	48"x36"	[✓ wood] / metal / other	N / R / M / [✓ G]	Sign at Entrance.
Regulations	1	48"x48"	[✓ wood] / metal / other	N / R / M / [✓ G]	Board covered by glass.
Directional	3	24"x10"	wood / metal / [✓ other]	N / R / M / [✓ G]	Plastic entrance and exit directional signs with arrows.
Interpretive	4	Various	wood / metal / other	N / R / M / [✓ G]	See notes and photos.

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:
Note the age of the facilities (if known) as well as any signs of overuse.

- Age of facility unknown. No signs of overuse.
- Five vehicle parking spots designated for boater use only. One of the five spots is designated for ADA use. Remaining 18 parking spots are for general public and use by Town of Vinton employees. The 18 spots are sized for vehicles but can be combined for use by vehicle with boat trailer.
- Information regarding signs provided in attached notes.
- Weather on day of inventory: Sunny with no clouds. Mild breeze. Temperature = 60°F.
- Overall, facilities well maintained and in good condition.
- No one was observed utilizing the site during the field inventory.

Notes from Town of Vinton, Va. – Tinker Creek Boat Launch Inventory and Condition Assessment – October 18, 2019

- Weather during the inventory and condition assessment was sunny with no clouds, a mild breeze, and temperatures near 60° F.
- The boat launch area is well maintained with little to no litter.
- Boat ramp is concrete for its entire length and in good condition. Depth of water at end of ramp at Tinker Creek is shallow and has a rocky bottom.
- There is a total of 23 vehicle parking spaces. Five of the spaces are designated for use by boaters only with one of the five being identified for handicap use. The remaining eighteen spaces are for use by those utilizing the boat launch as well as for uses unrelated to the boat launch including parking for employees for the Town of Vinton.
- Directional signs are provided along Virginia Ave. which is the nearest major road. The signs are visible from both directions.
- There are numerous signs at the boat launch area including the following:
    1. Entrance sign (48” W x 36” H) having a wood frame surrounding a composite sign board.
    2. Information sign (48” W x 36” H) describing contributors to the facility.
    3. One entrance and three exit direction signs (24” W x 10” H) made of plastic.
    4. Information sign (36” W x 24” H) describing the Virginia Treasure program. The sign is metal.
    5. Information sign (48” W x 48” H) containing regulations for the boat launch and providing information regarding local activities. The sign has a glass facing and is held on a wood frame.
    6. Handicap parking sign (12” W x 18” H) made of metal.
    7. Metal sign (24” W x 18” H) denoting parking spaces for boaters only.
- A timber canoe/kayak rack is located at the top of the boat ramp and provides the ability to stack up to six canoes/kayaks for temporary storage.
- A wood privacy fence is provided along the entire length of the north border of the boat launch area.
- Limited opportunities for bank fishing.
- There are neither restroom facilities nor trash receptacles provided.

Entrance Sign at 3rd Street

Boat Ramp Looking Uphill

Boater Only Parking

Boater Only Parking Sign

ADA Parking Sign

Information Sign at Fence Along North Property Line

Information Sign Along North Boundary Fence

Canoe/Kayak Temporary Storage Rack at Boat Ramp

Erosion at Base of Boat Ramp

View of Tinker Creek Downstream of Boat Ramp

View of Tinker Creek Upstream of Boat Ramp

Information Sign at Boat Launch Containing Rules and General Information

Boat Launch Common Parking

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Niagara Hydroelectric Project (FERC No. 2466)

Location: **Roanoke River Trail (37.2531; -79.8716)**
Date: **10/28/2019** **Surveyor:** **F. Simms/K. Simms**
Photo Number(s): **(Photos Attached)**

Type of Amenity	#	ADA	Condition	Notes
Portage (put-in/take-out)			N / R / M / G	
Portage Trail/Walking Trail (include length and footing materials)	1	**No**	N / R / [✓ M] / G	Upper Tail: 200 LF (Asphalt: 3 ft. wide). Mid-Portion: 280 LF (Gravel 4 ft. wide). At end of gravel trail, steps begin. Number of steps = 200 (Each step timber with gravel fill; 48" wide; 6" high; 20" avg. depth). See notes for more detail.
Trash Receptacles	1	**No**	N / R / M / [✓ G]	Located in parking lot at beginning of trail.
Other			N / R / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: _35____ Standard: __35___ ADA: _____ Double (trailer): _____ Other: _____	**Condition**
	Surface Type: [✓ *Asphalt*] *Concrete* *Gravel* *Other:___________*	N / R / M / [✓ G]

Signs	#	Size	Material	Condition	Comments
FERC Project			wood / metal / other	N / R / M / G	
Facility ID			wood / metal / other	N / R / M / G	
Regulations			wood / metal / other	N / R / M / G	
Directional	1	56" x 24"	[✓ wood] / metal / other	N / R / M / [✓ G]	In parking lot at trail start. See notes for other directional
Interpretive	1	48"x 20"	wood / metal / [✓ other]	N / R / M / [✓ G]	In parking lot at trail start. See notes for other interpretive

N – Needs replacement (broken or missing components, or non-functional)
R – Needs repair (structural damage or otherwise in obvious disrepair)
M – Needs maintenance (ongoing maintenance issue, primarily cleaning)
G – Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

ADDITIONAL COMMENTS/NOTES:
Note the age of the facilities (if known) as well as any signs of overuse.

- Age of upper portions of trail unknown. Steps constructed in 2015.
- No signs of overuse.
- Safety sign at end of asphalt portion of trail. Composite material (24" x 30"). Poor condition thus difficult to read. Needs replacement.
- Two wood trail direction signs at top of steps (20" x 8" and 25" x 6"). Good condition.
- Information sign about Niagara Project. Metal (36" x 24"). Good condition.
- No litter was noticed. Site appears to be well-maintained.
- No ADA accommodations.
- Weather during inventory and condition assessment: Sunny with mild wind, temperature 65°F.

Notes from Roanoke River Trail
Inventory and Condition Assessment – October 28, 2019

- The trail consists of three segments. The upper portion of the trail is 200 ft. long, has a slope of 16%, a width of 36”, and an asphalt surface. The asphalt is cracking and in need of repair.
- The middle portion of the trail is 150 ft. long and 48 in. wide. It is dirt with a gravel surface in some areas. Portions of the middle portion need maintenance including the addition of gravel at some locations.
- The lower portion of the trail is steep consisting of 200 timber steps with gravel fill. Each step is 48 in. wide, 6 in. high, and has an average depth of 20 in. The gravel fill has settled in certain locations and should be replenished. There are short landings of various lengths that provide an area to rest. A wood bench is located at one landing providing a place to sit and view the Project bypass and powerhouse. There also is a bench at another landing that has a seating area carved out of a segment of a tree trunk. The vertical distance from the top of the steps to the end at the Roanoke River is estimated at approximately 100 ft.
- The fishing access at the end of the steps is rocky but provides a good area for bank fishing. One individual was observed fishing during the inventory.
- The powerhouse for the Niagara Project is visible from the fishing access. Along the fence adjacent to the powerhouse is a sign that provides information regarding flow releases from the powerhouse. The lettering on the sign is difficult to read from the fishing access due to the lettering being too small. A larger sign should be considered.
- During the inventory which lasted for 2.5 hours beginning at 12:30 p.m., eight individuals were observed walking the trail. Based upon the license plates for the vehicles in the parking lot, those utilizing the trail and fishing access were from the local area as well as various states outside of Virginia including Minnesota, North Carolina, and Florida. The apparent primary activity for those utilizing the trail was to view the Niagara Project facilities and surrounding terrain.
- No restroom facilities are provided along the trail or at the parking lot.
- The trail and steps provide access to the USGS Gage (02056000) located near the end of the steps.
- The Niagara Project Canoe Portage Trail put-in at the Roanoke River can be observed from the trail fishing access. During the field inventory, no one was observed utilizing the portage.
- The bridge carrying the Blue Ridge Parkway over the Roanoke River downstream of the Niagara Project powerhouse is adjacent to the parking lot for the Roanoke River Trail. The Project spillway bypass and powerhouse can be viewed from the bridge.

Entrance from Blue Ridge Parkway to Roanoke River Trail Parking Lot

Roanoke River Trail Parking Lot

Overlook Sign at Roanoke River Trail Parking Lot

Trash Receptacle and Information Sign at Parking Lot

View of Project Spillway from Parking Lot

Seating at Parking Lot

Project Information Sign at Overlook Along Steps

Niagara Power Plant

National Park Service
U.S. Department of the Interior

Before the turn of the century, developers dreamed of using the Roanoke River as a power source. The Roanoke Hydraulic Power Company purchased land along this gorge with the intention of constructing a power plant. The Roanoke Power Company took over the project in 1906 and purchased enough land to accommodate the waters behind a proposed dam.

The Niagara Dam that you see here was built that same year, providing electricity for parts of the growing city of Roanoke. The lake quickly became a popular place for summer picnics and moonlight boat cruises. Today, Niagara is the smallest hydroelectric plant in the American Electric Power system, with a capacity to generate 2,400 kilowatts of power.

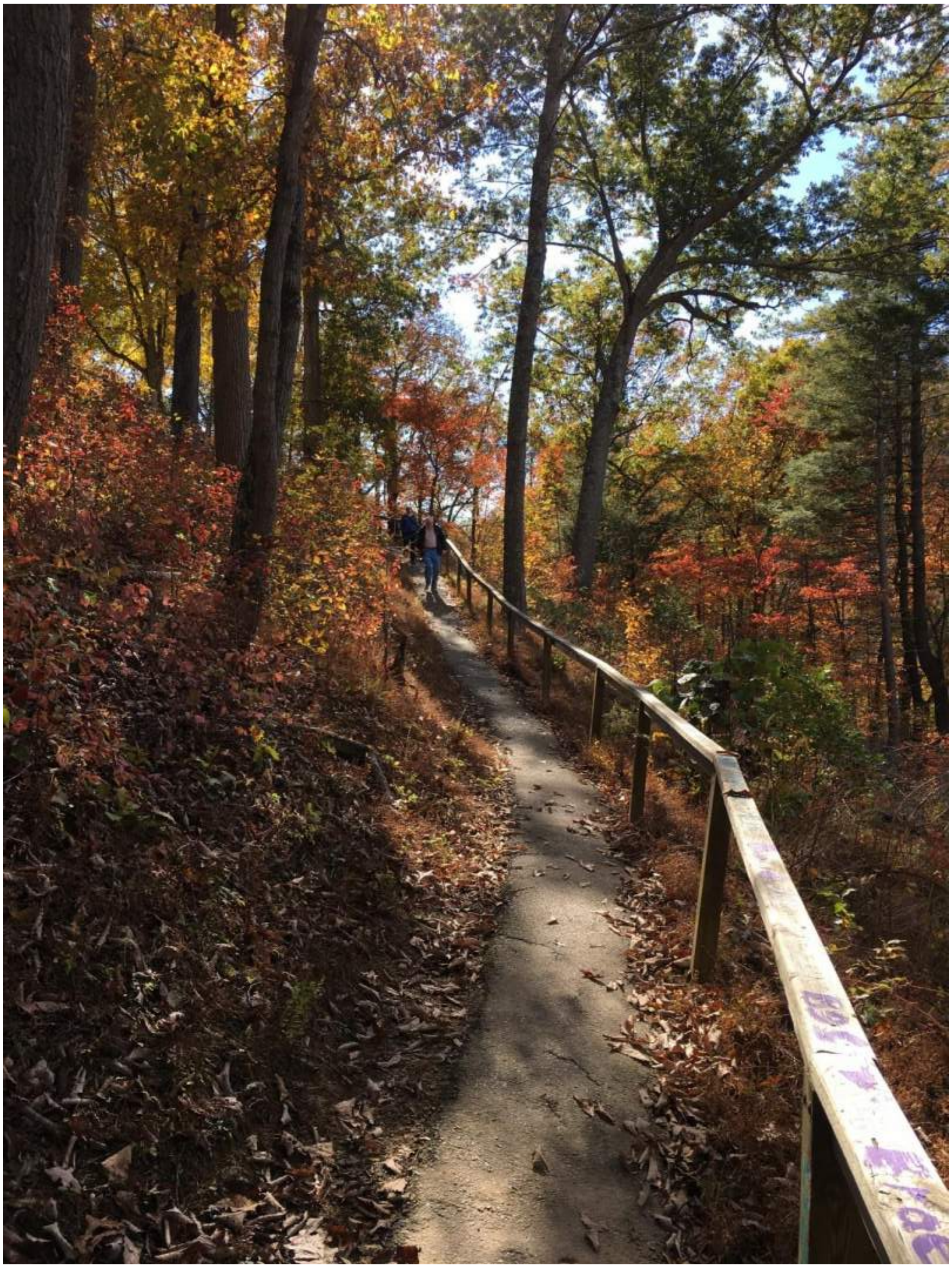
Aerial photograph of the Niagara power plant and dam before the Blue Ridge Parkway was constructed across the Roanoke River Gorge. (1924)

The intense community excitement created by the Niagara Dam had not worn off by 1909, when this postcard was made.

"Everybody who saw the lights was highly pleased and prophesied great things for the Water Power Company...lines will be extended to all parts of the city as fast as wire can be procured..."

***Roanoke Evening News* 20 September 1906**

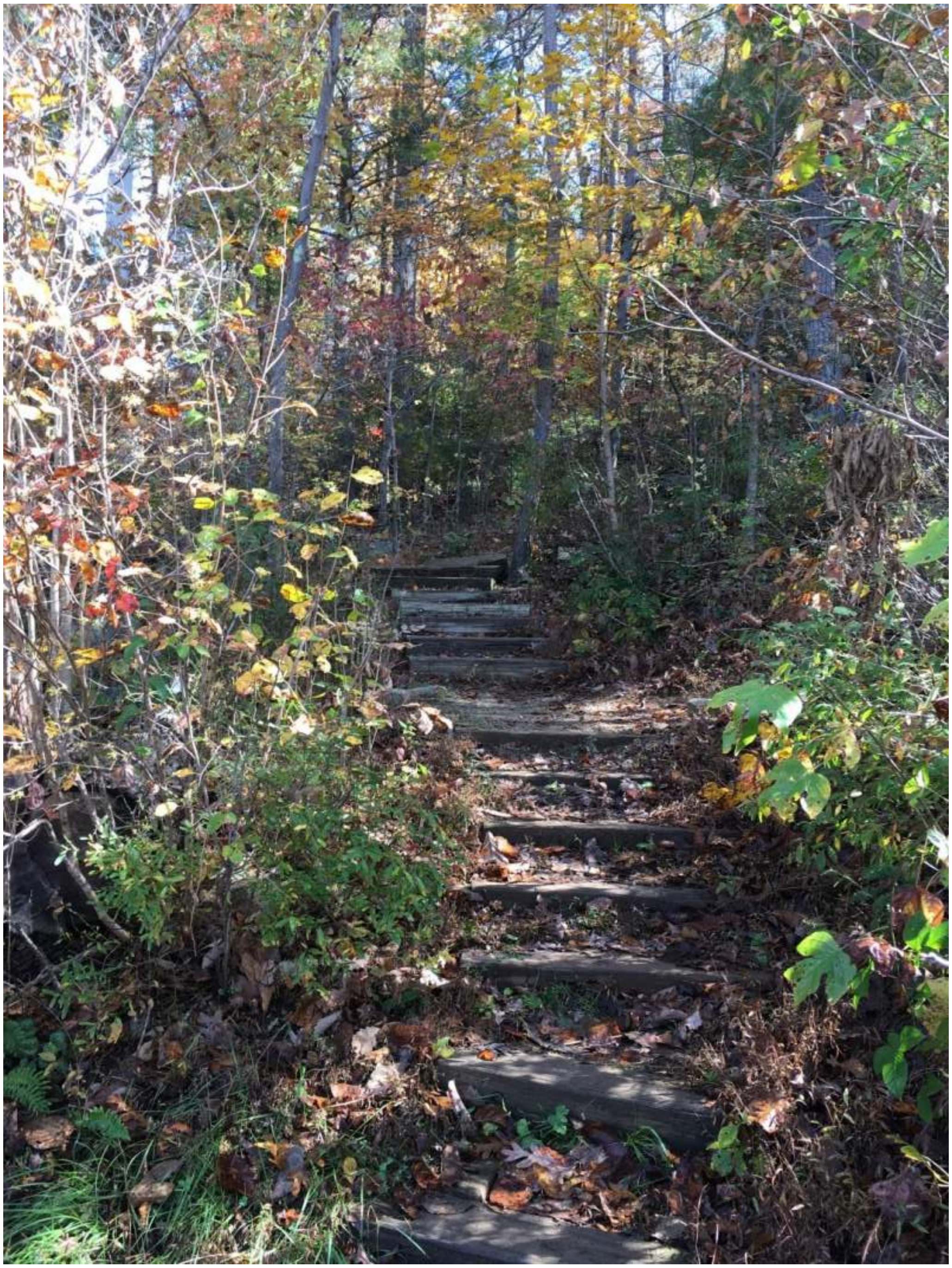
Asphalt Portion of Roanoke River Trail



Roanoke River Trail Gravel Segment

Roanoke River Trail Directional Sign at Top of Steps

Roanoke River Trail Steps



Bench at Steps Landing

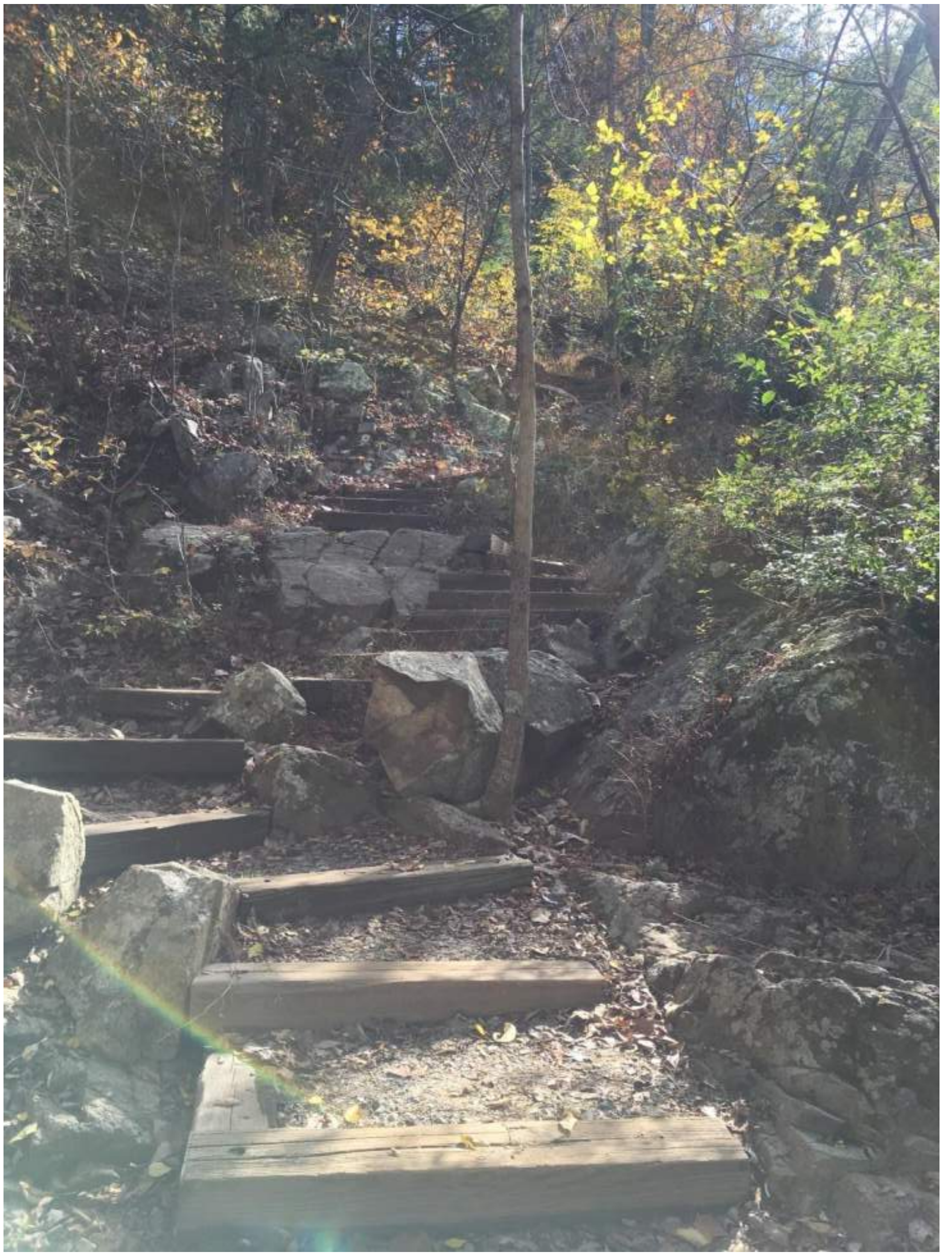
View of Project Bypass from Bench at Roanoke River Trail Steps

Log Bench at Landing Along Steps

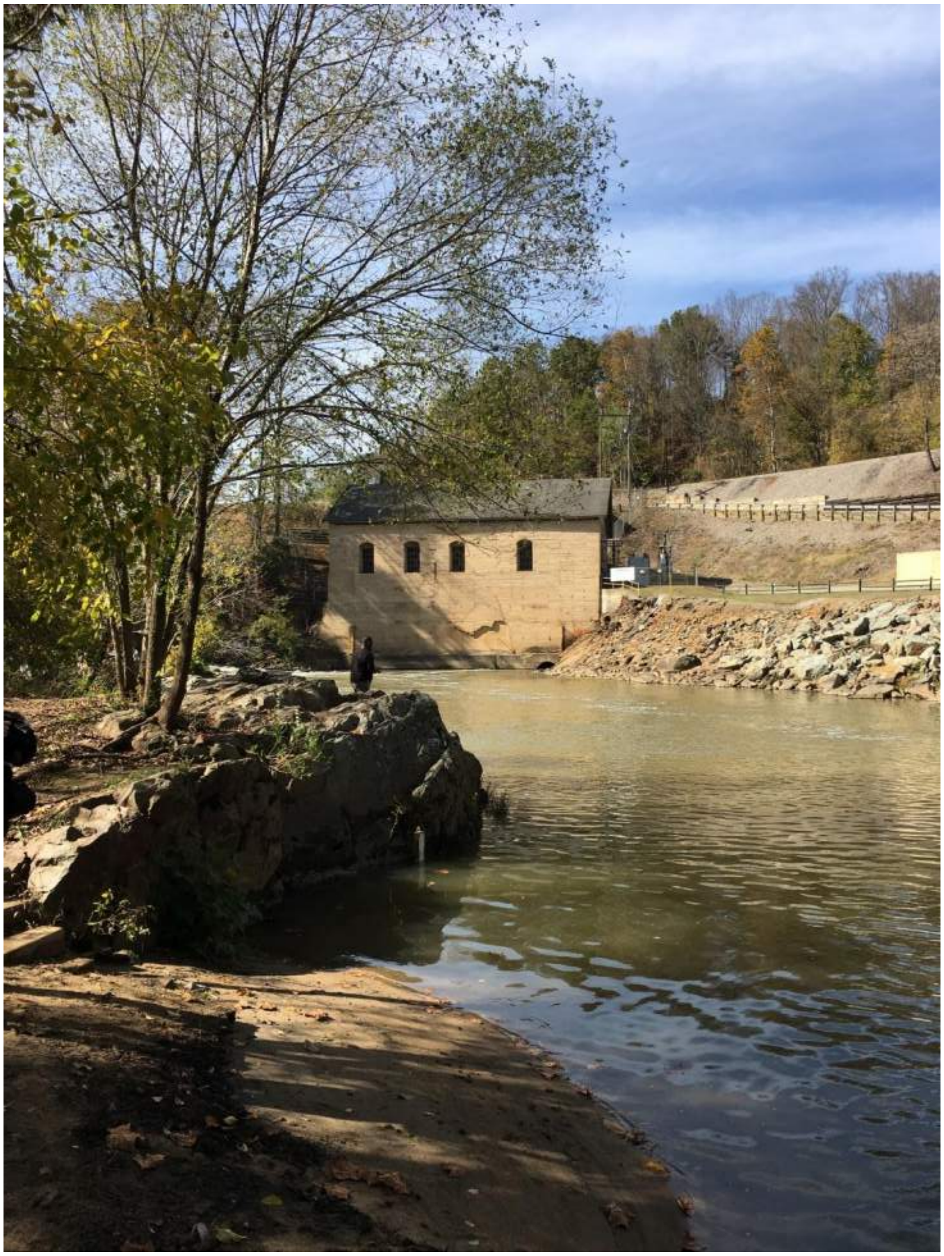
View of Powerhouse from Steps

Roanoke River Trail Steps

End of Steps at Roanoke River Fishing Area



Fishing Area at End of Steps Looking Upstream at Niagara Project Powerhouse



USGS Gage (02056000) located at End of Steps

Fishing Area at End of Steps Looking Downstream Along Roanoke River

View of Spillway Bypass from Fishing Area

View of Niagara Project Canoe/Kayak Portage Put-In Across Roanoke River from Roanoke River Trail

Warning Sign at Face of Niagara Project Powerhouse

View of Project Spillway Bypass from Blue Ridge Parkway Bridge

RECREATION FACILITY INVENTORY AND CONDITION ASSESSMENT
Niagara Hydroelectric Project (FERC No. 2466)

Location: **Rutrough Road Canoe and Kayak Access (37.2259; -79.8474)**
Date: **10/18/2019** **Surveyor:** **F. Simms/K. Simms**
Photo Number(s): **Photos Attached**

Type of Amenity	#	ADA	Condition	Notes
Portage (put-in/take-out)	1	**No**	N / R / [✓ M] / G	Timber steps. W=8 ft.; D=15 in.; H=6"; No. = 12. Accumulated debris and soil should be removed.
Portage Trail/Walking Trail (include length and footing materials)	1	**No**	N / R / [✓ M] / G	Dirt trail with some gravel. W=30 in.; L=75 ft. Trail leads from parking area to put-in.
Trash Receptacles	1	**No**	N / R / M / [✓ G]	
Other: Picnic table	1	**No**	N / [✓ R] / M / G	
Other			N / R / M / G	
Other			N / R / M / G	

PARKING	Total Spaces: __12___ Standard: __12___ ADA: _____ Double (trailer): _____ Other: _____	**Condition**
	Surface Type: *Asphalt* *Concrete* *[✓ Gravel]* *Other:___________*	N / R / [✓ M] /

Signs	#	Size	Material	Condition	Comments
FERC Project	N/A		wood / metal / other	N / R / M / G	Non-Project Facility
Facility ID			wood / metal / other	N / R / M / G	
Regulations			wood / metal / other	N / R / M / G	
Directional			wood / metal / other	N / R / M / G	
Interpretive			wood / metal / other	N / R / M / G	

N - Needs replacement (broken or missing components, or non-functional)
R - Needs repair (structural damage or otherwise in obvious disrepair)
M - Needs maintenance (ongoing maintenance issue, primarily cleaning)
G - Good condition (functional and well-maintained)
If a facility is given a rating of "N", "R", or "M", provide specific details.

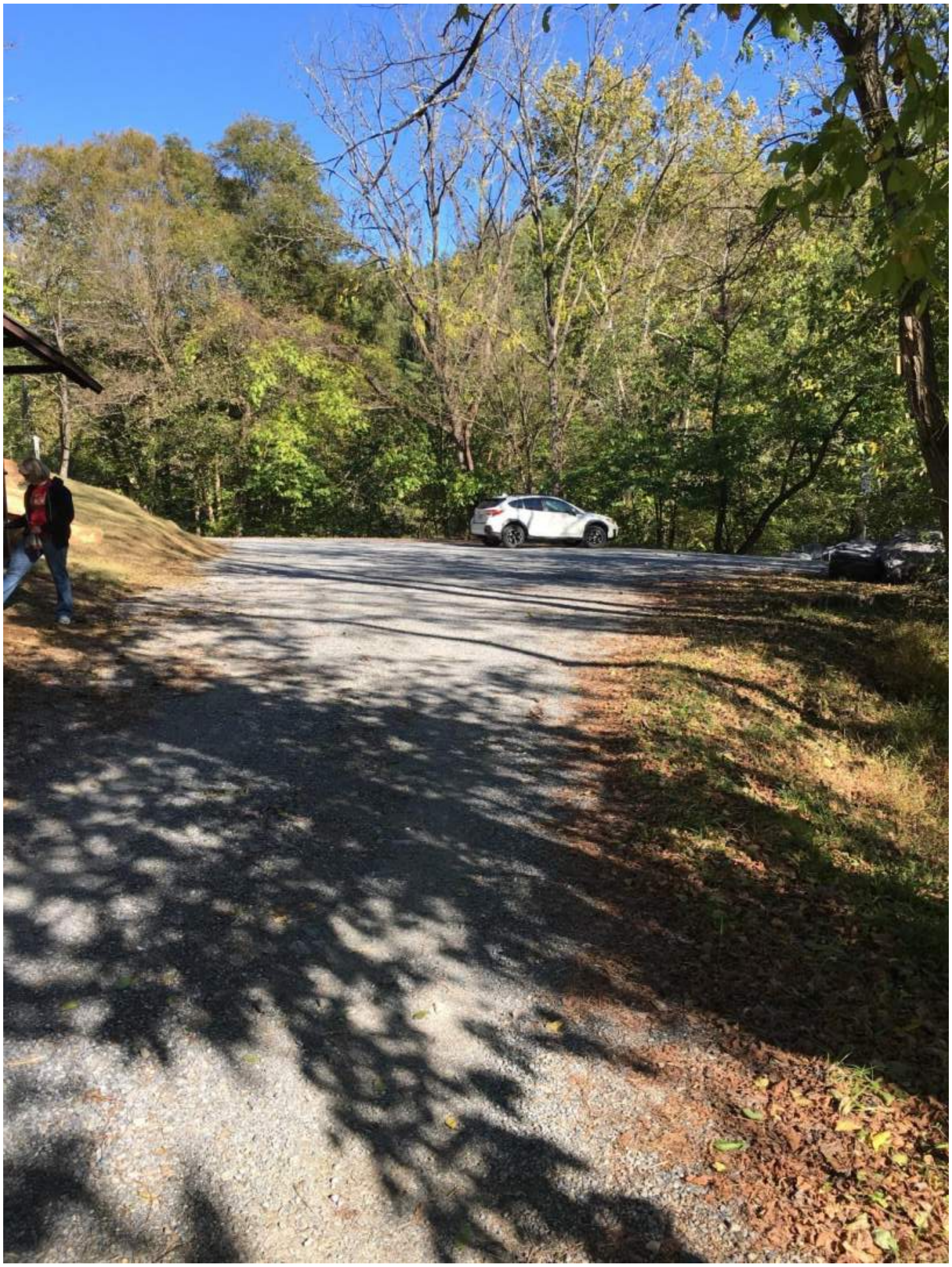
ADDITIONAL COMMENTS/NOTES:
Note the age of the facilities (if known) as well as any signs of overuse.

- Numerous signs at site. Information regarding signs provided on attached notes.
- Age of facilities unknown.
- No signs of overuse.
- Weather during inventory: Sunny, mild breezes, 70° F.

Notes from Rutrough Road Canoe and Kayak Access Inventory and Condition Assessment – October 18, 2019

- In general, the area is well kept and in good condition.
- Parking is available for an estimated twelve vehicles. There is no designated handicap parking space.
- The steps leading to the edge of the water to allow for launching of canoes and/or kayaks have been covered by silt and grasses which can cause the steps to be slippery to use. There are twelve timber with earth fill steps each being 8' wide, 15" deep, and 6" high.
- The trail leading from the parking area to the canoe/kayak put-in could use some resurfacing. It is primarily a 30" wide dirt path with some portions having a gravel surface.
- The picnic table provided at the put-in is in poor condition and requires either maintenance or replacement.
- Trails for Explore Park are accessible from the Rutrough Road Canoe/Kayak Put-In with the trails having directional signs at the point they connect to the parking area.
- Bank fishing occurs in vicinity of put-in and along banks near trails.
- There are no directional signs from Rutrough Road to the parking area.
- Numerous signs are provided at the parking area including the following:
    1. Recreation site identification sign (38" W x 58" H) constructed of wood. Eight gunshot holes were noticed through the sign.
    2. One high water warning sign (18" W x 12"H) made of metal.
    3. Metal "Virginia Treasures" informational sign (18" W x 12" H).
    4. Metal directional sign (24"H x 18"H ea.) stating that gate is not to be blocked.
    5. Information sign at the entrance to the parking area (72" W x 48" H) having a wood frame and glass cover. Current information includes rules to follow while utilizing the site along with maps of the adjoining Explore Park.
    6. Adventure plan and map metal sign (12" W x 12" H).
- No restroom facilities are provided.
- A trash receptacle along with "mutt-mitts" and trash bags are provided. The "mutt-mitts" and trash bags are stored on-site in metal containers.
- During the field inventory, two fisherman and four individuals hiking were observed.

Parking Entrance from Rutrough Road



Rutrough Road Kayak & Canoe Access Entrance Sign

Parking Area

High Water Warning Sign at Put-In

Trail from Parking Area to Put-In

Put-In at Roanoke River

Picnic Table at Put-In

Steps at Put-In

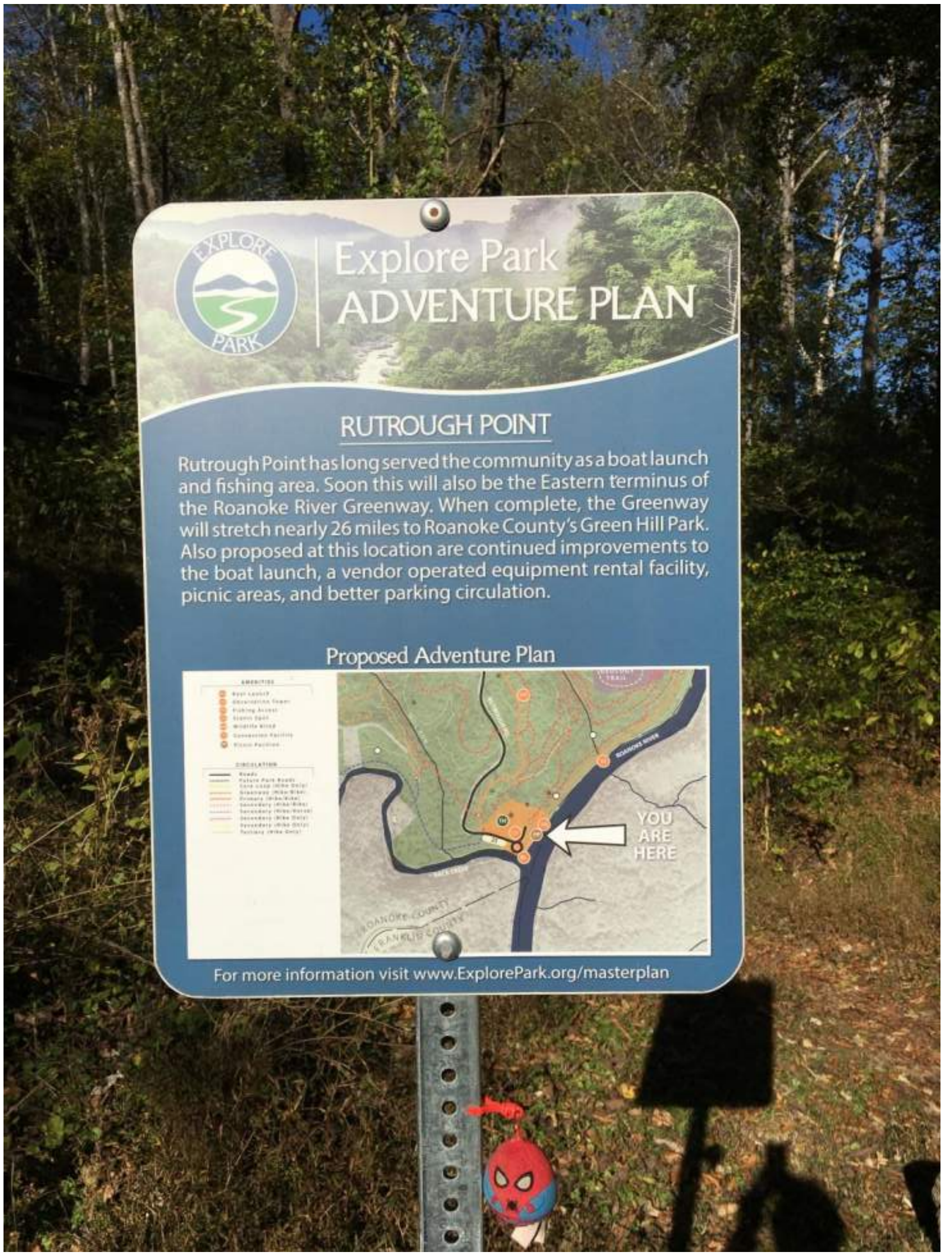
View of Roanoke River Upstream of Put-In

View of Roanoke River Downstream of Put-In

View Along Back Creek from Put-In

Information Sign at Parking Area

Planning Information at Parking Area



Rutrough Point has long served the community as a boat launch and fishing area. Soon this will also be the Eastern terminus of the Roanoke River Greenway. When complete, the Greenway will stretch nearly 26 miles to Roanoke County's Green Hill Park. Also proposed at this location are continued improvements to the boat launch, a vendor operated equipment rental facility, picnic areas, and better parking circulation.

For more information visit www.ExplorePark.org/masterplan

Explore Park Trail Connection to Parking Area Including Information Signs

Attachment 2

Attachment 2 – Online Survey Results

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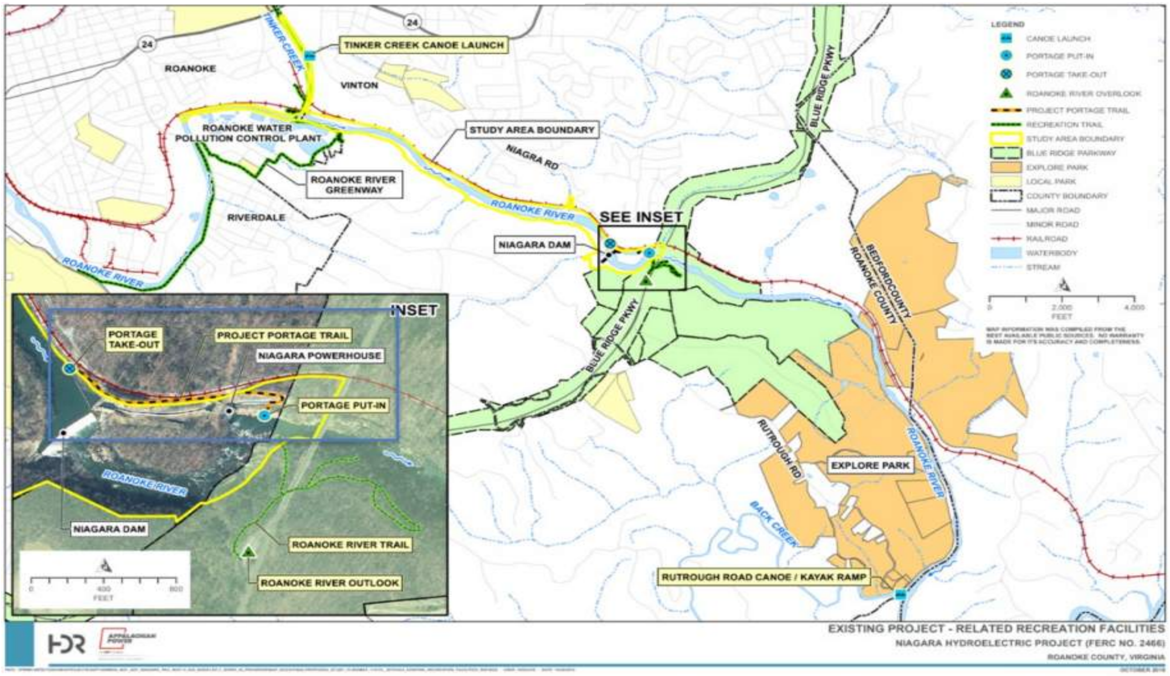
Niagara Recreation – *Cumulative Results for Niagara Portage Trail*

Survey Location:



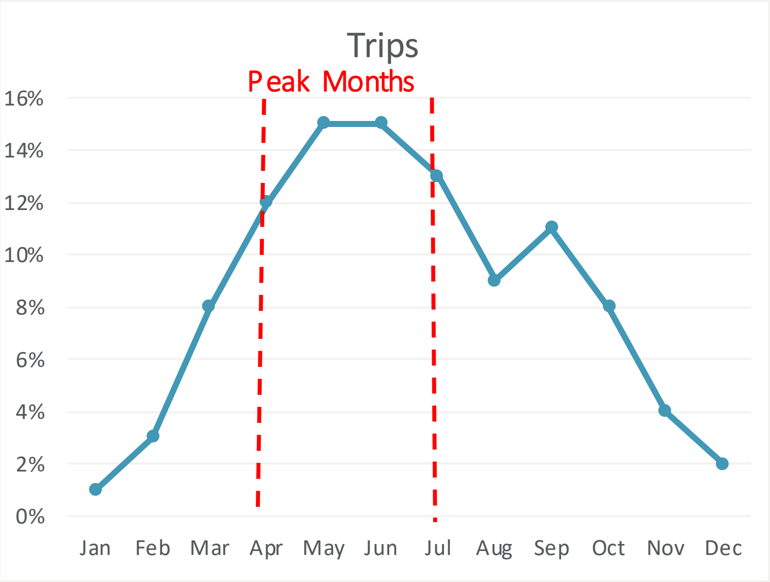
From **April 2020 to October 2020** there have been **42** respondents from **Niagara Portage Trail**. Overall, **35%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process and the study is on-going.

Predominately **56%** of the survey respondents come from four zip code locations, which average about **12** miles away from the Project. **86%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3** hours.

Males made up **83%** of the respondents, **59%** in their thirties, forties, and fifties.

The most frequent months visited are April through July. May and June were the highest visited months.

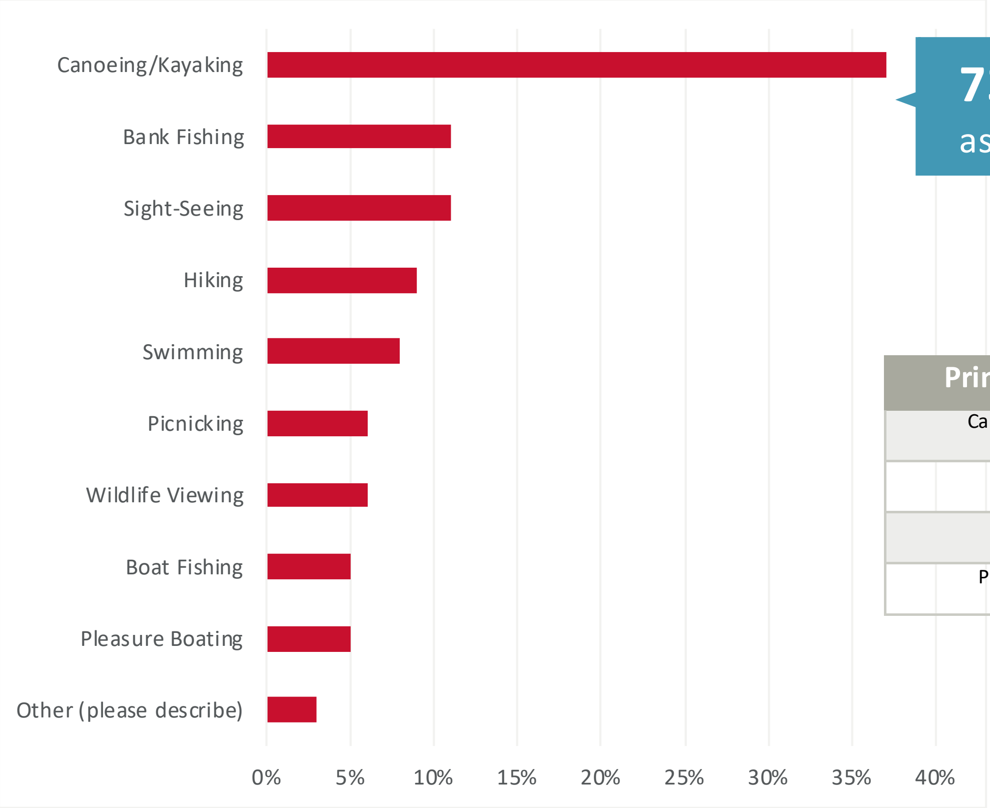


- Zip codes of most frequent visitors: **24014, 24015, 24018 & 24019**
- Average # of visits per year are **8**
- Average miles traveled: **16**

97% of respondents were not staying overnight in the Niagara Project area. Of the group staying overnight, **100%** were staying at RV/tent camping accommodations.

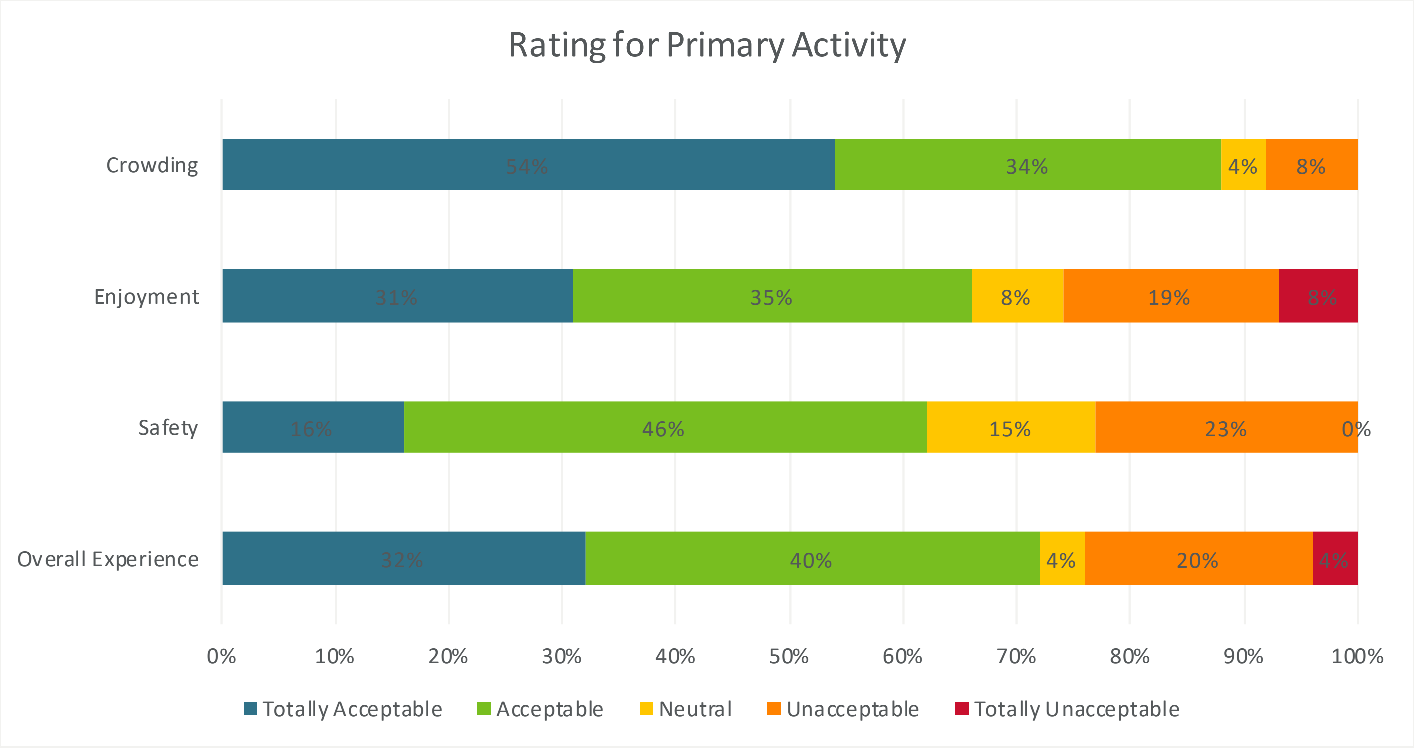
Niagara Recreation – *Cumulative Results for Niagara Portage Trail*

Activities Participated on Trip:

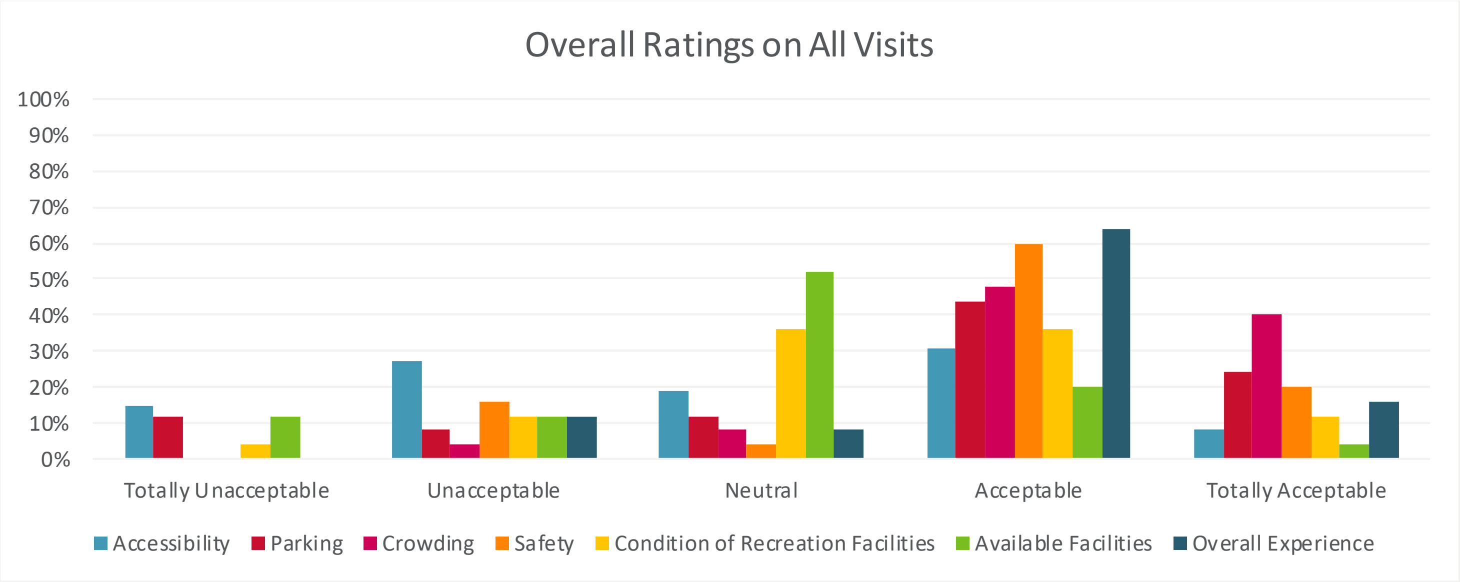


73% selected canoeing/kayaking as the primary activity

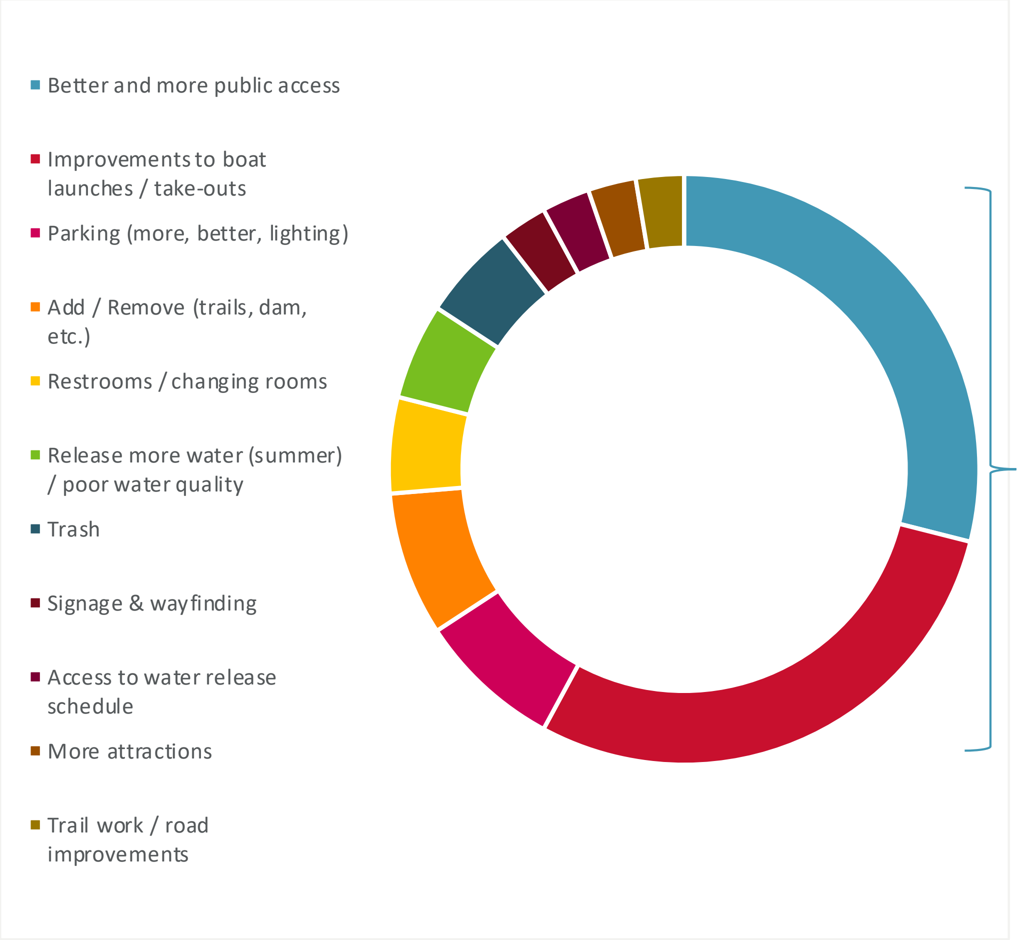
Primary Activity	Percent
Canoeing/Kayaking	73%
Fishing	19%
Hiking	4%
Pleasure boating	4%


Rating for Primary Activity

Niagara Recreation – *Cumulative Results for Niagara Portage Trail*



Suggested Improvement Responses from Niagara Portage Trail:



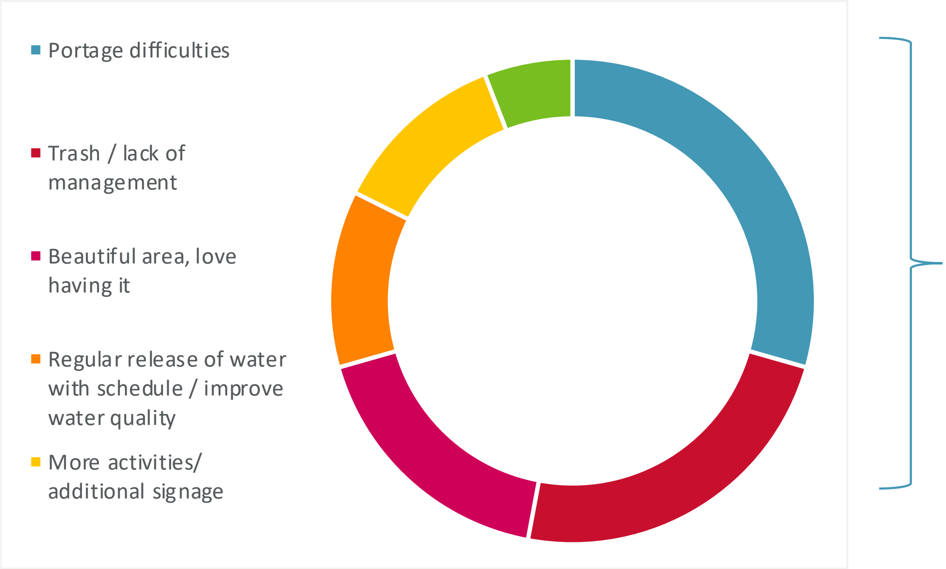
Improvement Suggestions	**#**
Better and more public access	11
Improvements to boat launches / take-outs	11
Parking (more, better, lighting)	3
Add / Remove (trails, dam, etc.)	3
Restrooms / changing rooms	2
Release more water (summer) / poor water quality	2
Trash	2
Signage & wayfinding	1
Access to water release schedule	1
More attractions	1
Trail work / road improvements	1

Niagara Recreation – *Cumulative Results for Niagara Portage Trail*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Niagara Project: *(verbatim responses)*

- A boat rail to assist with getting your boat to water. Improved portage.
- Access trail(s) from north side of Roanoke River bridge.
- At the parking there could be bathrooms and an easier way to access the river. Also, in the bathrooms maybe some lock boxes for people to put their keys in while they float the river. Also, the trash through here is high and some of the areas that could be nice stop offs need to be cleared. I understand not destroying habitats, however small beaches, etc. in case of storms or to enjoy your time would be nice.
- Better access and parking. Safer access to both sides of the river.
- Continued work on trail to River, request for a dam release conversation/schedule.
- Extend Greenway
- I would like public access to both sides of the river from the Gorge overlook area. Currently if you are on the opposite/other bank, this is considered trespassing. I also think a Swinging bridge, located under the Parkway Bridge would be an awesome addition, and attract many more people to the Explorer Park/ Niagra dam area.
- Improved access in general would be phenomenal. The portage trail is in better condition than it used to be in for sure thanks to the work of volunteers... but it is still a tough portage.
- It would be a blessing if there were an easier way to get my kayak down to the river .I't not that easy for a 68 year old .
- More access for fishing and walking above and below dam that dies not interfere with aep operations. Thank you.
- Need for improved portage around dam. 1/4 mile gravel with no assistance device was rough. This is a really significant barrier to joining the blueway in the Roanoke City/Salem area to the Explore Park and county blueway areas. Its like a dead zone right now due to the challenging portage. With easier, nicer portage, there could be more fluid connection between usage of the river upstream and downstream
- Paddler take-out on river right above dam. Parking on river right above dam. Trail from take-out to parkway fisherman's trail.
- Parking lot lighting, water access trail needs improved, more accessible fishing areas
- Possibly add controlled releases to enhance kayak and canoe experience as well as regulate water temperature below dam.
- Recreational water releases from the dam over the summer months
- Remove the dam
- Restrooms at put ins and take outs for the two runs involved, namely Vinton canoe launch to the damn and from the damn to rutrouph point
- Shorter portage around the Dam
- Take out is often trashy at the steps and difficult to get out. Portage is very hot and dusty. Put in is often very slick and dangerous.
- The signage and put-in for the Niagara dam portage is not ideal. It is not clearly marked on both ends (and along the route). We would benefit from a graded put-in below the dam.
- There needs to be better access for Paddlers on the river. It is a long hike down from the parkway or a long portage at the dam. A put in down stream would be a great improvement to a beautiful part of the river. Older paddlers as myself have a hard time with the hike
- Whitewater park

Additional Comment Responses from Niagara Portage Trail:



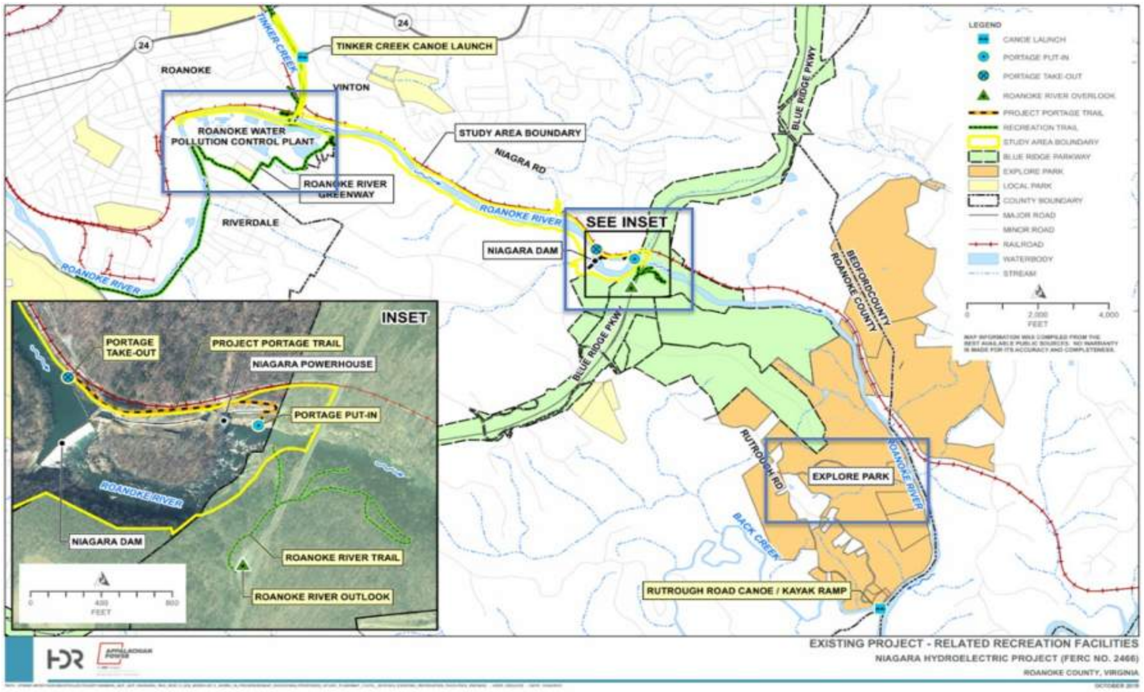
Comments	**#**
Portage difficulties	5
Trash / lack of management	4
Beautiful area, love having it	3
Regular release of water with schedule / improve water quality	2
More activities/ additional signage	2
Removal of dam	1

Additional comments: *(verbatim responses)*

- A better portage around the dam is needed.
- A dream scenario would be to REMOVE THE DAM altogether so that the roanoke river gorge could be accessed via the tinker creek put in which is far more convenient. There is also the potential that the river beneath the lake created by the dam would offer additional whitewater/recreational opportunities!
- Amazing scenery in the gorge below the dam but too low of flow for boaters to enjoy in the summer months.
- Easier access please. Thank you
- Hampered by the railroad right of way, lack of bank management, and poor portage options
- More accessible fishing areas
- Recreation is pretty clearly discouraged.
- Scheduled water releases on weekend during agreed upon months, to increase CFS to a level for consistent recreational paddling.
- That is a long portage around the Dam
- The portage around the damn IS difficult and the water is often to low. The portage around the damn would be better on the other side of the river. Putting in below the rapids
- This area is great, other than some maintenance and safer walk ways to the water it is always a fun spot to float and enjoy a day on the river.
- This has always been an adventure, though as I get older it becomes more challenging. Always a fun time.
- This survey is dysfunctional. The instructions are not clear. It is confusing, asking a question and then not providing proper options.
- Way too much trash
- While the capture of debris above the dam at the booms is great, there needs to be regular clean-out to prevent it from being washed downstream during high water events, and better high-water capture. I have property along the river below the dam (edge of SML) so I see what all floats by during high water events.

Niagara Recreation – *Cumulative Results for “Other” Locations*

Survey Location:



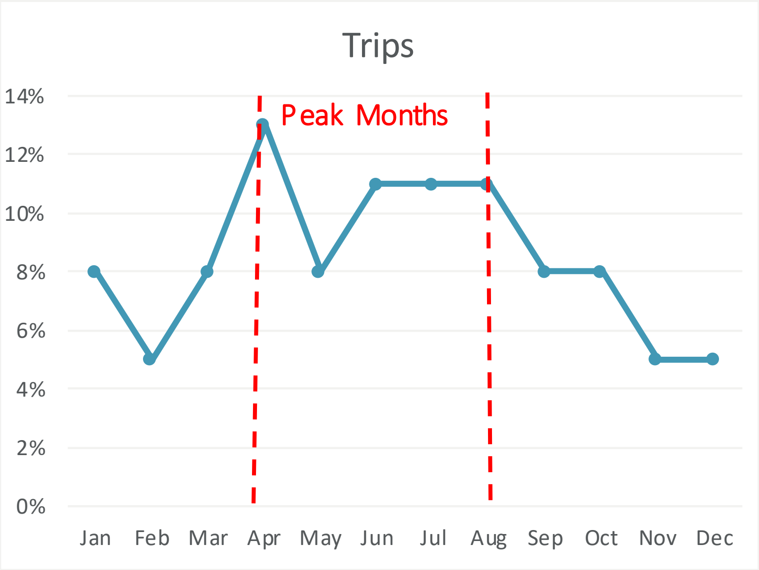
From **April 2020 to October 2020** there have been **6** respondents from **“Other” locations (not assessed by the Recreation Study)**. Overall, **5%** of the responses came from this location.

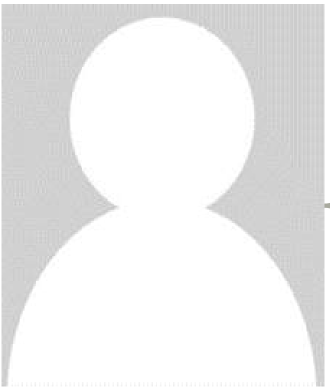
These respondents answered questions about their use of recreation facilities outside of the Project area or not assessed by the Recreation Study. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process.

There was no predominate zip code location from the survey respondents. **100%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3** hours.

Males made up **83%** of the respondents, **100%** in their thirties and forties.

The most frequent months visited are March through October with September being the highest visited month.



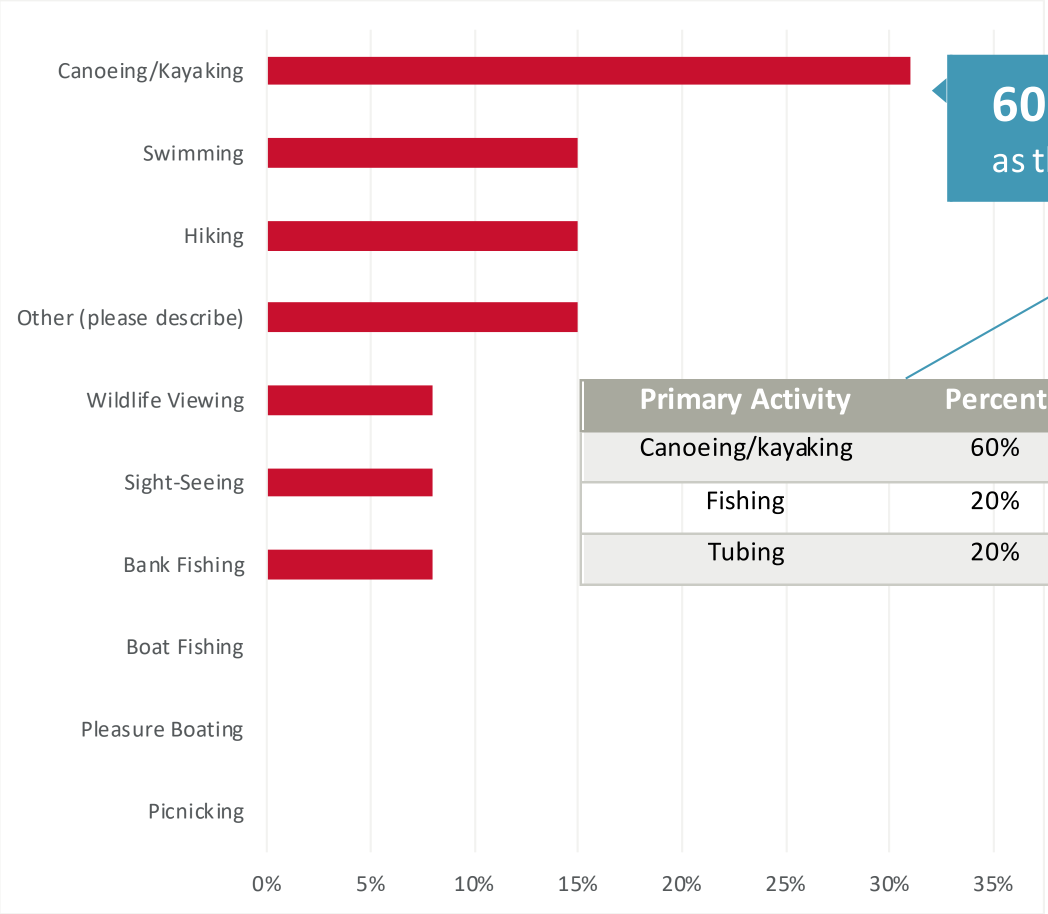


- Average # of visits per year are **14**
- Average miles traveled: **18**

100% of respondents were not staying overnight in the Niagara Project area.

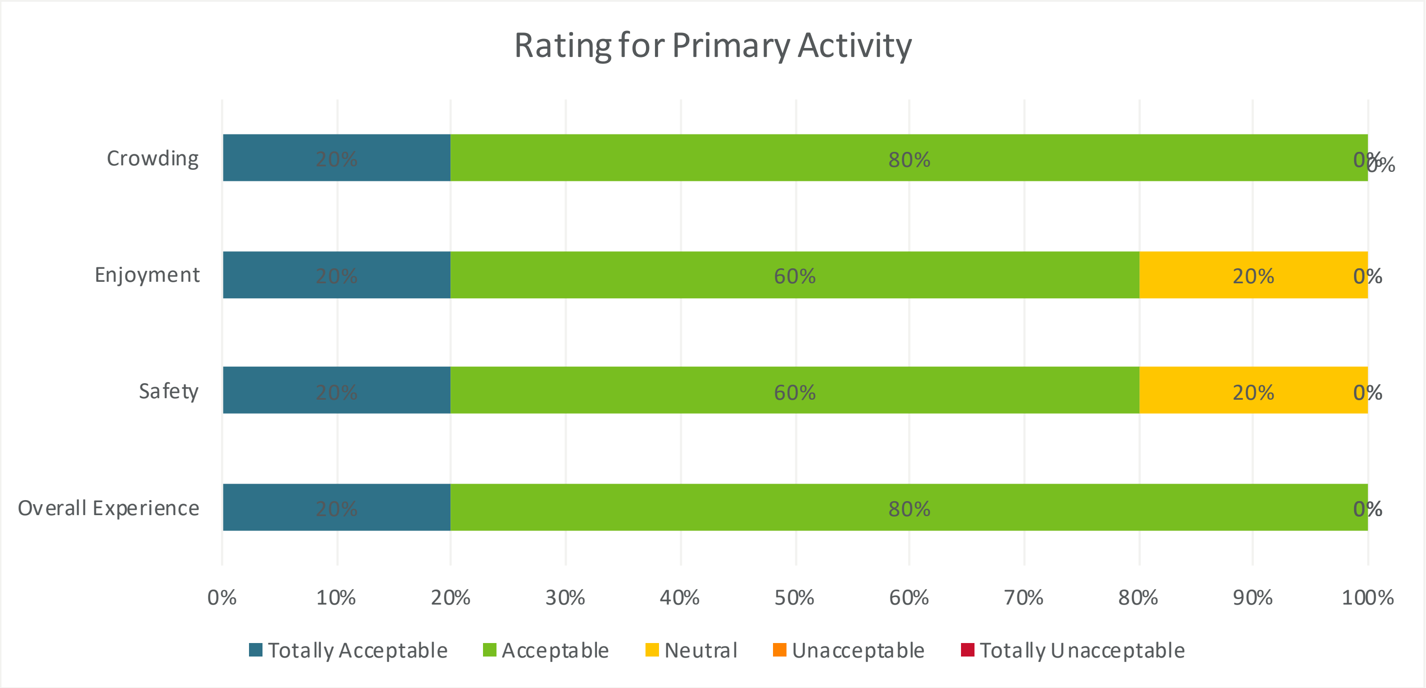
Niagara Recreation – *Cumulative Results for "Other" Locations*

Activities Participated on Trip:



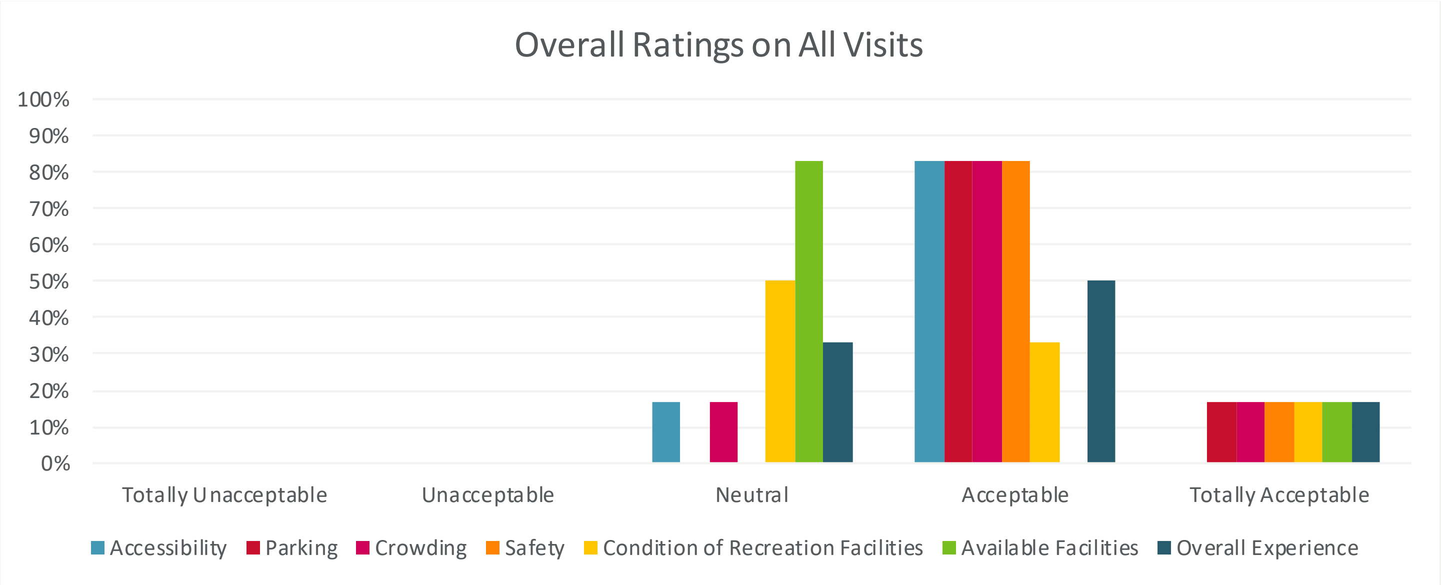
60% selected canoeing/kayaking as the primary activity

Primary Activity	Percent
Canoeing/kayaking	60%
Fishing	20%
Tubing	20%

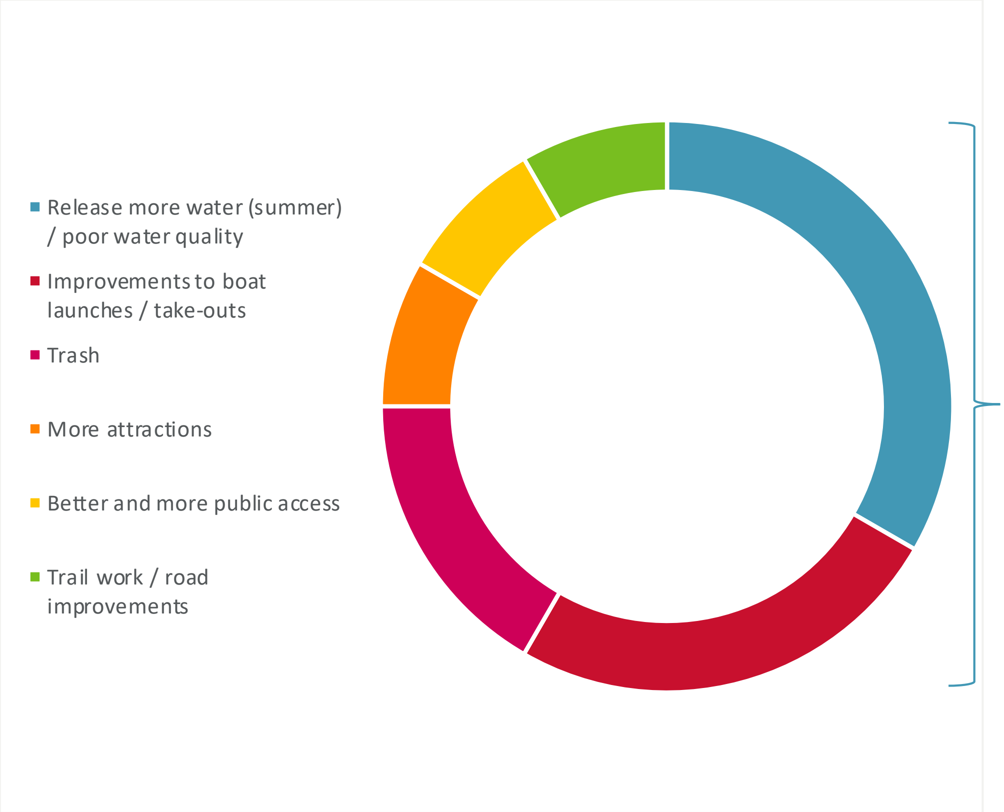


Rating for Primary Activity

Niagara Recreation – *Cumulative Results for "Other" Locations*



Suggested Improvement Responses from Other locations within the recreation site:



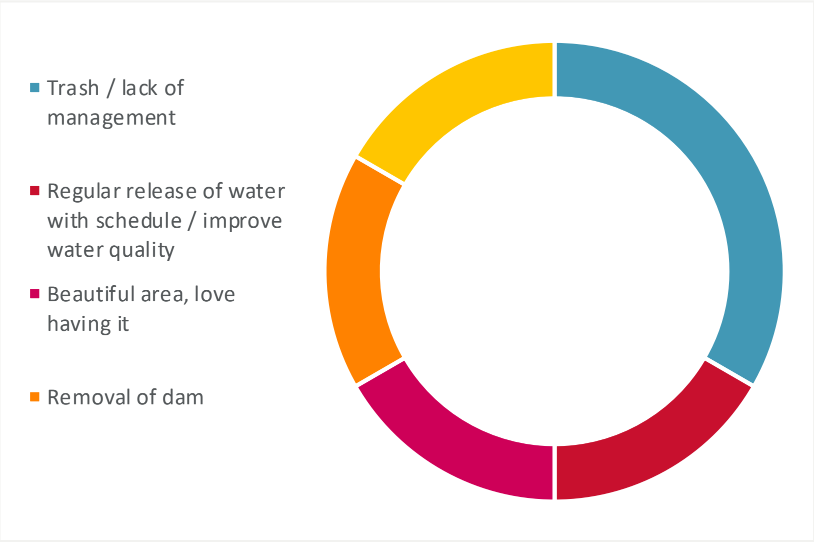
Improvement Suggestions	**#**
Release more water (summer) / poor water quality	4
Improvements to boat launches / take-outs	3
Trash	2
More attractions	1
Better and more public access	1
Trail work / road improvements	1

Niagara Recreation – *Cumulative Results for "Other" Locations*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Niagara Project: *(verbatim responses)*

- Cell signal at blue mountain adventures
- Enhanced access at various locations. Thanks
- Recreational releases of water during weekends in the summer are would dramatically improve paddling through the Roanoke Gorge.
- Separate boat launch and fishing areas. Trash receptacles near fishing areas. Scheduled water releases for recreation. Water clean up projects/ shore cleanup projects.
- Summer dam releases!!
- There should at minimum be a safe portage trail around the dam. It may also be out of the scope of the project, but a riverside trail that goes from Routrough rd all the way up to the Blue Ridge Parkway would be a wonderful way to access the river gorge below. There is already a lot of trail that goes about halfway up the gorge in Explore Park, so it would be a simple extension.

Additional Comment Responses from Other locations:



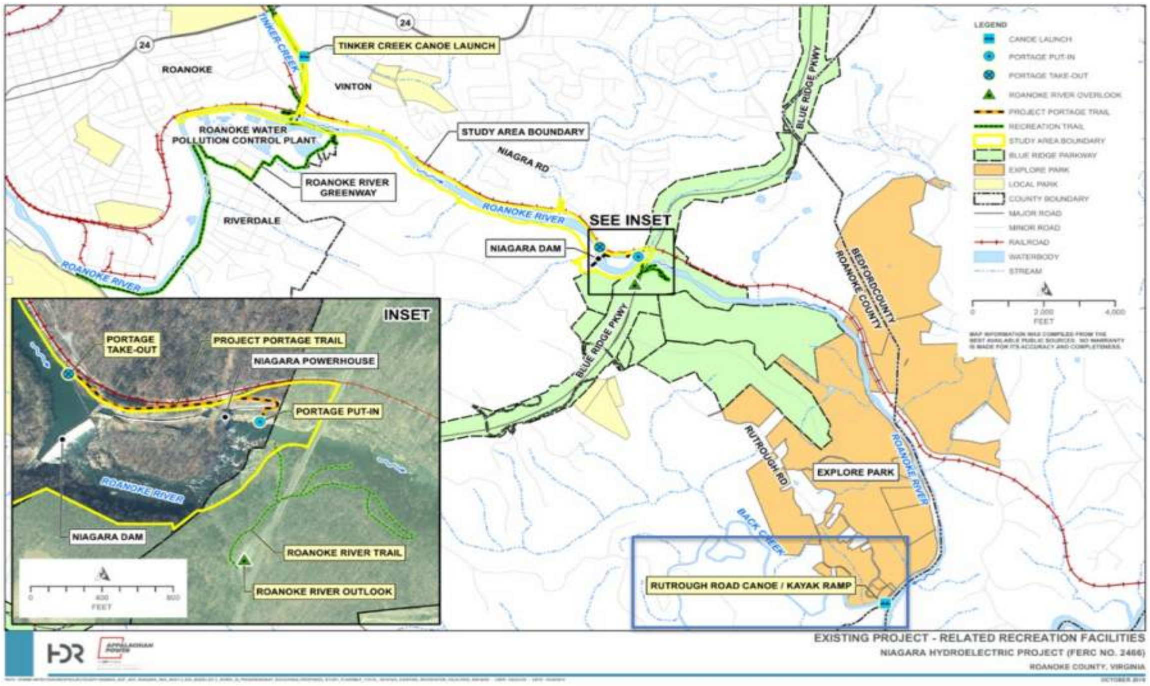
Comments	**#**
Trash / lack of management	2
Regular release of water with schedule / improve water quality	1
Beautiful area, love having it	1
Removal of dam	1
More activities/ additional signage	1

Additional comments: *(verbatim responses)*

- I think there would be great interest in having a calendar of recreational releases in the gorge for the whitewater community. It could be as simple as one weekend a month from June-August, depending on water levels behind the dam. It could do a lot for aquatic life downstream and improve fish habitat as well. Also, as a side note, the gorge below the dam is FULL of trash. I realize its downstream of Roanoke, but every tree along the banks is full of junk from highwater events and there is a lot of larger trash that has been discarded from behind the landfill like tires and appliances.
- Ideally, the dam should be removed to improve paddling and fishing throughout the entire Roanoke River corridor.
- Really appreciate the work that is going into the area and hope to see continued improvements.

Niagara Recreation – *Cumulative Results for Rutrough Road Canoe / Kayak Ramp*

Survey Location:



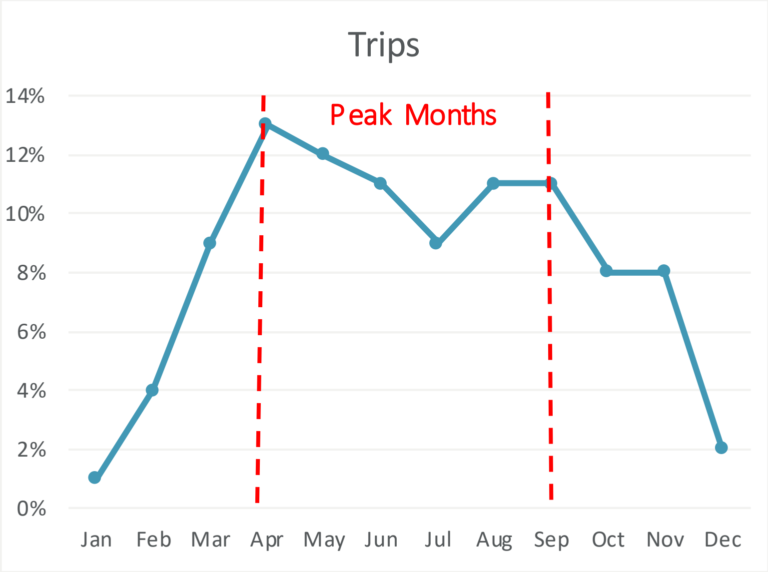
From **April 2020 to October 2020** there have been **27** respondents from **Rutrough Road Canoe / Kayak Ramp**. Overall, **23%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process and is on-going.

Predominately **26%** of the survey respondents come from two zip code locations, which average about **8** miles away from the Project. **89%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3** hours.

Males made up **74%** of the respondents, **63%** in their thirties and sixties.

The most frequent months visited are March through October with September being the highest visited month.

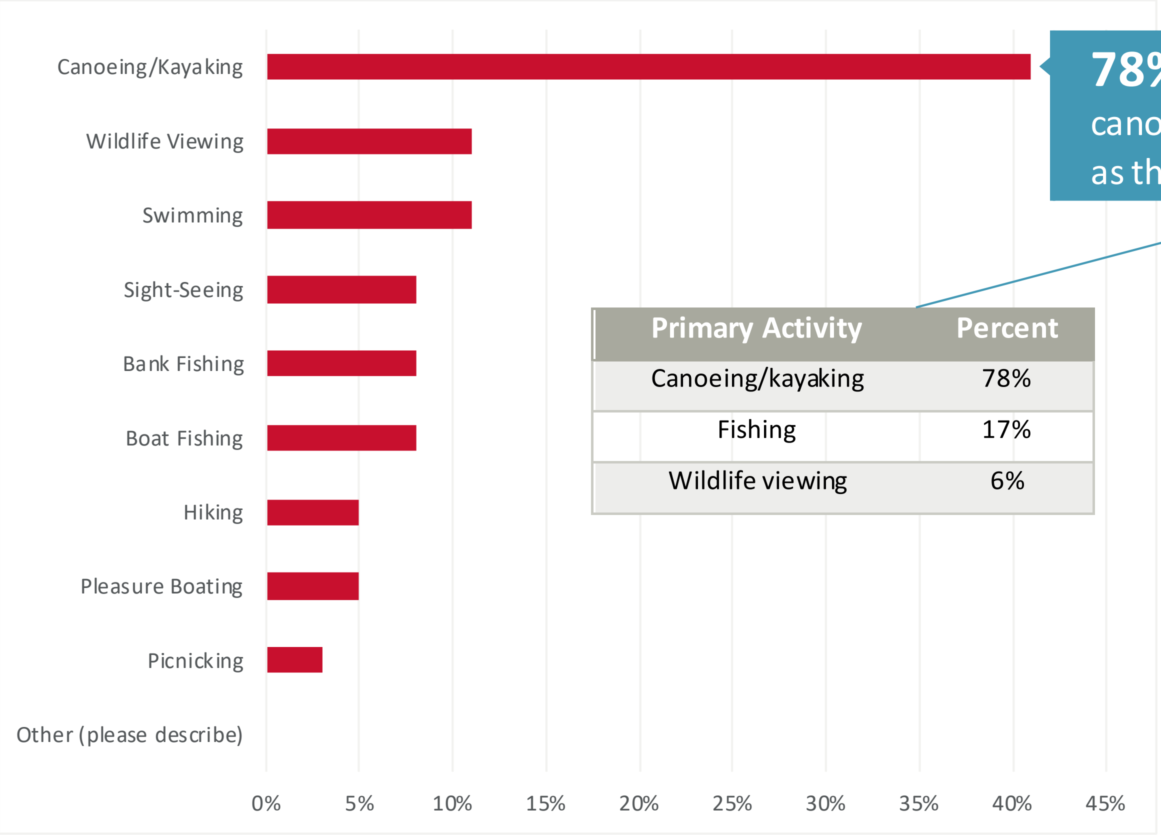


- Zip codes of most frequent visitors: **24014 & 24015**
- Average # of visits per year are **9**
- Average miles traveled: **10**

100% of respondents were not staying overnight in the Niagara Project area.

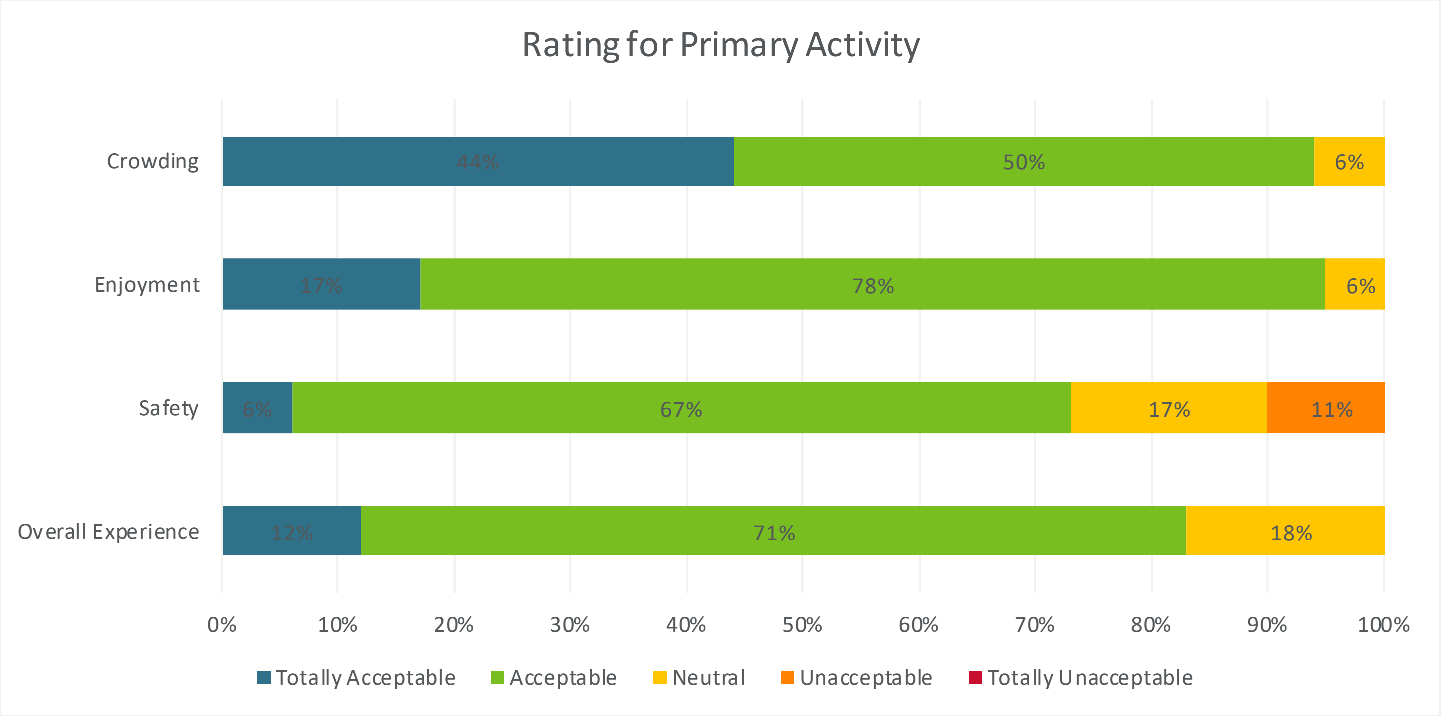
Niagara Recreation – *Cumulative Results for Rutrough Road Canoe / Kayak Ramp*

Activities Participated on Trip:

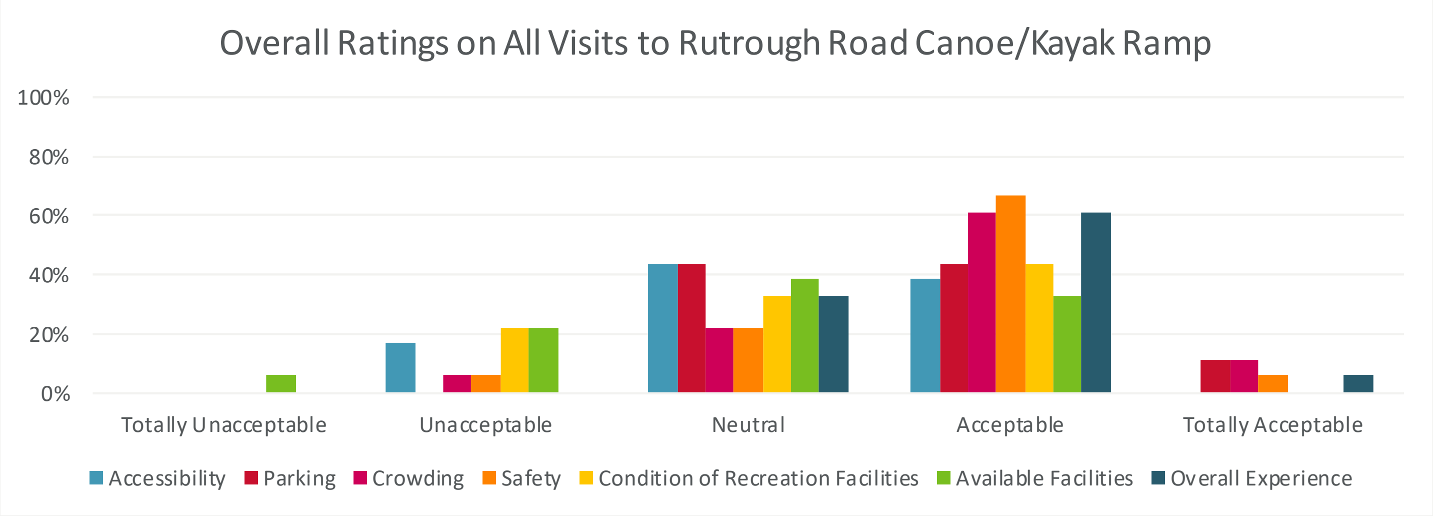


78% selected canoeing/kayaking as the primary activity

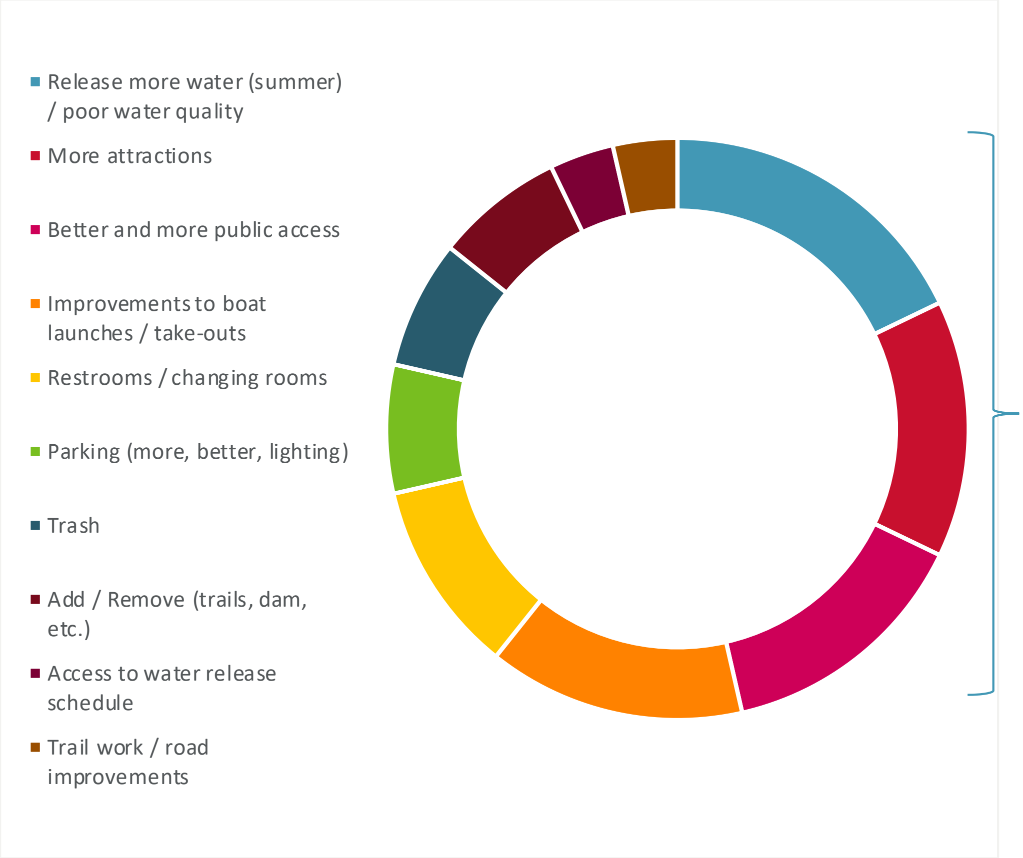
Primary Activity	Percent
Canoeing/kayaking	78%
Fishing	17%
Wildlife viewing	6%



Niagara Recreation – *Cumulative Results for Rutrough Road Canoe / Kayak Ramp*



Suggested Improvement Responses from Rutrough Road Canoe / Kayak Ramp:



Improvement Suggestions	**#**
Release more water (summer) / poor water quality	5
More attractions	4
Better and more public access	4
Improvements to boat launches / take-outs	4
Restrooms / changing rooms	3
Parking (more, better, lighting)	2
Trash	2
Add / Remove (trails, dam, etc.)	2
Access to water release schedule	1
Trail work / road improvements	1

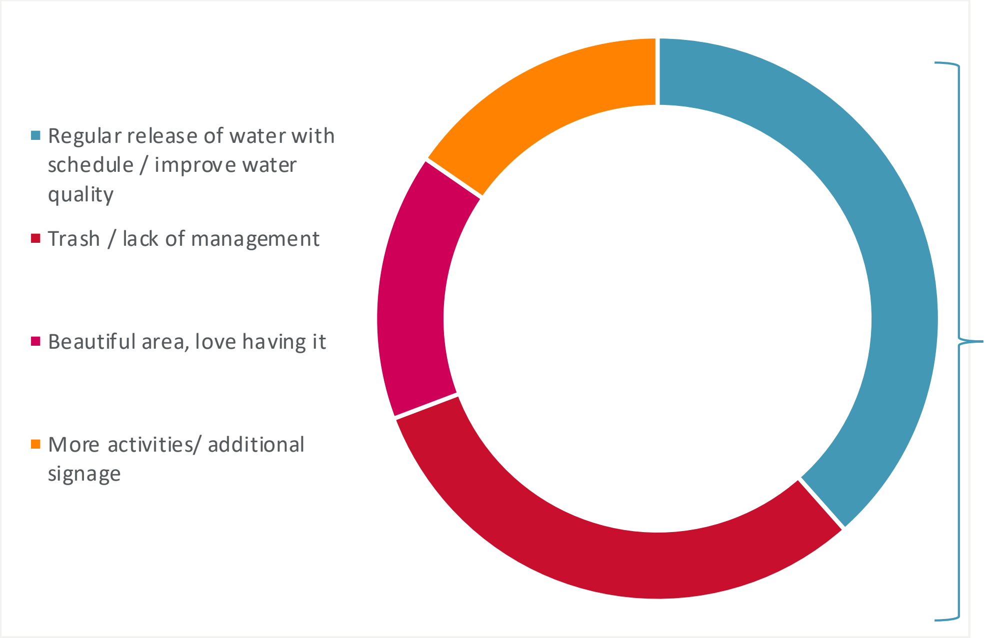
Niagara Recreation – *Cumulative Results for Rutrough Road Canoe / Kayak Ramp*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Niagara Project: *(verbatim responses)*

- Online accessible hydro release schedule. The lack of any hydro release schedule, and recreational releases on weekends and other times during the summer, makes it very difficult to plan canoe and Kayaking outings at the project.
- A quality boat ramp would be nice, especially for people my age & older as well as disabled persons so we can access a unique fishery that is pretty much inaccessible to those other than the young and physically fit individuals.
- Alter the site to create a whitewater park
- Boat ramp improvements. The banks are difficult.
- It would be nice to have some type of system that would make it easier to get kayaks from the parkway parking lot to the river. The stairs are pretty difficult.
- More parking area at rutrough rd. and more accofor fishing.
- more public access throughout the entire Project area
- Planned river releases are needed to ensure the river is at an acceptable level for recreational whitewater kayaking
- Play wave
- Release water! Its a great paddling resource but is only usable after rains. Release water, get more people on the river
- Rutrough Boat Launch needs major improvement. It is a mud hole and difficult for a lot of people who are not familiar with it.
- Rutrough Point: Park benches. No parking in the culdesac. Remove the old house.
- Safer entry into water for boating. Toilets. Road improvement near the end.
- Scheduled water releases, or at least 1 or 2 days notice; and some kind of trash collection at the dam-perhaps a boom. Being downstream from Roanoke means lots of trash along the river.
- The installation of a surf wave or two on the Roanoke River between the dam and Rutrough Point is needed. Also, a bathroom or vault toilet is needed at Rutrough Point. Changing facilities at Rutrough Point would also be welcomed.
- Water quality is poor through the river in this area. We could use more regular flow (release from the dam) in the summer and better water quality (clean up the wastewater treatment plant).

Niagara Recreation – *Cumulative Results for Rutrough Road Canoe / Kayak Ramp*

Additional Comment Responses from Rutrough Road Canoe / Kayak Ramp:



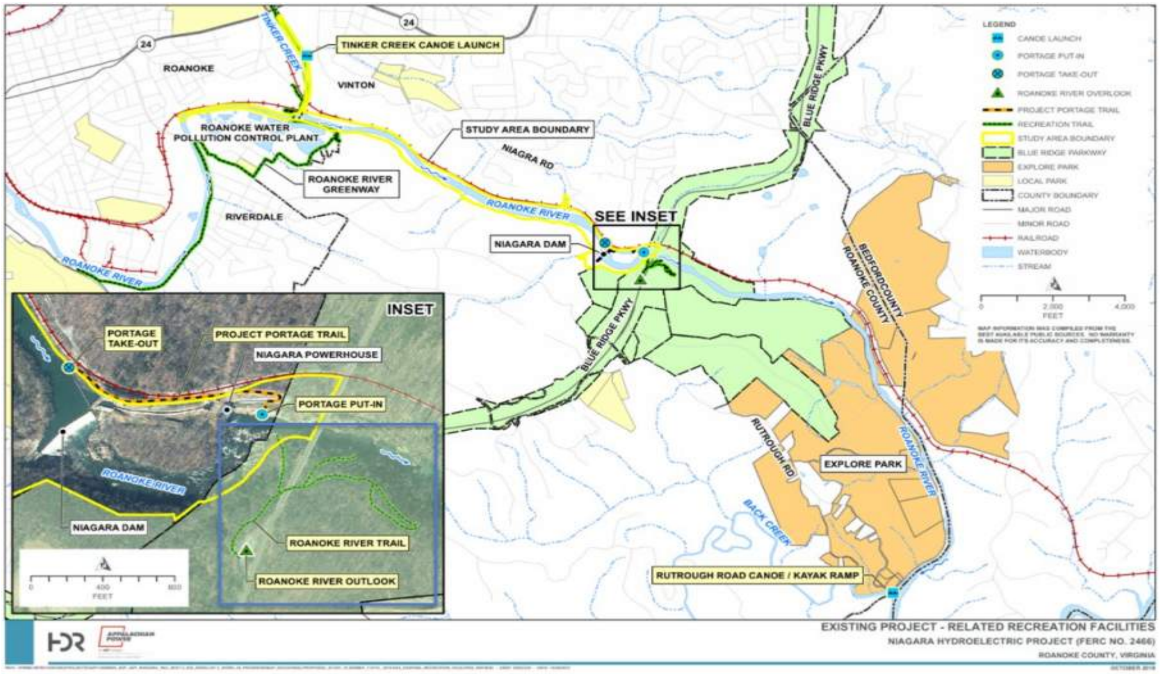
Comments	**#**
Regular release of water with schedule / improve water quality	5
Trash / lack of management	4
Beautiful area, love having it	2
More activities/ additional signage	2

Additional comments: *(verbatim responses)*

- It is a beautiful area for a picnic also.
- My only complaint is the amount of trash on the banks and hanging in the trees.
- Needs more water
- On line accessible hydro release schedule for the power house. The lack of any release schedule, and recreational releases on weekends and other times during the summer, makes it very difficult to plan canoe and Kayaking outings at the project.
- Recreation is a popular and important draw for this area and lots of people enjoy the Roanoke River through this area. Continued recreation and opportunity for portage should be a priority.
- Regular summer releases would be key here. Work with the WVWA to clean up the wastewater treatment plant so the water quality is better.
- The recent improvements are very nice and hope to see more in the future. Thanks
- Trash clean up efforts need to be in the forefront. Also heavy fines for those caught littering. Too much trash on the banks. Also, we need more facilities. Fish cleaning station. Picnic areas etc.

Niagara Recreation – *Cumulative Results for Roanoke River Trail / Overlook*

Survey Location:



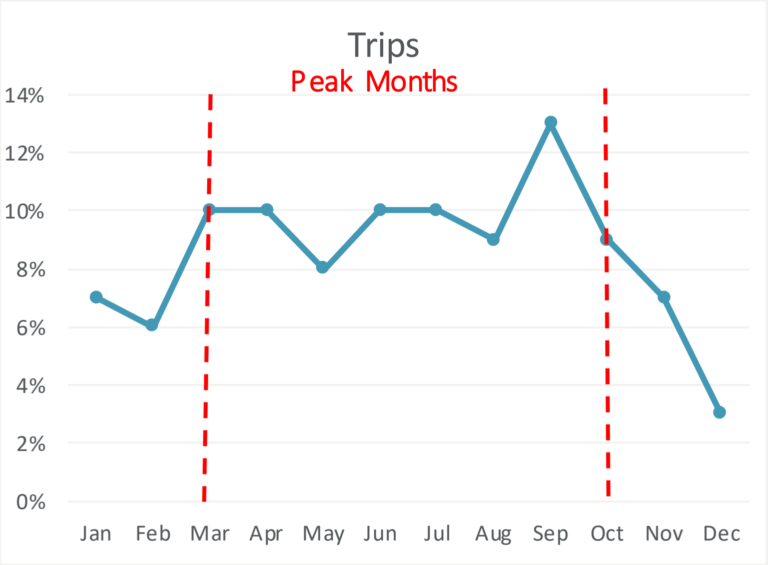
April 2020 to October 2020 there have been **33** respondents from **Roanoke River Trail / Overlook**. Overall, **28%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process and is on-going.

Predominately **45%** of the survey respondents come from four zip code locations, which average about **12** miles away from the Project. **85%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **2** hours.

Males made up **73%** of the respondents, **68%** in their forties, fifties, and sixties.

The most frequent months visited are March through October with September being the highest visited month.

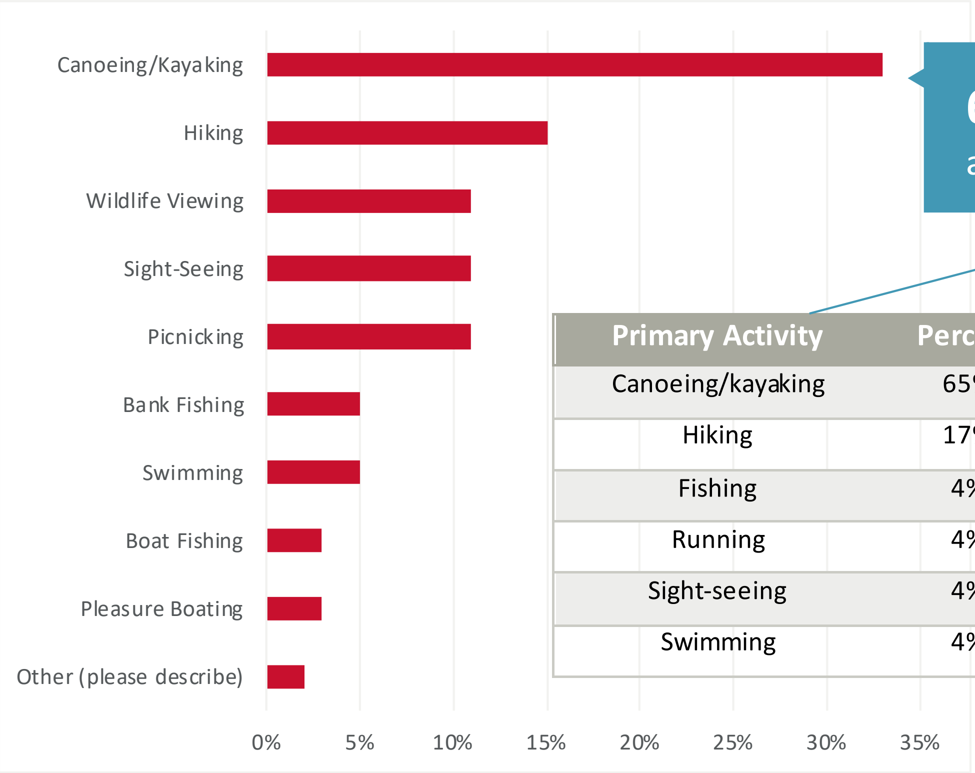


- Zip codes of most frequent visitors: **24015, 24018, 24065 & 24153**
- Average # of visits per year are **9**
- Average miles traveled: **34**

92% of respondents were not staying overnight in the Niagara Project area. Of those staying overnight, **50%** were staying at a vacation or rental home and **50%** were staying at a friend's home.

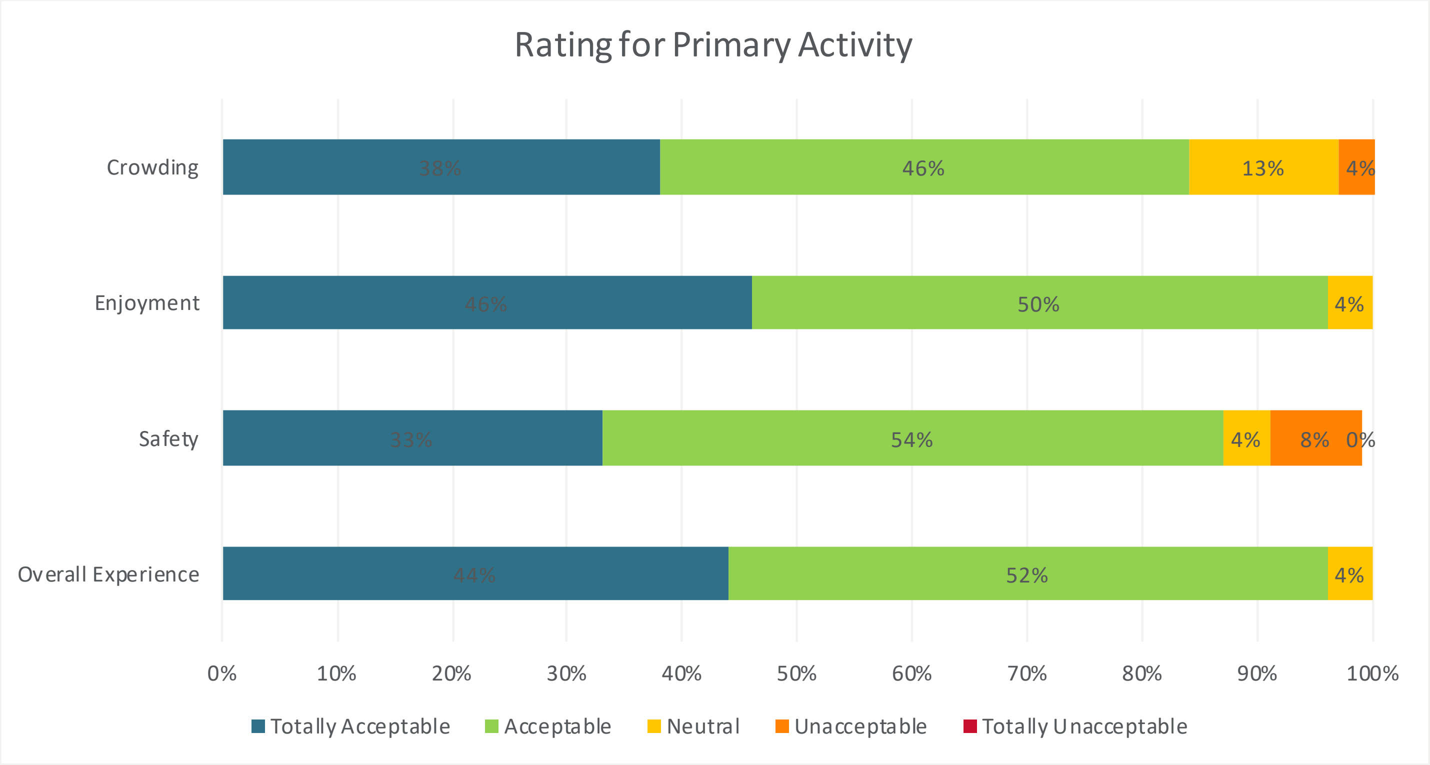
Niagara Recreation – *Cumulative Results for Roanoke River Trail / Overlook*

Activities Participated on Trip:

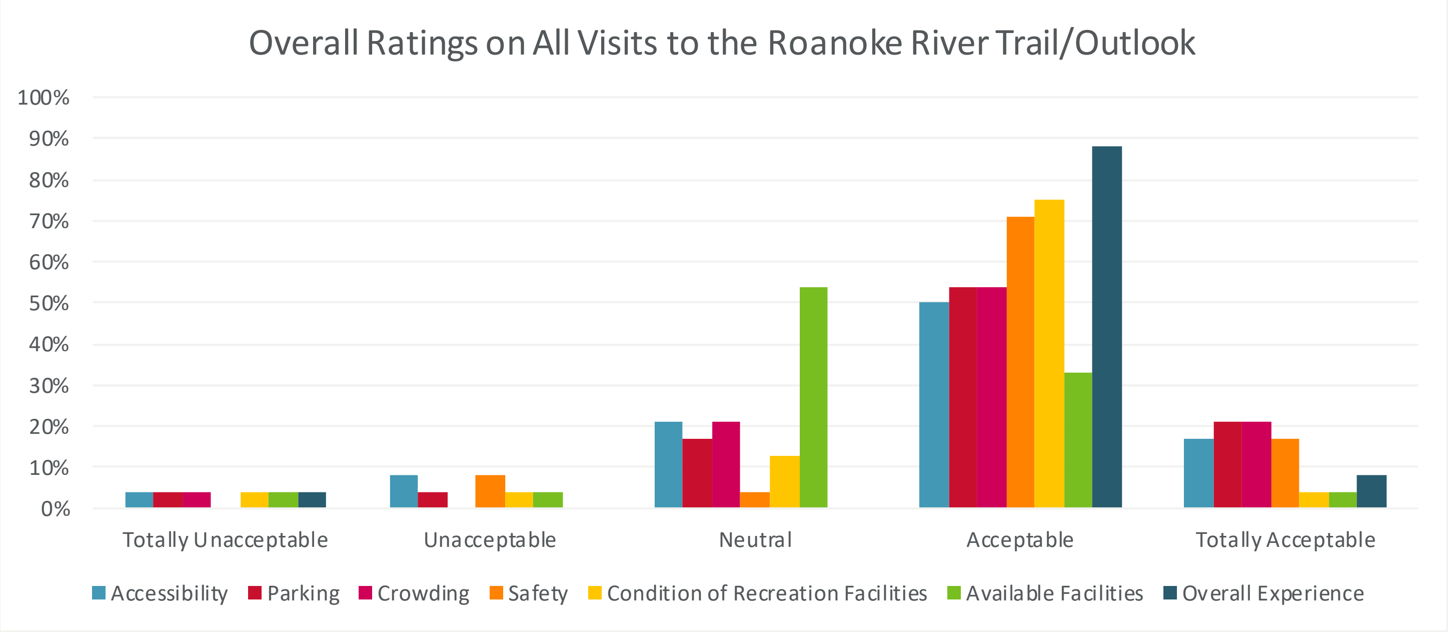


65% selected canoeing/kayaking as the primary activity

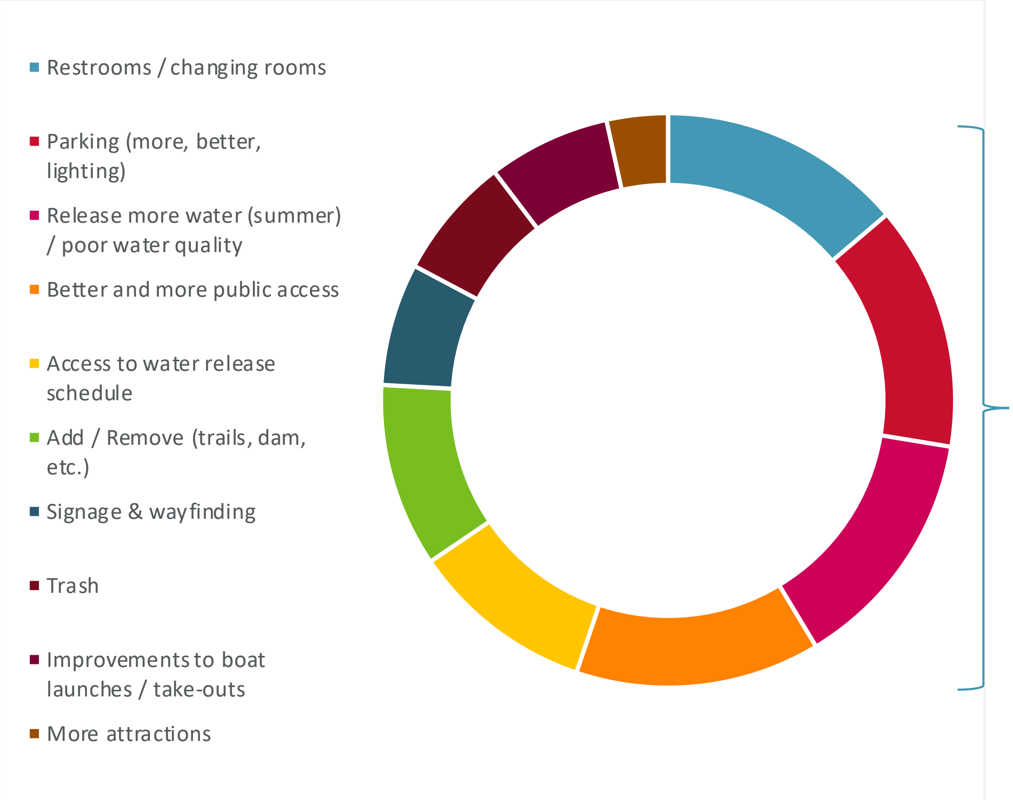
Primary Activity	Percent
Canoeing/kayaking	65%
Hiking	17%
Fishing	4%
Running	4%
Sight-seeing	4%
Swimming	4%


Rating for Primary Activity

Niagara Recreation – *Cumulative Results for Roanoke River Trail / Overlook*



Suggested Improvement Responses from Roanoke River Trail / Overlook:



Improvement Suggestions	**#**
Restrooms / changing rooms	4
Parking (more, better, lighting)	4
Release more water (summer) / poor water quality	4
Better and more public access	4
Access to water release schedule	3
Add / Remove (trails, dam, etc.)	3
Signage & wayfinding	2
Trash	2
Improvements to boat launches / take-outs	2
More attractions	1

Niagara Recreation – *Cumulative Results for Roanoke River Trail / Overlook*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Niagara Project: *(verbatim responses)*

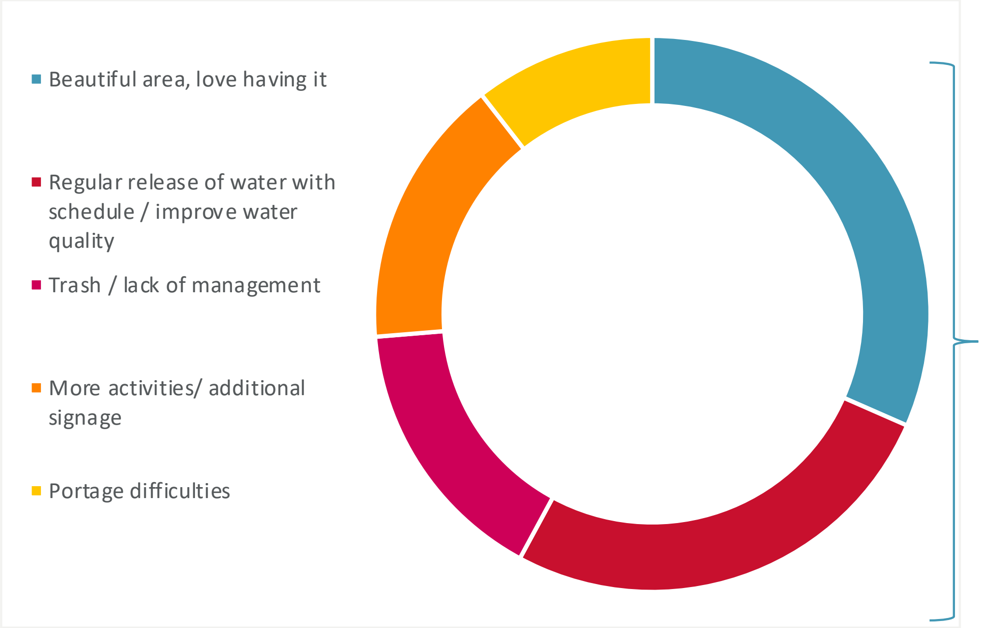
- Any chance we can clean the water up?
- Better boating access at Niagara Dam
- Better canoe/kayak access from the Blue Ridge Parkway, especially a route to the base of the dam so the rapids above the powerhouse can be run. Also I may have missed it, but if there is a way to access the portage route from the parkway that would be desirable, as that put-in may be less steep than the one from the other side of the bridge.
- Bike trail would be nice.
- Dam releases during low water summer months
- General litter pick up along the river banks should by systemically addressed.
- Good for me!
- More access points, ? Open up to put in take out vendors
- more parking
- Need scheduled water releases for paddling in the summer. Need a trail to access the rapids in river between the powerhouse and the dam.The
- Notice of any intentional water releases, and doing them during commonly usable freetime (e.g., weekends, or later afternoons) would be nice
- On line accessible hydro release schedule for the power house.
- Parking at both the put-in (Roanoke River Overlook) and take-out (Explore Park) is limited. Extreme wish list: an easily accessible whitewater park on this stretch
- Parking other than the Blue Ridge Parkway lot
- Recreational dam release dates would be a large driving factor in bringing folks out who tend to take care of and respect the areas in which they play.

  Restrooms and / or changing room facilities would also better accommodate for various recreational opportunities.

  The topography of the area also beckons for additional trails to allow for mountain biking travel in addition to the current hiking trails. This could, again, bring yet another crowd in that seems to care for areas that they recreate in.
- Scheduled releases for the Roanoke river gorge for kayaking
- show Tinker Creek Greenway trail on your map. ADA facilities are non-existant. Lack of public restroom facilities. Poor NPS type informational and wayfinding signs. Lack of bank fishing opportunities.
- Summer time release of Niagara dam
- Toilet facility at NPS put-in and Rutrough take out. More parking at Rutrough if use increases. There's a lot of trash on this River run, which was the primary reason I scored the experience as less enjoyable. LOVE having the RRG as a local kayaking resource.

Niagara Recreation – *Cumulative Results for Roanoke River Trail / Overlook*

Additional Comment Responses from Roanoke River Trail / Overlook:



Comments	**#**
Beautiful area, love having it	6
Regular release of water with schedule / improve water quality	5
Trash / lack of management	3
More activities/ additional signage	3
Portage difficulties	2

Additional comments: *(verbatim responses)*

- Great place to have in Roanoke. Would love to see releases more often.
- Its a cool area and the locals would love there to be an investment but the water needs to get cleaned up first.
- Like to stop the litter bugs!
- Such a beautiful area should have a host of activities to be enjoyed by all! Fishing and biking is great but the opportunities are ample! Especially with explore park in such close proximity, the two provide great terrain for boating, zip lining, mountain biking, hiking, and much more.

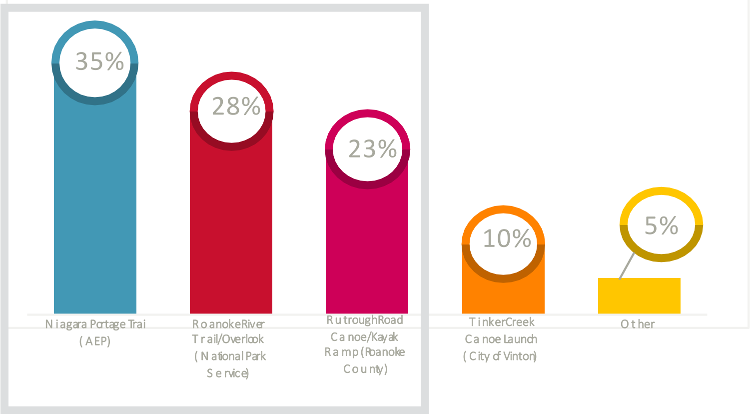
  The trails already in place could also use some more interpretive features such as signage at unique species and vistas to explain the importance of each and educate the public on caring for them.
- The lack of any release schedule, makes it very difficult to plan canoe and Kayaking outings at the project.
- The river rapids between the dam and powerhouse are much underutilized for recreation. Some regular water releases in this bypass section and access trail would greatly improve utilization.
- There's a lot of trash on this River run, which was the primary reason I scored the experience as less enjoyable. I LOVE having the RRG as a local kayaking resource and would love to see some summer releases.
- This is a nice stretch of whitewater and an asset to the community. Every effort should be taken to preserve it and maintain access for the community.
- This is the best in-town run for boaters who want a lap after work and is underutilized by the community due to conditions/trash and accessibility

- Wonderful urban whitewater asset accessible most of the year. With additional signage, programming, and engagement from the region, this could be a more publicly enjoyed amenity and thus help the region address public health and economic development weaknesses.

- Would love to see a recreational focus on portage improvements to promote connectivity between the city blueway, and the river, Explore park, and SML below the dam. What about portage river-right an option? That would be shorter, and put users at the "bypass reach" (?) for smoother continuous use of water by kayakers, tubers, canoeists, etc., and improve a trail for times when the reach is too shallow. Apco owns land around the SW edge of the dam, and appears to be ample room. I would think some public money could be made available to assist with it. Looks like some safety measures would have to be implemented to prevent inadvertent drifting over the dam and spillway in the SW corner. I leave the technical discussion for later, but perhaps a safety-buffered 'raceway' that is usable other than during high water to get safely near the dam prior to exit, but which would be submerged during flooding, protected from floating debris, etc., at times when access would be deemed closed due to high water anyway. A short trail then winding down to the bypass reach? A 'flume' for canoes and kayaks, to get them down to the waterway below, would be cool, but I imagine that would be too involved and present too many liability issues, especially if there were any chance of them being ridden by people. In the alternative, keeping the old portage, then a better system for use of boat toting rigs, including some sort of return system so that borrowing one doesn't mean walking another 1/2 mile to return it, then go back to the river below the dam. Or perhaps some sort of narrow boat-dragging lane with fake grass or some other non-damaging surface, with minimal friction, to drag a boat along the 1/4 mile route? The lake was once an active social area with row boats, etc. Would be nice to see it revived as a well-functioning part of the Roanoke River Blueway.

Niagara Recreation – *Overall* Online *Summary Results*

Survey Locations:



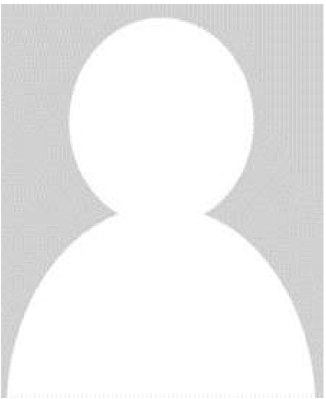
From **April 2020** to **October 2020** there have been **120** respondents various locations within Niagara Recreation Project Area who completed this survey. Overall, **86%** of the responses primarily came from three locations: Niagara Portage Trail (AEP), Roanoke River Trail/Overlook (National Park Service), and Rutrough Road Canoe/Kayak Ramp (Roanoke County).

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process and is an on-going study.

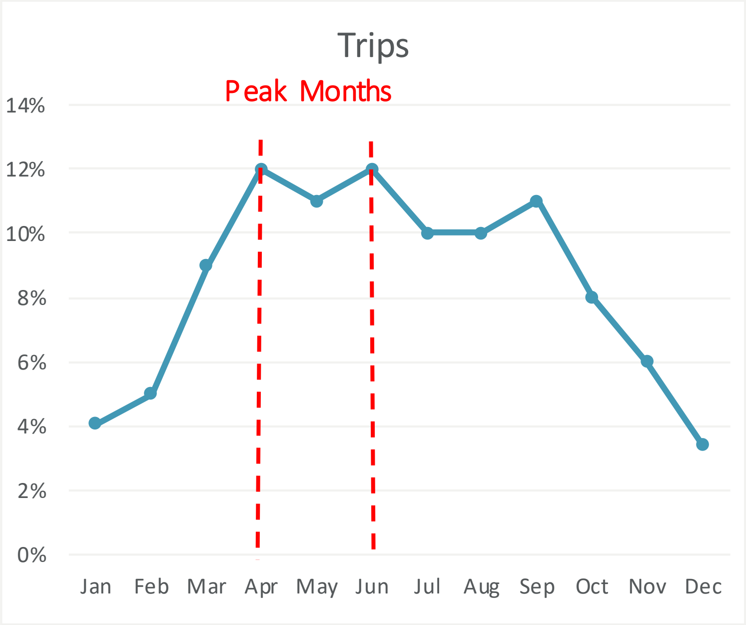
Predominately **45%** of the survey respondents come from four zip code locations, which are on average **9** miles away from the Project. **88%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3.5** hours.

Males consist of **76%** of the respondents, **45%** in their thirties and forties.

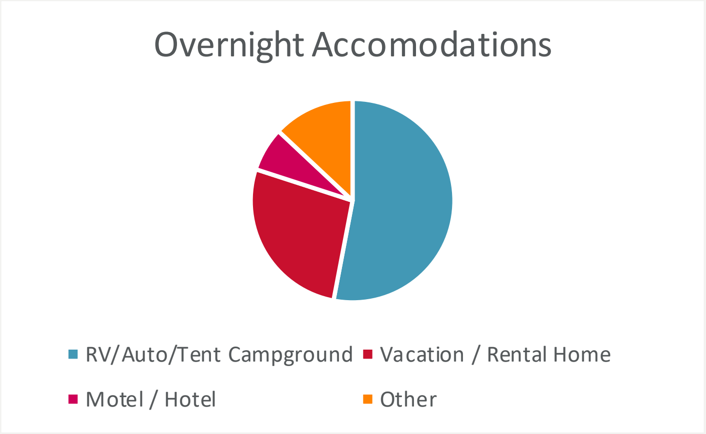
The most frequent months visited are from April to September, and April and June are the peak months.



- Zip codes of most frequent visitors; **24014, 24015, 24018 & 24179**
- Average # of visits per year are **10**
- Average miles traveled **20**

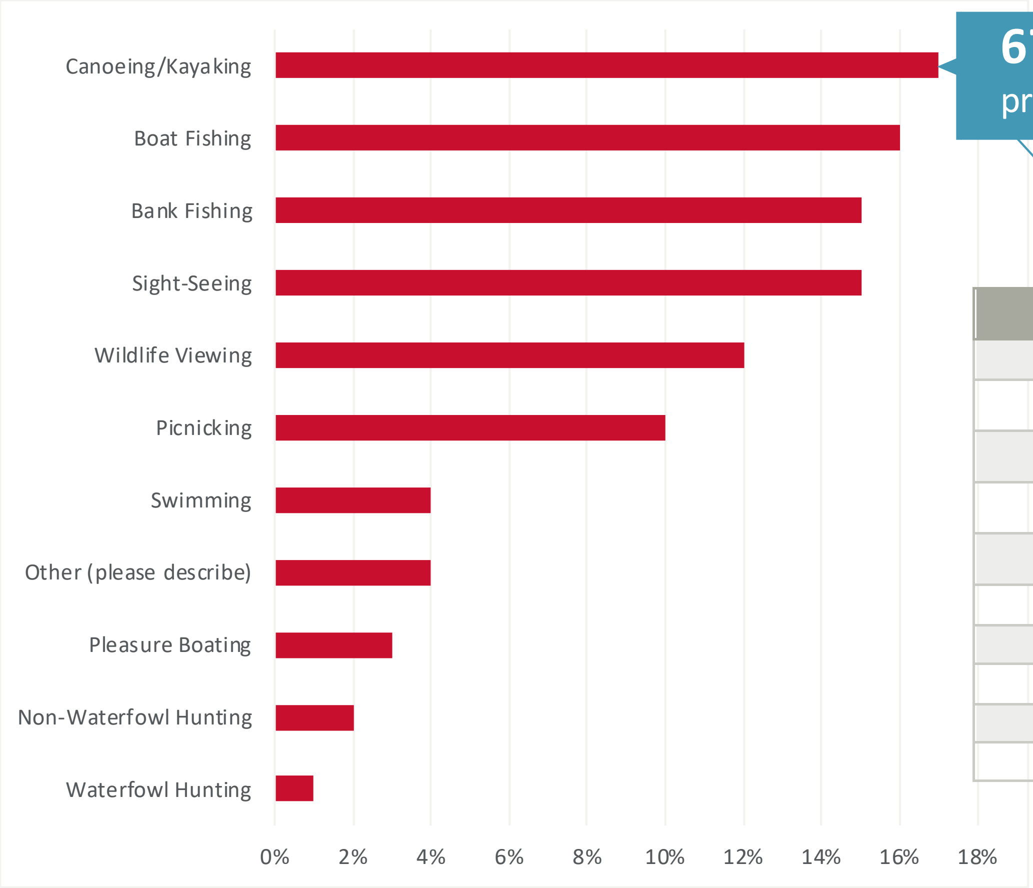


97% of respondents were not staying overnight in the Project area. Of the **3%** that were staying overnight here is a breakdown of the accommodations they were staying:



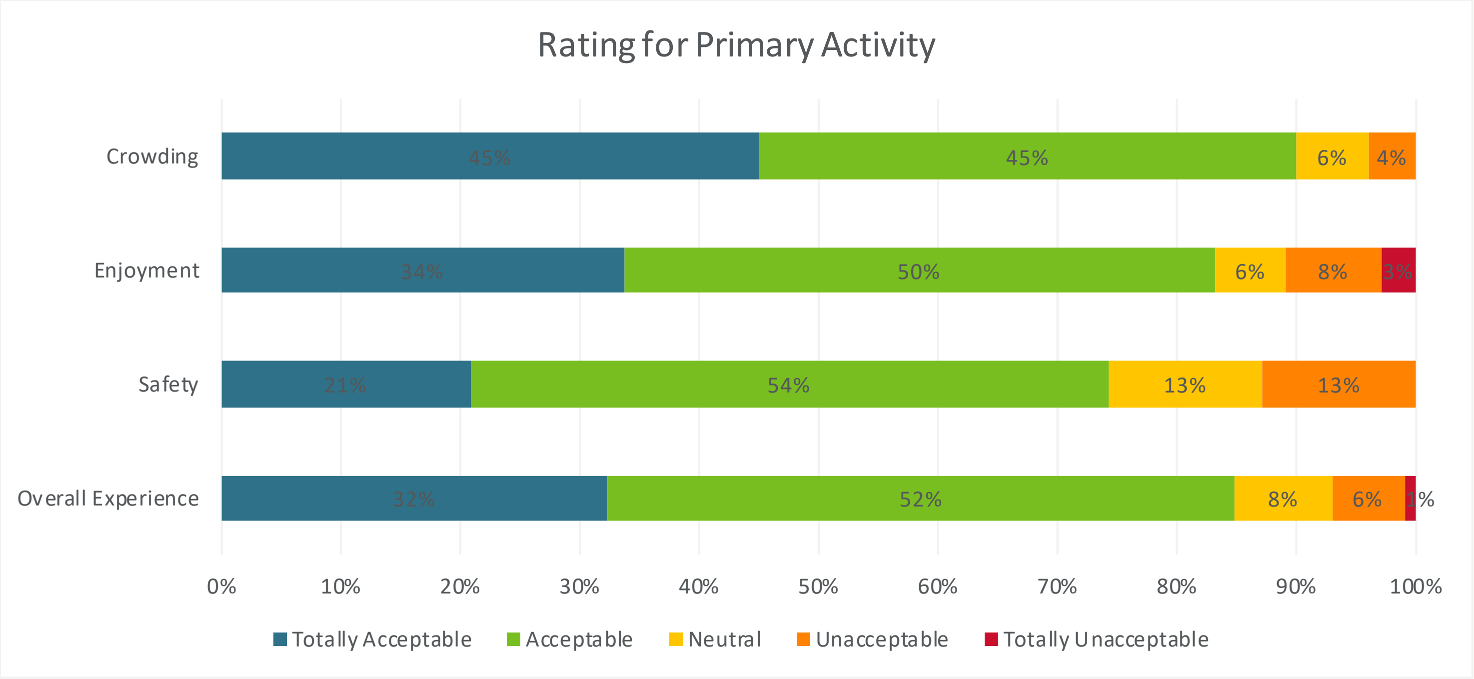
Niagara Recreation – *Overall Online Summary Results*

Activities Participated on Trip:

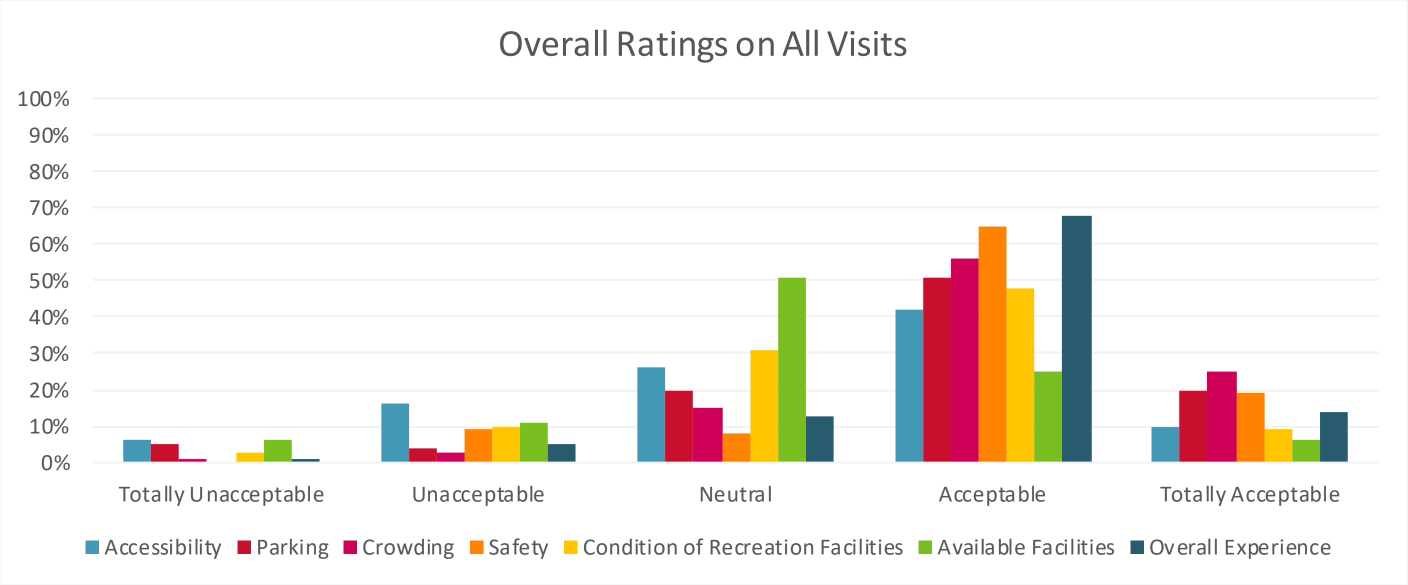


67% Canoeing/kayaking is the primary activity

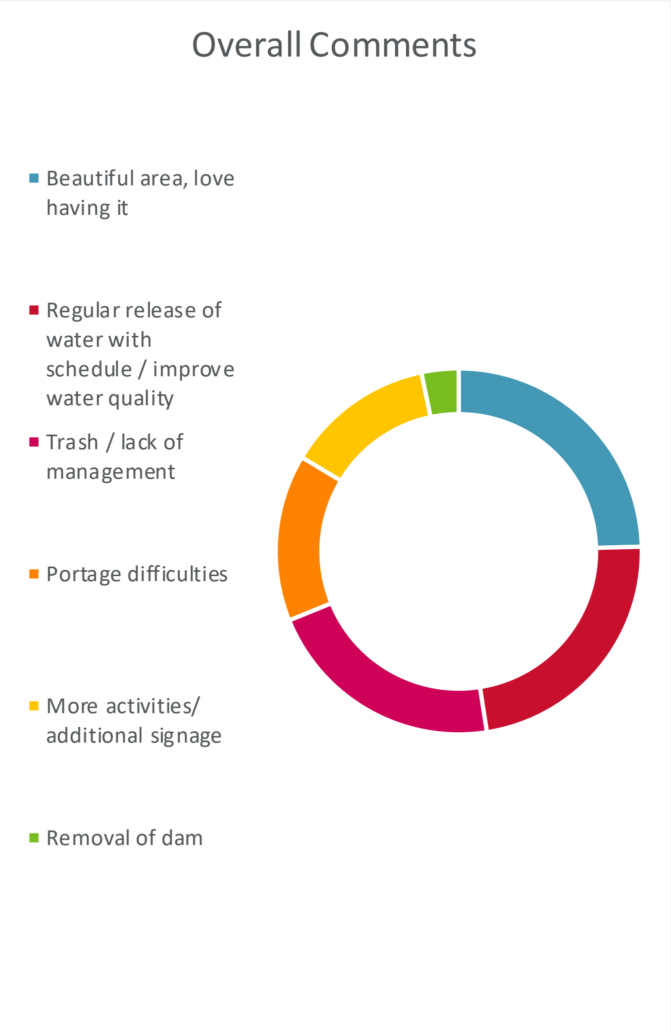
Primary Activity	Percent
Canoeing/kayaking	67%
Fishing	17%
Hiking	6%
Sight-seeing	3%
Picnicking	1%
Pleasure boating	1%
Running	1%
Swimming	1%
Tubing	1%
Wildlife viewing	1%



Niagara Recreation – *Overall Online Summary Results*



Improvement Suggestions	**Count**
Better and more public access	22
Improvements to boat launches / take-outs	20
Release more water (summer) / poor water quality	16
Trash	11
Restrooms / changing rooms	10
Parking (more, better, lighting)	9
Add / Remove (trails, dam, etc.)	9
More attractions	8
Access to water release schedule	5
Signage & wayfinding	3
Trail work / road improvements	3

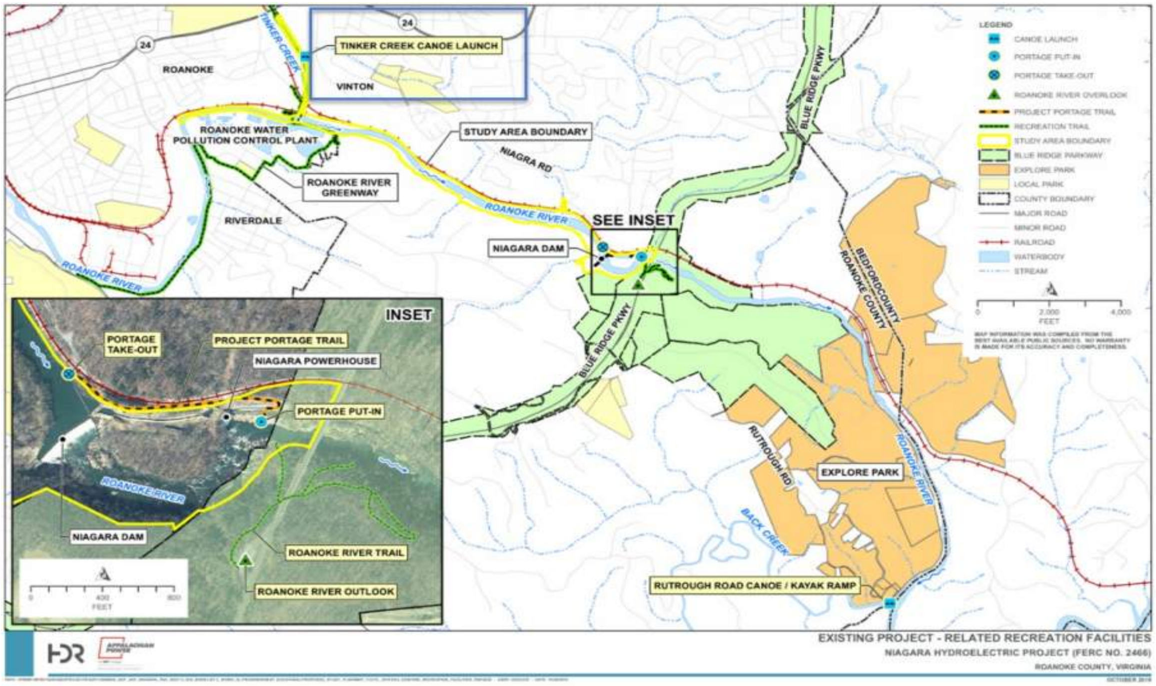


Overall the comments from the respondents show that almost 25% “love” having the Niagara recreation site(s) and would like to see a regular release of water to improve overall water quality. They would also like to see the trash picked-up.

The top **2** suggestions for improvement include better and more public access with improvements to portages.

Niagara Recreation – *Cumulative Results for Tinker Creek Canoe Launch*

Survey Location:



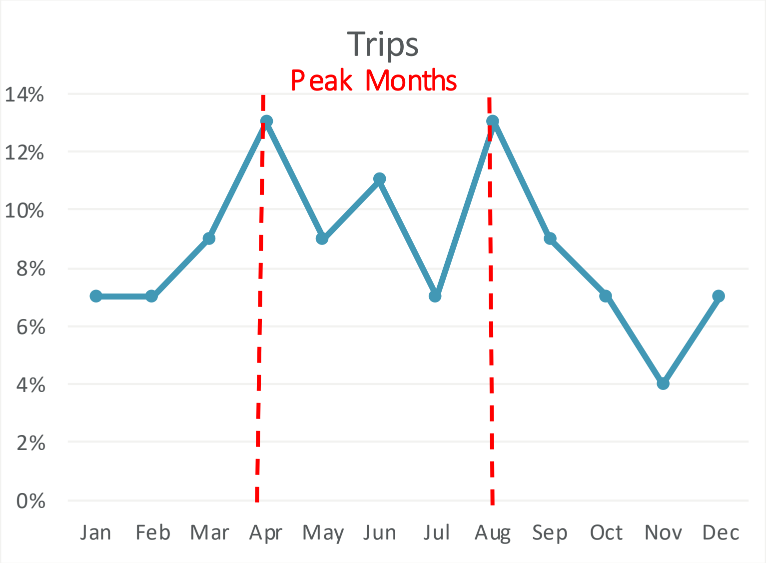
From **April 2020 to October 2020** there have been **12** respondents from **Tinker Creek Canoe Launch**. Overall, **10%** of the responses came from this location.

These respondents answered questions about their use of the recreation facilities. This data is collected to support the Federal Energy Regulatory Commission (FERC) relicensing process and is on-going.

Predominately **50%** of the survey respondents come from one zip code location, which is about **4** miles away from the Project. **86%** consider themselves to be regular visitors to the area with at least 3 or more times a year with an average length of stay being **3** hours.

58% of the respondents were male, 42% were female, and **50%** of the respondents were in their thirties and forties.

The most frequent months visited are April through August with April and August being the highest visited months.

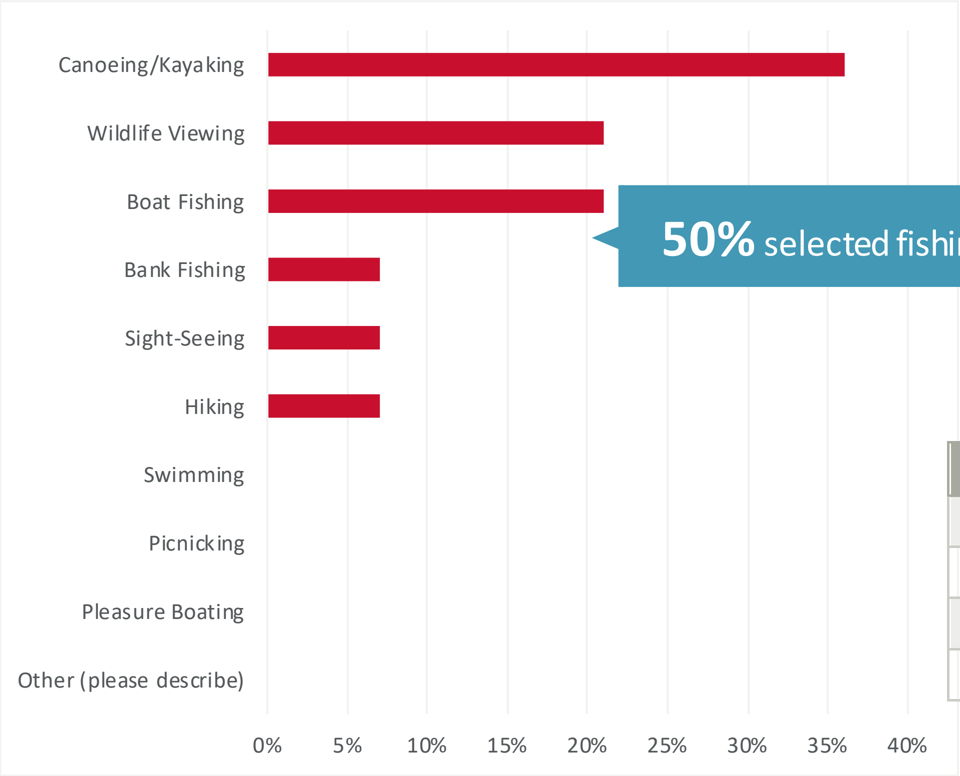


- Zip code of most frequent visitors: 24179
- Average # of visits per year are 23
- Average miles traveled: 4

100% of respondents were not staying overnight in the Niagara Project area.

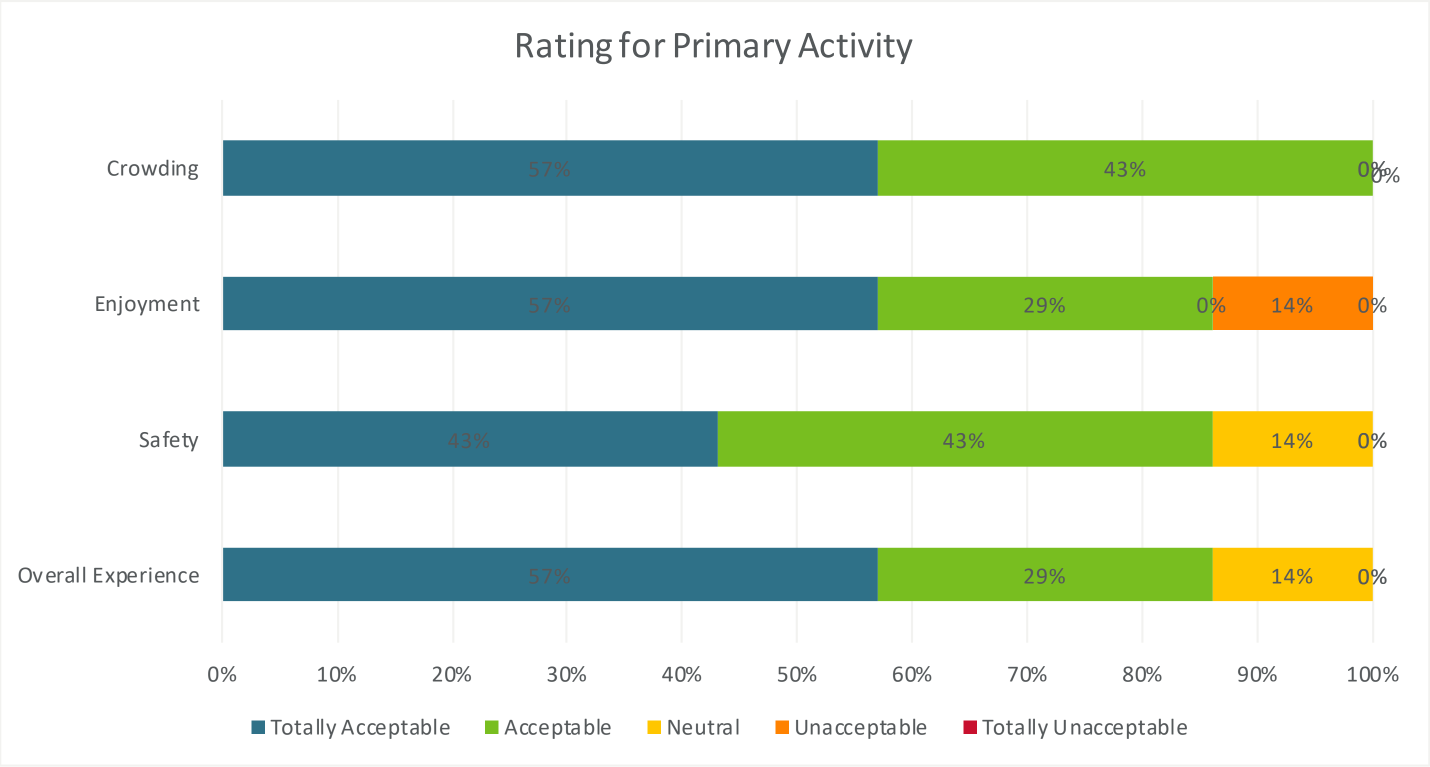
Niagara Recreation – *Cumulative Results for Tinker Creek Canoe Launch*

Activities Participated on Trip:

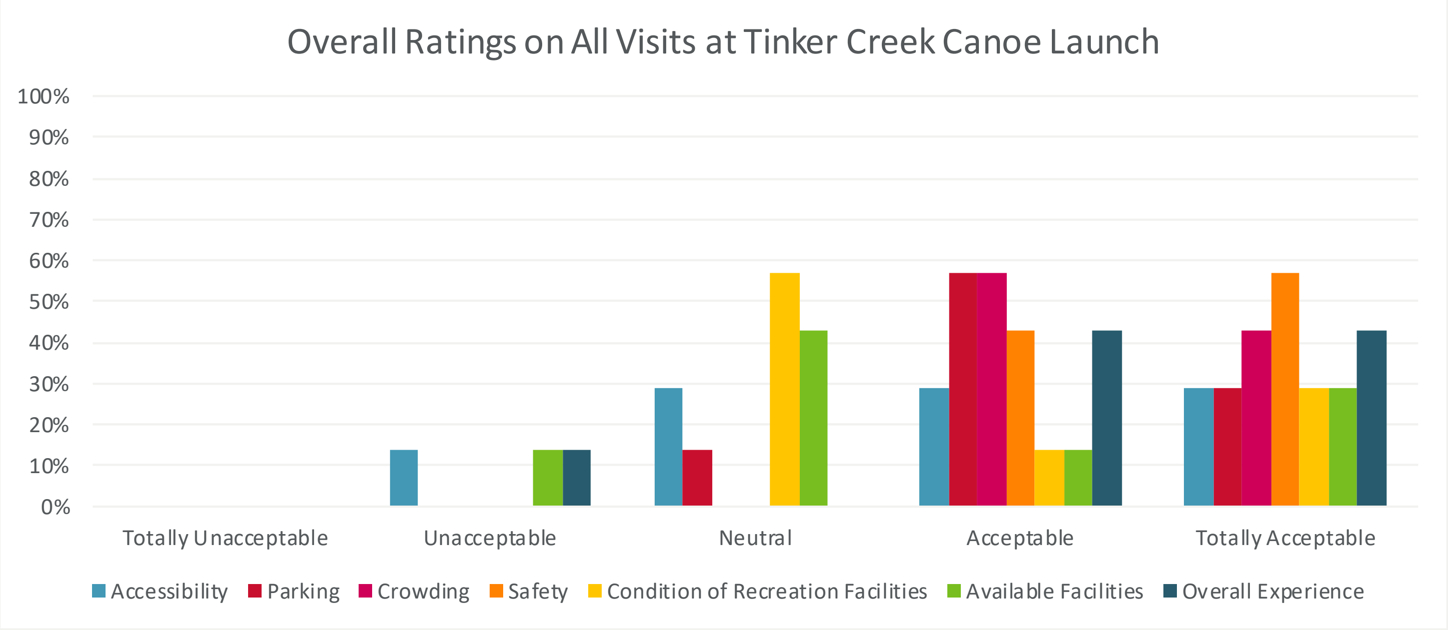


50% selected fishing as the primary activity

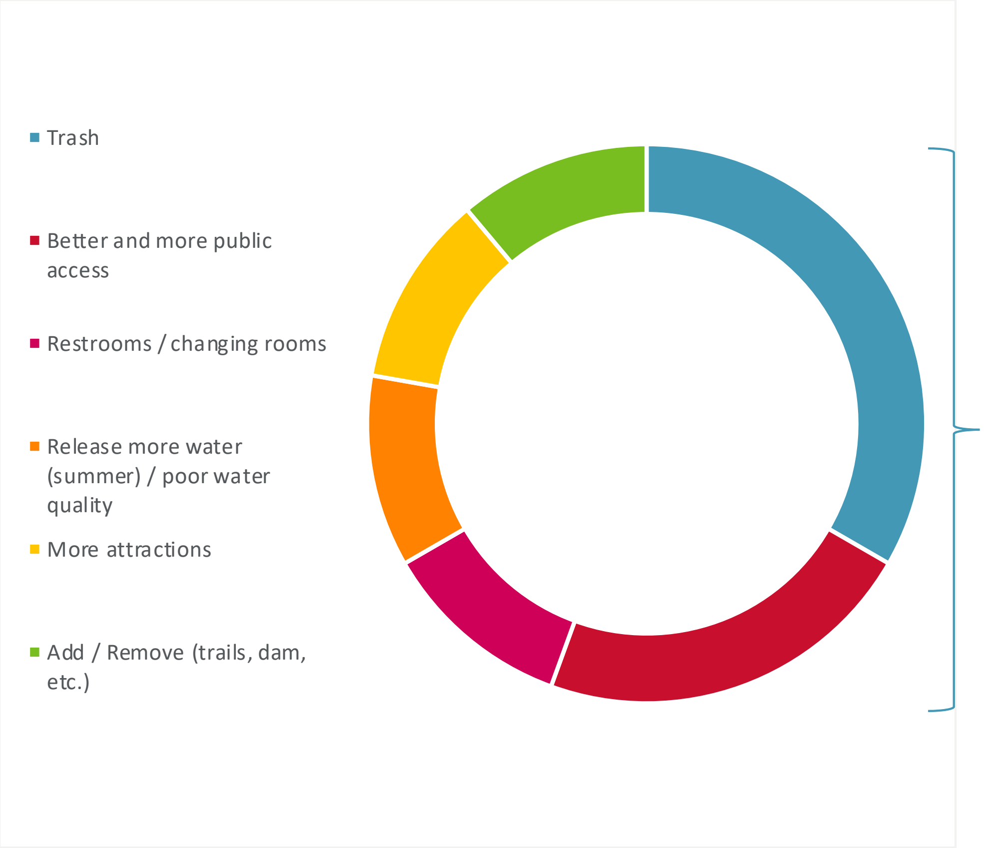
Primary Activity	Percent
Fishing	50%
Canoeing/kayaking	17%
Picnicking	17%
Sight-seeing	17%



Niagara Recreation – *Cumulative Results for Tinker Creek Canoe Launch*



Suggested Improvement Responses from Tinker Creek Canoe Launch:



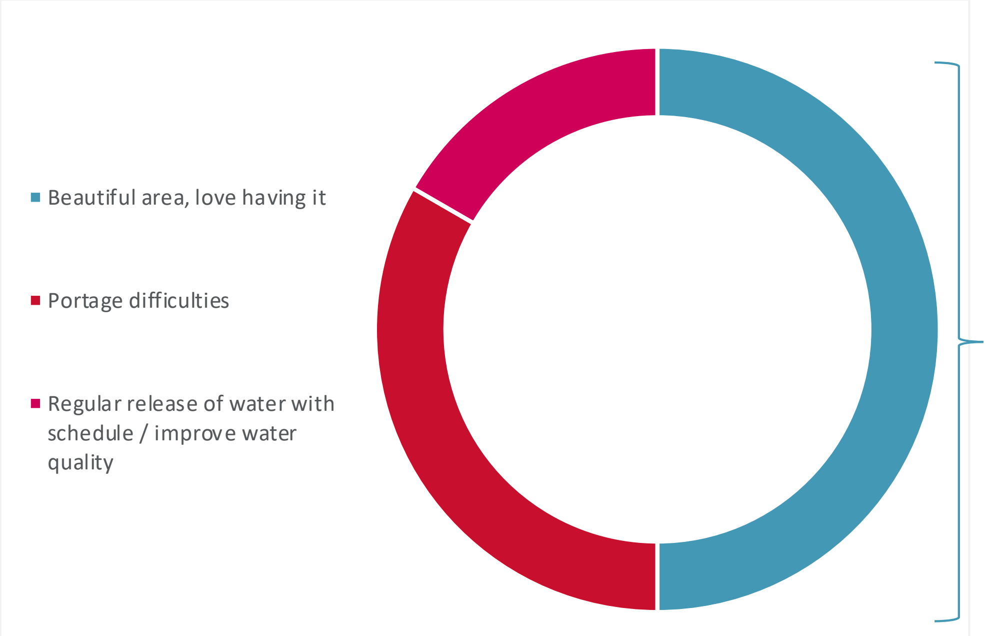
Improvement Suggestions	**#**
Trash	3
Better and more public access	2
Restrooms / changing rooms	1
More attractions	1
Add / Remove (trails, dam, etc.)	1

Niagara Recreation – *Cumulative Results for Tinker Creek Canoe Launch*

Type(s) of recreation facilities or improvements respondents believe are needed and at what specific location(s) at the Niagara Project: *(verbatim responses)*

• Anything to attract more visitors!! I live about a mile up above the dam!
• Better access for fisherman.
• Not allowed to get in the water
• Portajohn
• Removal of Niagara Dam
• Water quality and/or trash improvements; Removal of the large number of tires that are falling in from the closed landfill just downstream of the Blue Ridge Parkway on river right; Removal of trash in the gorge

Additional Comment Responses from Tinker Creek Canoe Launch:



Comments	**#**
Beautiful area, love having it	3
Portage difficulties	2
Regular release of water with schedule / improve water quality	1

Additional comments: *(verbatim responses)*

• Great asset for the valley
• I go to either Tinker Creek and paddle flatwater to the dam and back or go to the Blue Ridge Parkway access and paddle to Explore Park. I go many times a year between these two locations. Each is a jewel. Water quality is the biggest problem. Also, the portage at Niagra Dam is rough - the takeout often has deep floating garbage and the walk is not short. It would be helpful to have a portage on River Right also for whitewater boaters to more easily access the good rapids between the dam and the powerhouse.
• Looks nice
• Very beautiful place!! A lot of people do not know about it!!

Attachment 3

Attachment 3 – Aesthetic Photolog

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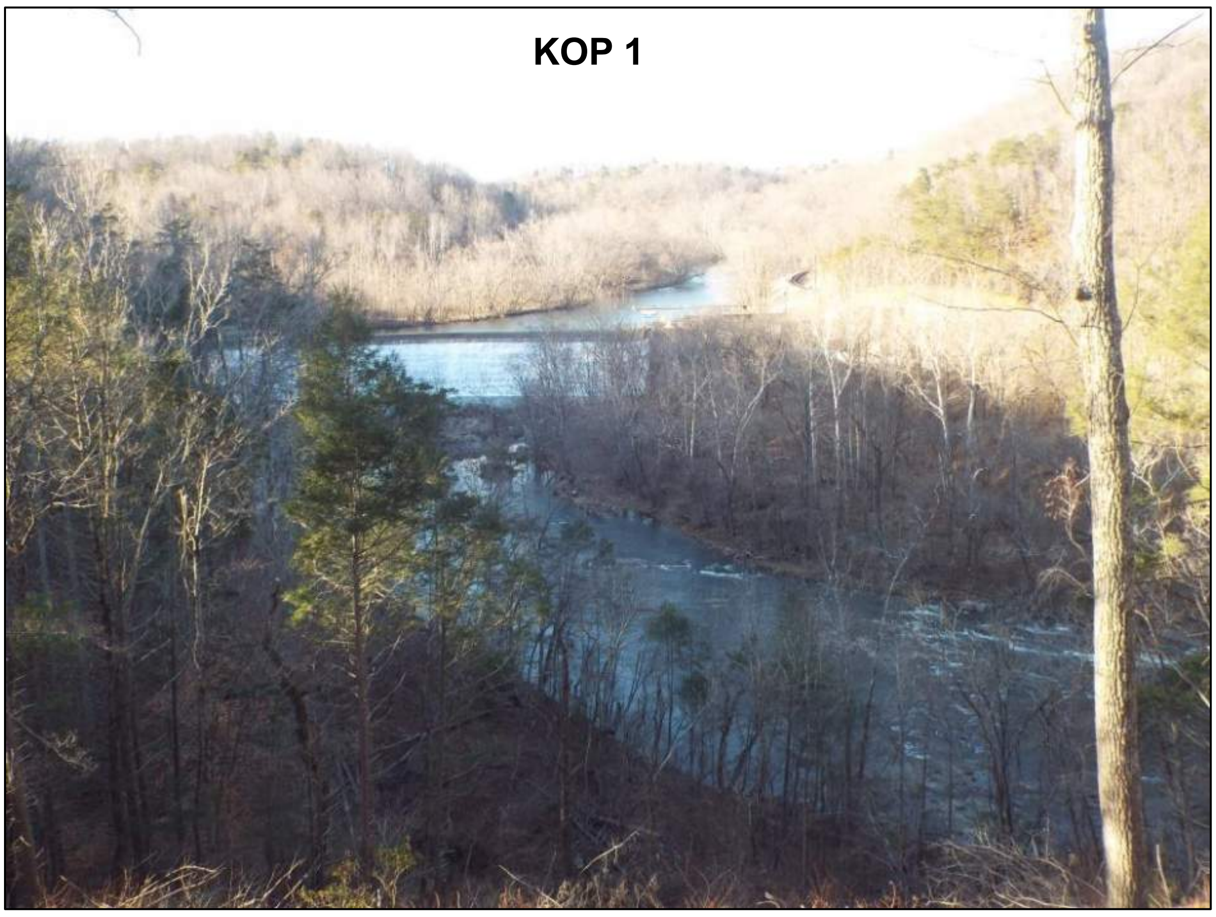
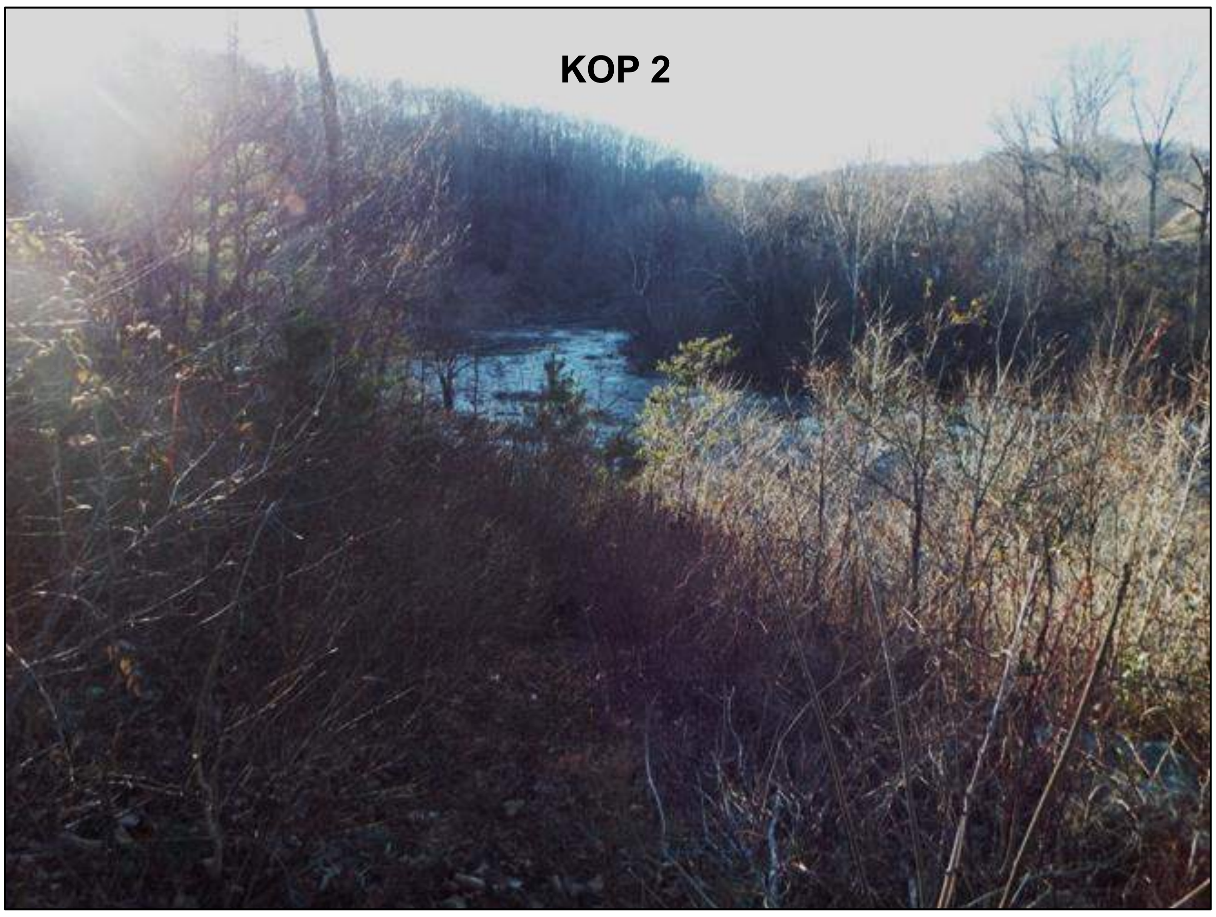
Figure 3-1. November 15, 2019, estimated 24 cfs





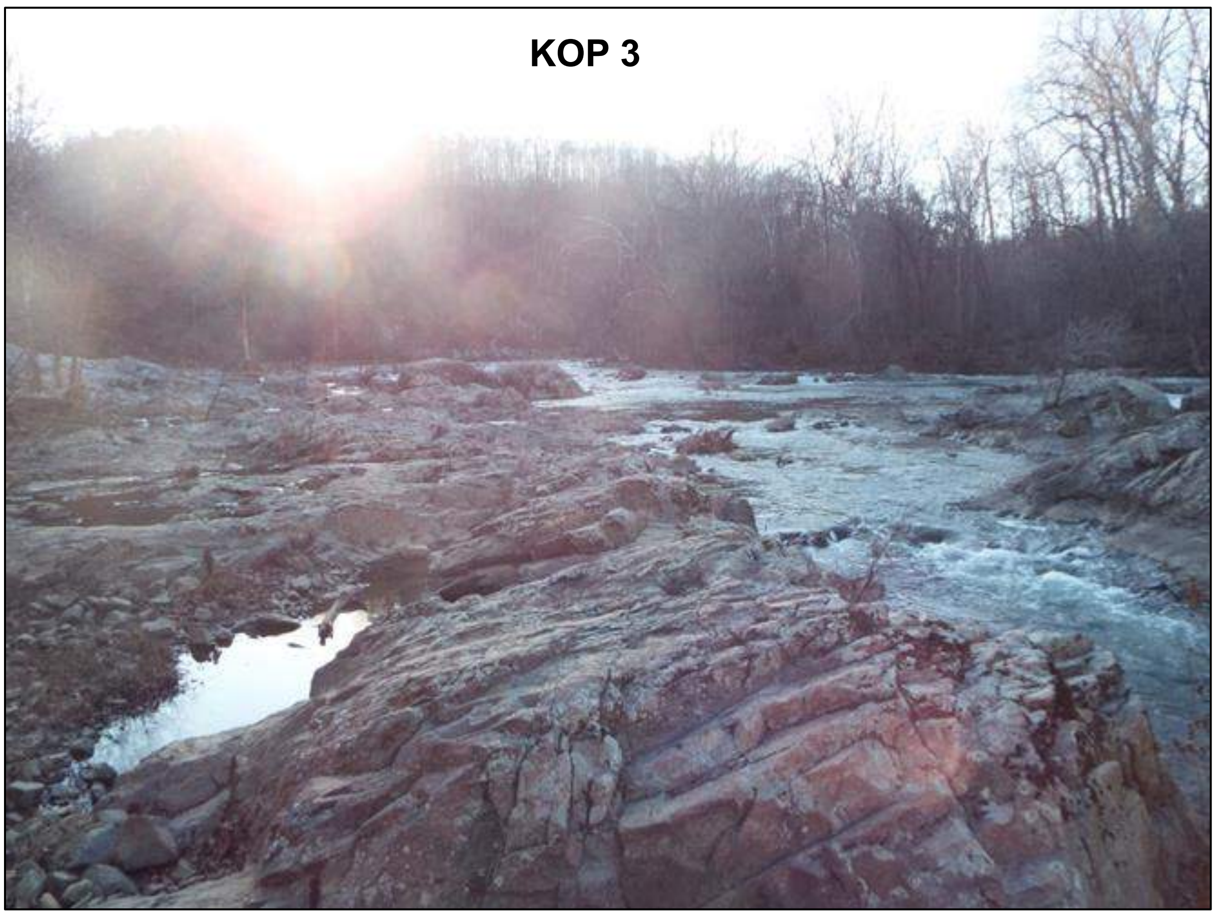
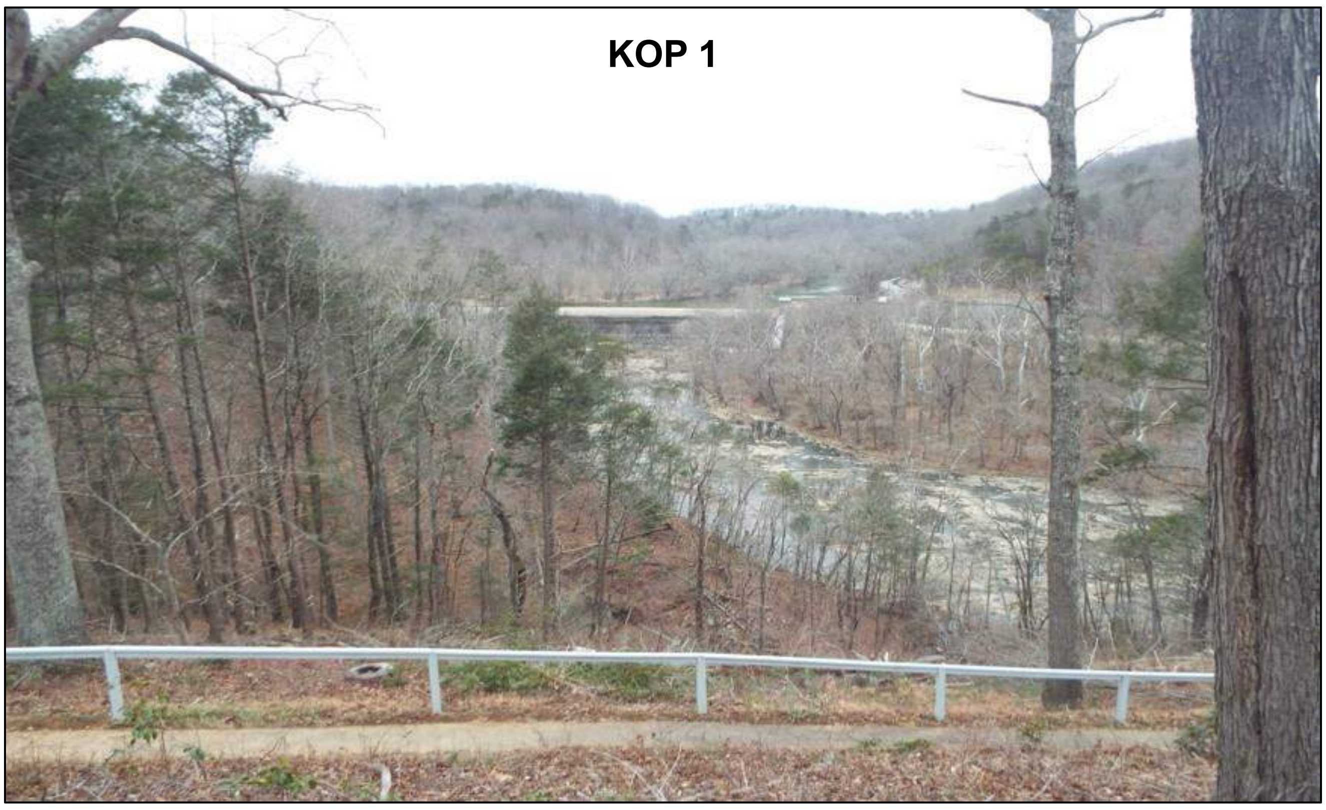


Figure 3-2. January 1, 2020, estimated 332 cfs



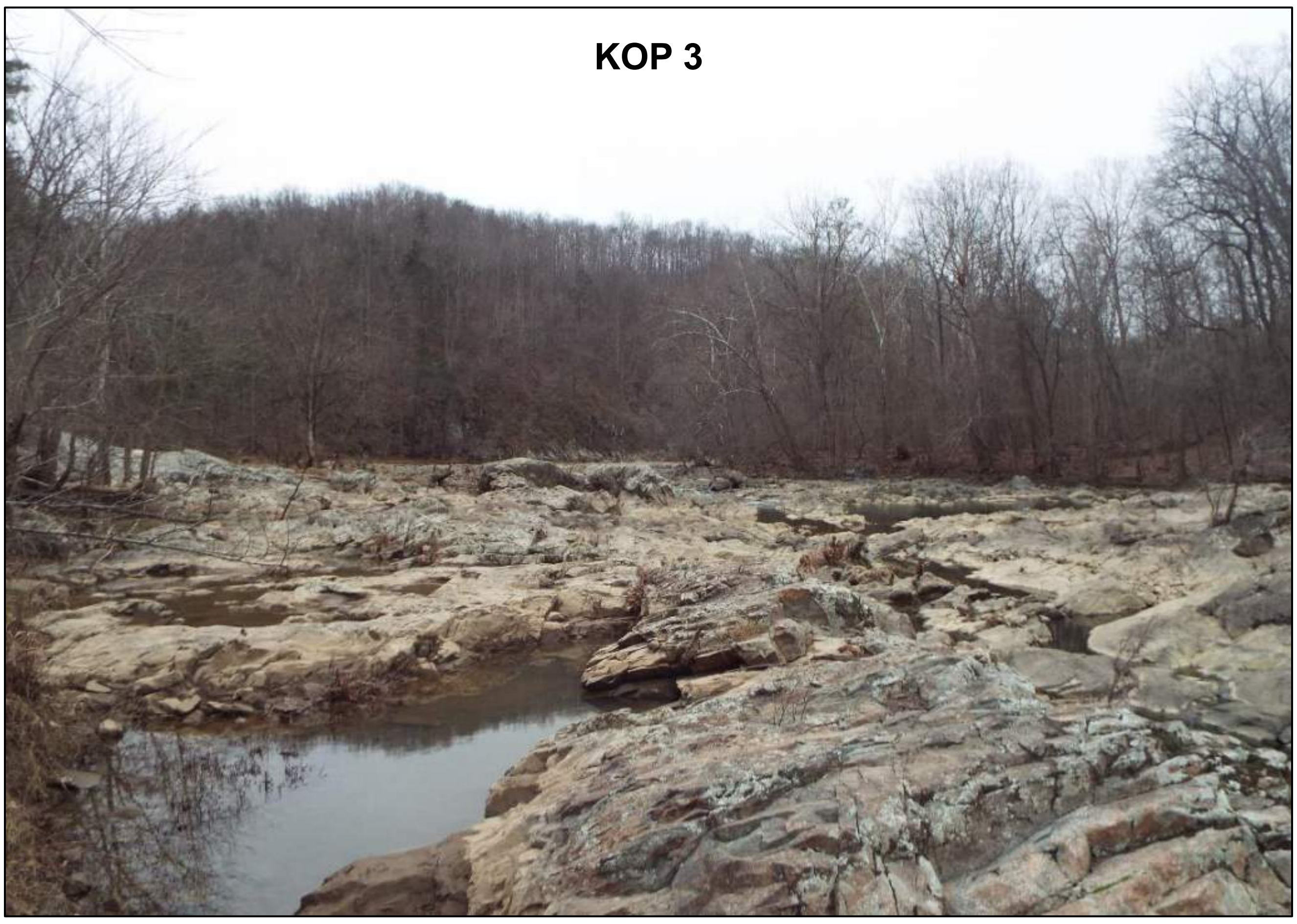


Figure 3-3. January 30, 2020, estimated 31 cfs

Figure 3-4. February 7, 2020, estimated 11,716 cfs

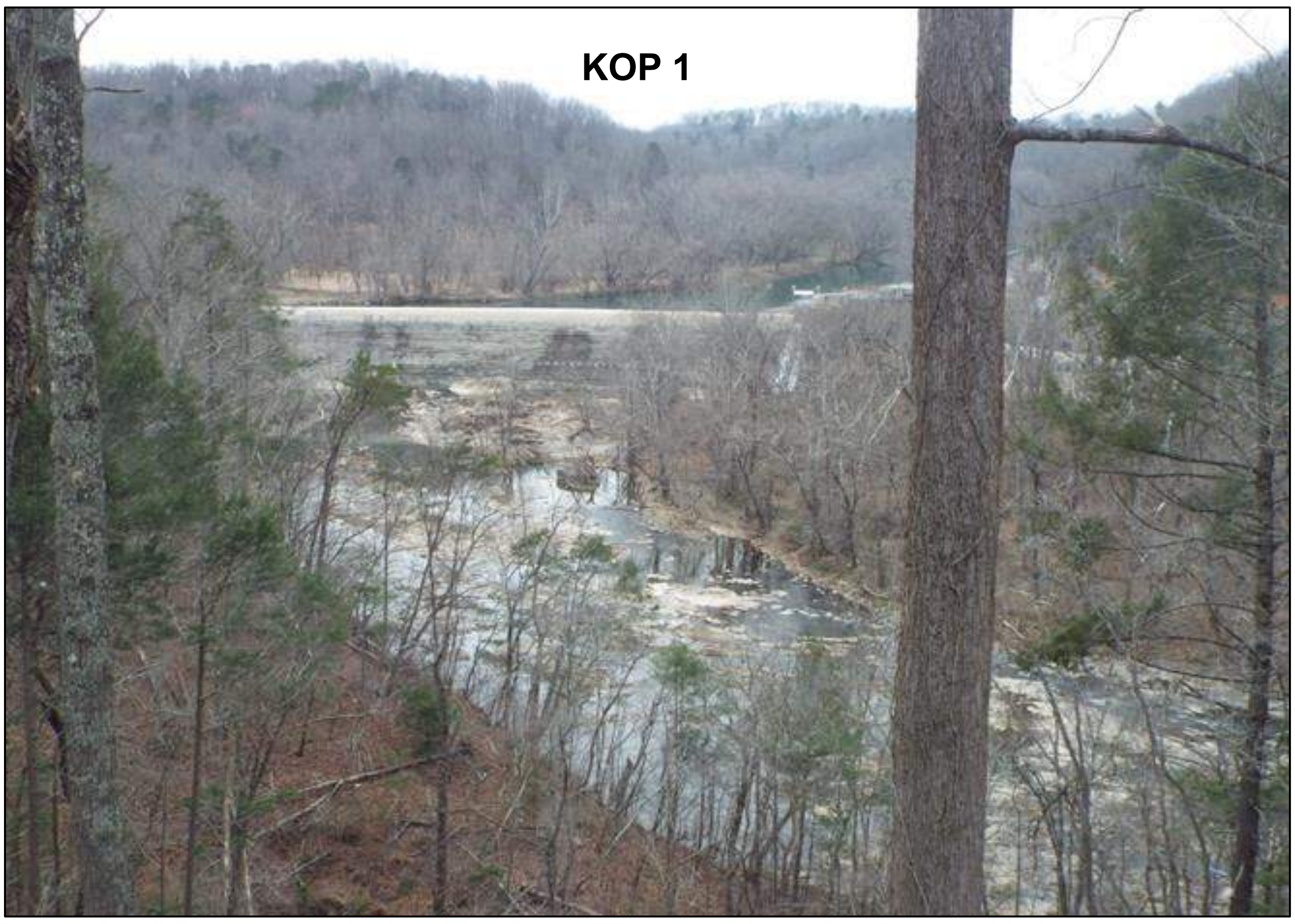
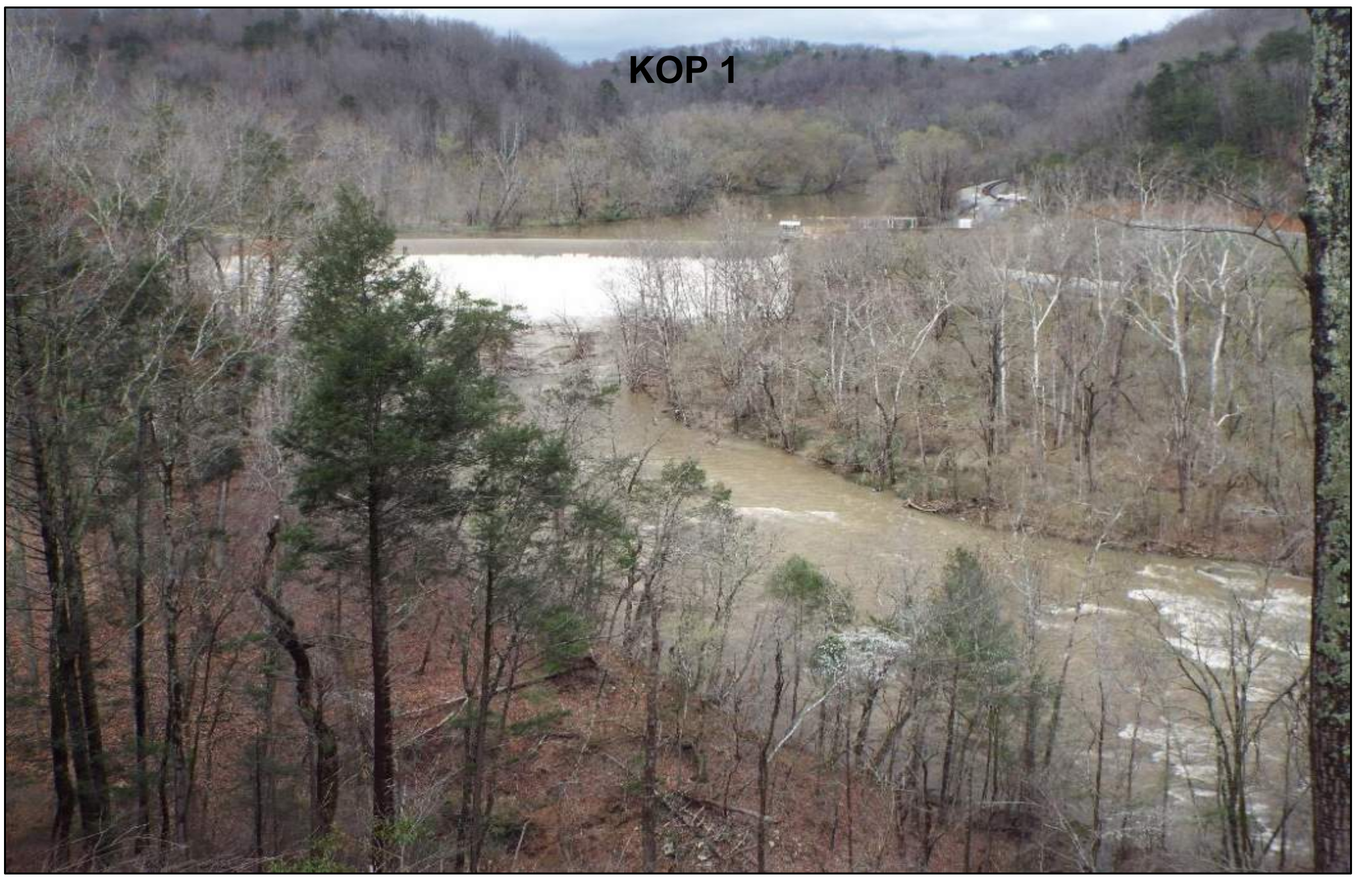


Figure 3-5. March 2, 2020, estimated 28 cfs



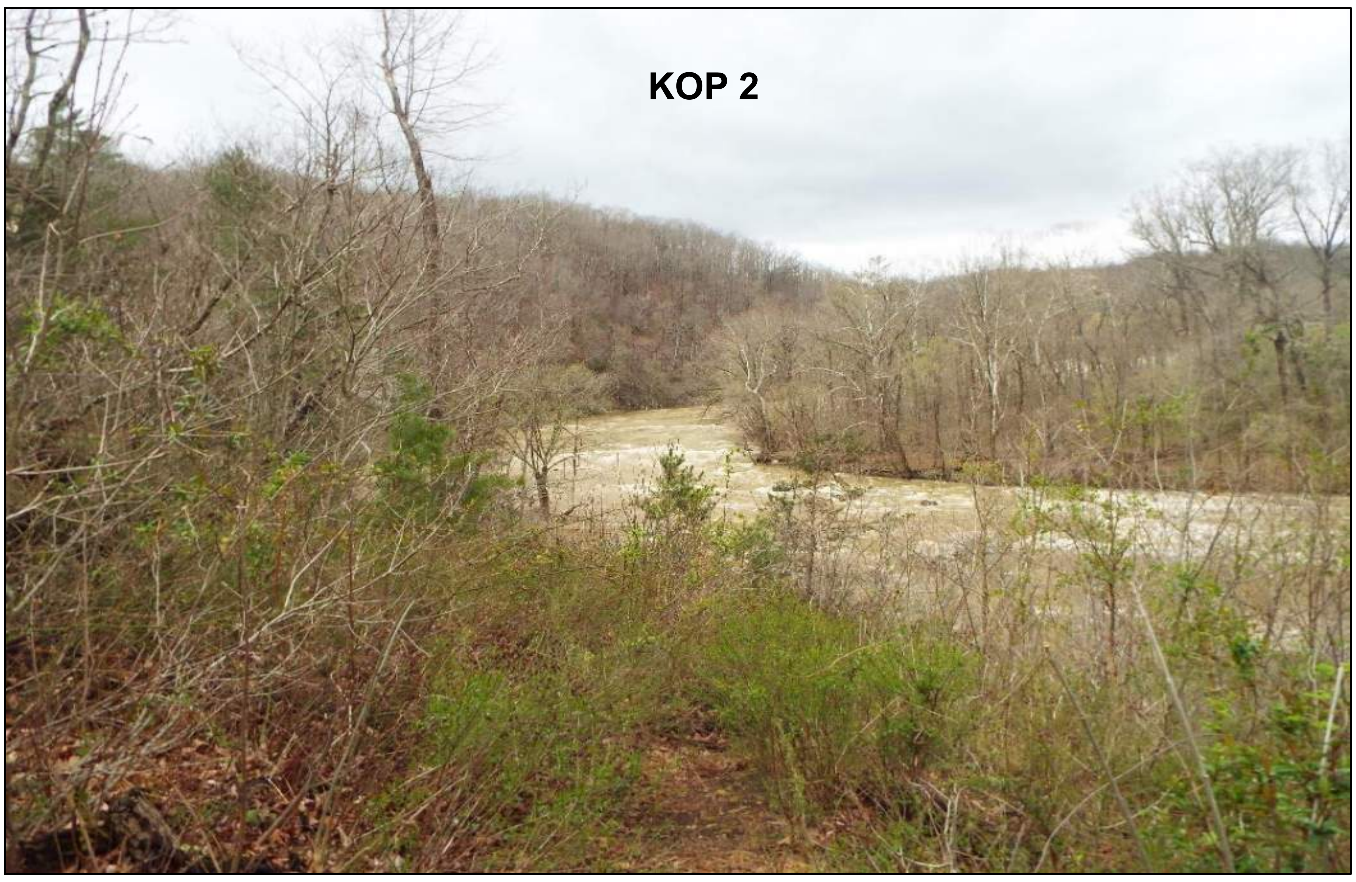


Figure 3-6. March 25, 2020, estimated 2,638 cfs

Figure 3-7. May 1, 2020, estimated 3,317 cfs

Figure 3-8. July 11, 2020, estimated 32 cfs

Figure 3-9. September 5, 2020, estimated 30 cfs

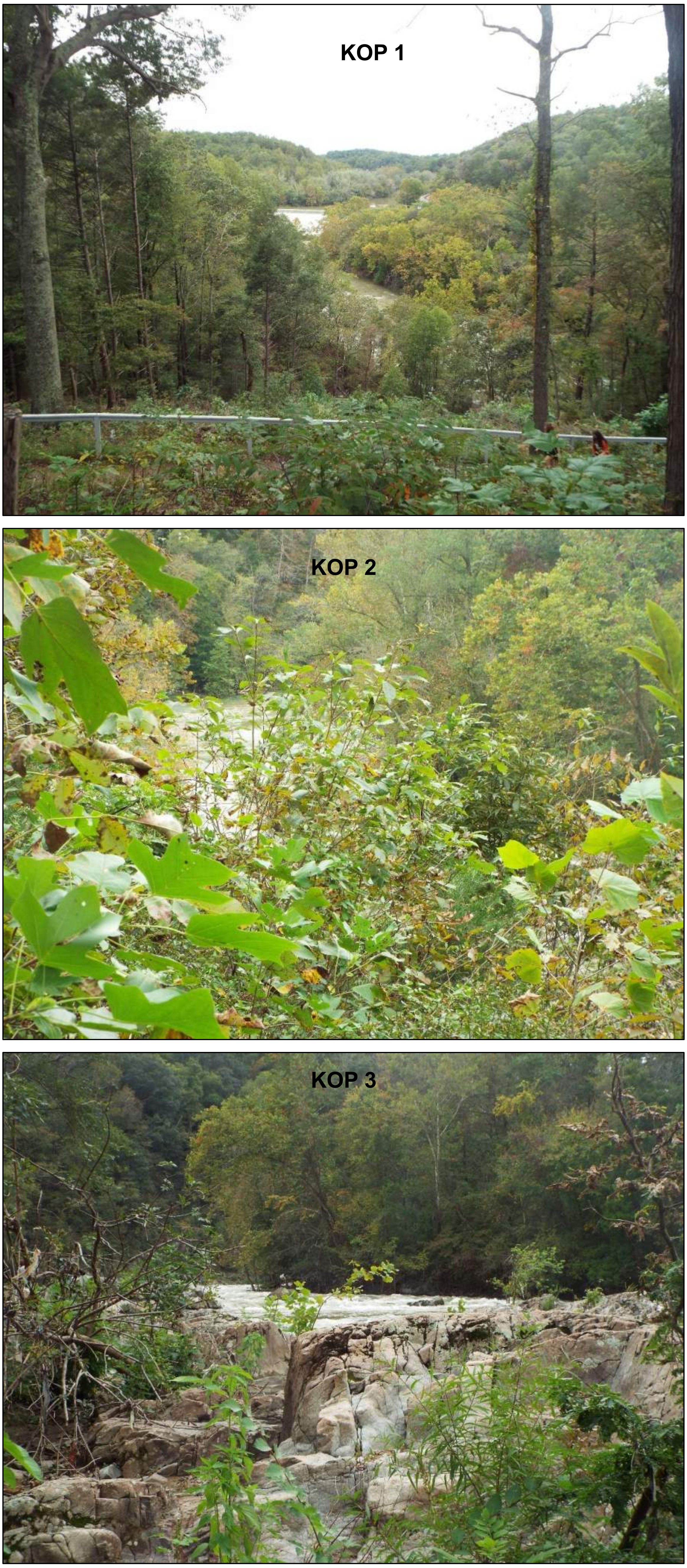


Figure 3-10. September 26, 2020, estimated 765 cfs

Appendix F

Appendix F – Preliminary Cultural Resources Study Report

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