PRE-APPLICATION DOCUMENT (PAD)

PARR HYDROELECTRIC PROJECT
FERC PROJECT NO. 1894

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt Associates
Lexington, South Carolina

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DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

Af	acre-foot, the amount of water needed to cover one acre to a depth of one foot
APE	area of potential effect as pertains to Section 106 of the National Historic Preservation Act
Applicant	South Carolina Electric & Gas Company
BIA	Bureau of Indian Affairs, an agency of the DOI
BLM	Bureau of Land Management, an agency of the DOI
CFR	Code of Federal Regulations
cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission
CWA	Clean Water Act
DLA	Draft License Application
DO	dissolved oxygen, generally expressed in units of parts per million or milligrams per liter (mg/L)
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
EA	Environmental Assessment
EAP	Emergency Action Plan
EFH	essential fish habitat
EIS	Environmental Impact Statement
EL	Elevation
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
FEA	Final Environmental Assessment
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Federal Power Act
FWCA	Fish and Wildlife Coordination Act
GIS	geographic information system
GWh	gigawatt-hour (equals one million kilowatt-hours)
Hp	Horsepower
Hz	hertz (cycles per second)
installed capacity	the nameplate megawatt rating of a generator or group of generators
ILP	Integrated Licensing Process
interested parties	individuals and entities that have an interest in a proceeding
kW	Kilowatt
kWh	kilowatt-hour
kV	Kilovolts
kVA	kilovolt-ampere
Licensee	South Carolina Electric & Gas Company
Licensing	the process of acquiring an original FERC license for a new proposed hydropower project
licensing participants	Individuals and entities that are actively participating in the licensing proceeding
Msl	mean sea level

MW	megawatt
MWh	megawatt-hour
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NMFS	National Marine Fisheries Services, also known as NOAA Fisheries
NOAA	National Oceanic and Atmospheric Administration, including NMFS
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NOI	Notice of Intent to file an application for license
normal operating capacity	The maximum MW output of a generator or group of generators under normal maximum head and flow conditions
NWI	National Wetlands Inventory
PAD	Pre-Application Document
PDF	Portable Document Format
PM&E	protection, mitigation and enhancement measures
PMF	probable maximum flood
PPM	parts per million
Project	Parr Hydroelectric Project (FERC No. 1894)
Project Area	zone of potential, reasonably direct project effects within the FERC Project Boundary
Project Boundary	the boundary line defined in the license issued by FERC that surrounds areas needed for Project purposes
Project Vicinity	the general geographic area in which the Project is located for the purposes of describing the existing environment around a Project or proposed Project
RM	river mile
RTE Species	rare, threatened, endangered, and special status species
SD	Scoping Document
Service List	a list of parties who have formally intervened in a proceeding that is compiled and maintained by FERC; once FERC establishes a Service List, any documents filed with FERC must be sent to all entities on the Service List
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCPRT	South Carolina Department of Parks, Recreation and Tourism
SHPO	State Historic Preservation Officer
Tailrace	Channel through which water is discharged from the turbines
TLP	traditional licensing process
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service, an agency of the DOI
USGS	U.S. Geological Survey
WQC	Water Quality Certification, issued under Section 401 of the Federal Clean Water Act

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is filing a Notice of Intent (NOI) and Pre-Application Document (PAD) with the Federal Energy Regulatory Commission (FERC) to relicense the Parr Hydroelectric Project, FERC No. 1894. This Project consists of two developments located in Fairfield and Newberry counties, South Carolina, including the 14.88-megawatt (MW) Parr Shoals Development and the 511.2-MW Fairfield Pumped Storage Development. Parr Reservoir is a 4,400-acre impoundment formed by the Broad River and the Parr Shoals Dam and serves as the lower reservoir for the Fairfield Pumped Storage Development. Monticello Reservoir is a 6,800-acre impoundment formed by a series of four earthen dams and serves as the upper reservoir for the pumped storage development. The existing FERC license for the Parr Hydroelectric Project expires on June 30, 2020. SCE&G intends to file for a new license with FERC on or before May 31, 2018.

This PAD has been prepared in accordance with §5.6 and §16.8 of FERC's regulations set forth in Title 18 of the Code of Federal Regulations (CFR). As required by the regulations, SCE&G exercised due diligence in preparing this PAD by contacting appropriate governmental agencies, non-governmental organizations (NGOs), Native American tribes, and others that might have relevant information. It did so by holding public outreach meetings to identify existing and reasonably available information relevant to the Project. Meetings were conducted at the following locations and on the specified dates: the city of Winnsboro on January 15, 2013 (attended by approximately 33 people); the city of Newberry on January 17, 2013 (attended by approximately 26 people); the city of Columbia on January 29, 2013 (attended by approximately 33 people); and the town of Jenkinsville on July 9, 2013 (attended by approximately 34 people). Prior to each meeting, advertisements were placed in local newspapers to notify the public of the meetings and meeting locations. Affidavits for each meeting notice can be found in Appendix C.

In addition to contacting agencies and other stakeholders through public outreach meetings, SCE&G hosted tours of the reservoirs with interested stakeholders at the two developments. These reservoir tours were conducted on April 30, 2013, and May 2, 2013, and were attended by representatives of agencies, NGOs, and other interested stakeholders. Additionally, SCE&G hosted a two day canoe/kayak trip of the Broad River downstream of Parr Shoals Dam, and thus beyond the Project Boundary lines (March 19 and 20, 2013), to familiarize the stakeholders with the river downstream of the Project. SCE&G also worked closely with organizations and agencies to identify existing relevant studies conducted in the watershed. SCE&G also thoroughly reviewed its files for information about the Project. By exercising due diligence and involving the stakeholders early and thoroughly, SCE&G has ensured that this PAD provides existing, relevant and reasonably available information to FERC and other interested stakeholders. All information sources cited in this PAD are appropriately referenced. Appendix C is a record of the pre-PAD consultation process SCE&G initiated with agencies, tribes, and other organizations to obtain data and information about Project resources. The resulting comprehensive information assembled with this PAD will enable FERC and other entities to review study plans developed in consultation with resource agencies and other stakeholders, prepare documents analyzing any license application that may be filed with FERC and develop additional information requests and study plans to the extent they are necessary and related to direct effects of the Project.

2.0 PROCESS PLAN AND SCHEDULE [§ 5.6 (d)(1)]

2.1 TIME FRAMES FOR PRE-APPLICATION CONSULTATION, INFORMATION GATHERING, AND STUDIES

In accordance with FERC's regulations (18 CFR 5.3) and integral to the filing of this PAD, SCE&G requests use of the Traditional Licensing Process (TLP). Typically, the TLP includes three stages, as described at 18 CFR 4.38. The first stage involves coordination between the Applicant, resource agencies, affected Native American tribes, and the public. This stage includes sharing Project information, notifying interested parties, and planning studies using the PAD as a guide. The second stage involves implementing studies (to the extent that pre-filing studies are necessary) to gather additional data, developing a draft license application (DLA), and submitting the application for review by resource agencies and FERC, if they so wish. The third stage begins with the filing of the final license application (FLA). During this stage, FERC conducts its review of the FLA as well as the public comment process, completes an environmental analysis under NEPA, and makes a final decision regarding issuing a license for the Project.

SCE&G believes not only that it is appropriate, but also that the objectives of the relicensing process will be best served by and therefore requests the use of the TLP for a number of reasons: 1) A wealth of relevant and material information is already available regarding the surrounding resource areas, as presented in this PAD. 2) SCE&G has implemented a thorough and substantive pre-PAD consultation process through which it already has identified all material areas of inquiry for which information is required. 3) These factors convince SCE&G that it is highly unlikely that there will be significant disputes over studies and we expect a low level of controversy and complexity relating to resource issues. 4) SCE&G is confident that employing the TLP process will provide local, state and federal agencies with manageable timeframes within which to conduct their studies and perform their reviews, thereby enabling them to meet their separate statutory and regulatory obligations as well as support of FERC's timely issuance of a new license for this Project. 5) SCE&G's confidence in the TLP process is bolstered by virtue of its recent completion of a TLP pre-filing consultation for the relicensing of the Saluda Hydroelectric Project (FERC No. 516) with the same resource agencies and many of the same resource agency representatives and stakeholders involved in the pre-PAD consultation for the Parr Hydroelectric Project. The use of the TLP for the Saluda Hydroelectric Project relicensing resulted in the filing of a robust settlement agreement. SCE&G is confident that it can achieve a similar successful pre-filing process at Parr through the use of the TLP. 6) Although the enhanced nature of proposed TLP process will result in numerous meetings and discussions, given its experience in the Saluda Project (FERC P-516) TLP process and knowledge of the experiences of utilities and agency as well as non-agency participants in relicensing conducted according to the ILP process, SCE&G fully expects material cost savings for all participants through the use of the TLP rather than the ILP. Accordingly, SCE&G's proposed schedule assumes FERC approval of TLP for relicensing the Project.

Regardless of what licensing process is required, SCE&G absolutely will assure adequate opportunities for all interested parties to be meaningfully involved in the relicensing process. As a part of its efforts to assure that objective, SCE&G requests that FERC attend the JAM to ensure that it is as fully informed as it can be when involved in future scoping proceedings. Appendix C includes records of the licensing proceedings to date, including information received from the stakeholders and appropriate communication records. SCE&G will compile and maintain records of licensing and other relevant information on SCE&G's relicensing website at www.parrfairfieldrelicense.com. The PAD will be made publicly available at the Newberry County Library in Newberry, SC and the Fairfield County Library in Winnsboro, SC, as well as on SCE&G's relicensing website at www.parrfairfieldrelicense.com.

Comments on SCE&G's request to use the TLP are due within 30 days of filing the NOI. Following the comment period, according to regulatory prescriptions, FERC must act on the request to use the TLP within 30 days. SCE&G plans to file a Draft License Application on or before January 30, 2017 and a Final License Application on or before May 31, 2018, pending results of consultation with resource agencies and other interested stakeholders.

2.2 PROPOSED LOCATION AND DATE FOR JOINT AGENCY MEETING AND FOR THE SITE VISIT [§ 16.8 (B)(3)(II)]

SCE&G will host a JAM and site viewing no earlier than 30 days, and no later than 60 days after TLP approval, if FERC approves this request. As discussed, SCE&G will invite FERC to the JAM to secure for itself and all other attendees and participants, FERC's perspective on the initial scoping of issues. Generally, SCE&G understands the purpose of the JAM to be to provide stakeholders the opportunity to view the Project, to discuss the information presented in the PAD, and to begin identifying issues related to the Project. In the case of this Project, site visits of the reservoirs and issue identification workshops have already occurred and have included many interested stakeholders. Nevertheless, the JAM will provide another, formal opportunity for stakeholders and FERC to become involved. Currently, SCE&G proposes to hold the JAM at the Lake Murray Training Center in March or April 2015. However, the date and location of the meeting may be altered after consultation with jurisdictional agencies and other licensing participants, pending FERC's decision regarding SCE&G's request to use the TLP. If FERC requires that SCE&G use the ILP, then FERC will hold a scoping meeting in accordance with the regulations at § 5.8.

3.0 PROJECT LOCATION, FACILITIES, AND OPERATIONS [§ 5.6 (d)(2)]

3.1 CONTACT INFORMATION FOR EACH PERSON AUTHORIZED TO ACT AS AGENT FOR APPLICANT (EXACT NAME, BUSINESS ADDRESS, AND PHONE NUMBER)

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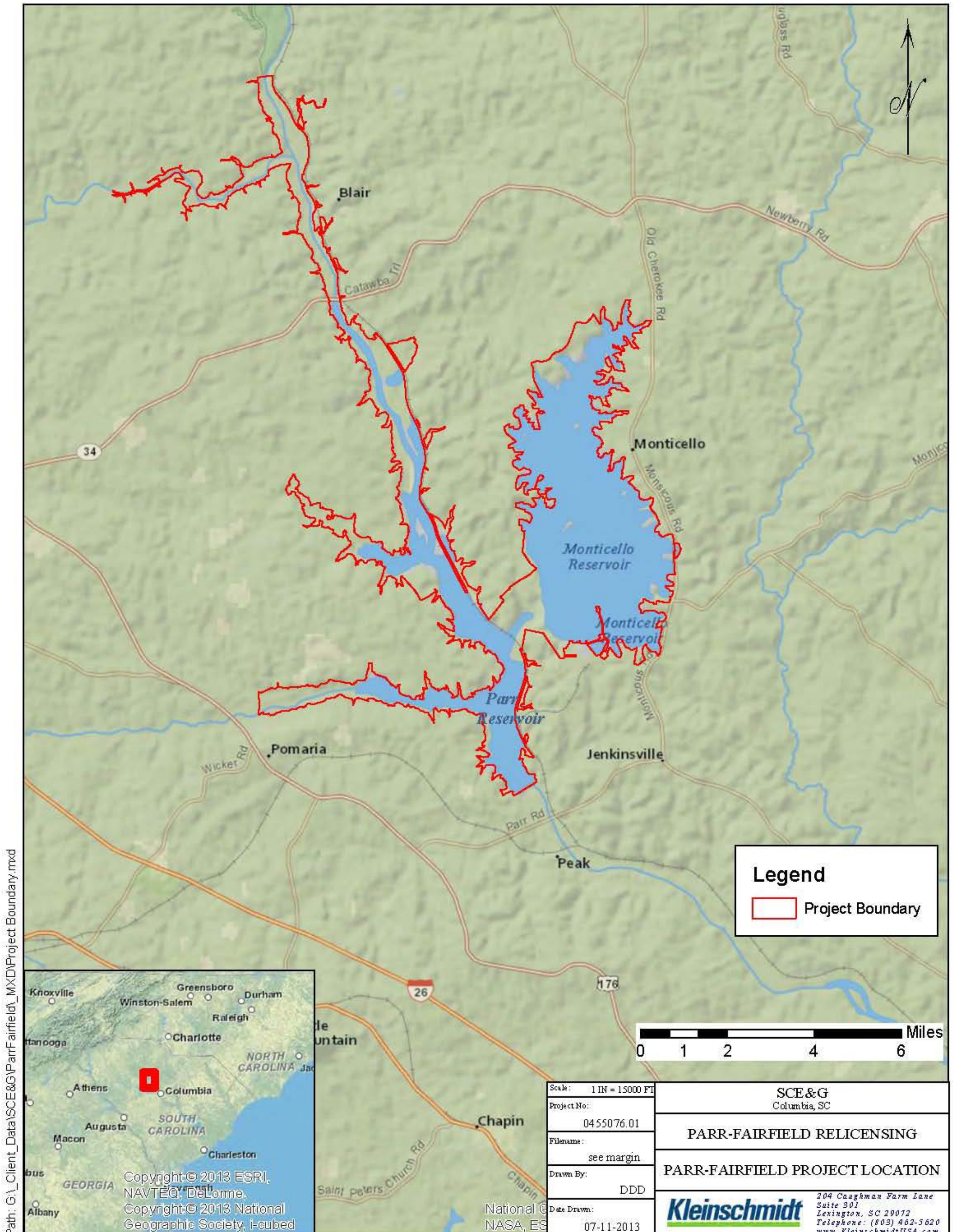
3.2 MAPS OF LAND USE WITHIN PROJECT BOUNDARIES (TOWNSHIP, RANGE AND SECTION, STATE, COUNTY, RIVER, RIVER MILE, AND CLOSEST TOWN) AND, IF APPLICABLE, FEDERAL AND TRIBAL LANDS, AND LOCATION OF EXISTING FACILITIES

The Project is located in Newberry and Fairfield counties, South Carolina, on the Broad River, approximately 26 river miles upstream from the City of Columbia, South Carolina (see Figure 3-1). The Project includes the existing Parr Shoals Development, which consists of a powerhouse with 6 generators, a 2,715 foot long dam, a 4,400 acre reservoir and transmission and appurtenant facilities. The Project also includes the existing Fairfield Pumped Storage Development, which is composed of a 6,800 acre reservoir, four earthen dams, an intake channel, a gated intake structure, four surface penstocks bifurcating into eight concrete-encased penstocks, a semi-outdoor generating station housing eight pump-turbine units and transmission and appurtenant facilities. Exhibit G Project Boundary maps, currently on file with the Commission as Exhibits K, have been included in Appendix D of this PAD. Detailed information on land use within the Project Boundary is included in section 4.7.

FIGURE 3-1: PROJECT LOCATION MAP



Sources: ESRI, SCE&G, Kleinschmidt

3.3 DETAILED DESCRIPTION OF EXISTING FACILITIES

3.3.1 COMPOSITION, DIMENSIONS, AND CONFIGURATION OF DAMS, SPILLWAYS, PENSTOCKS, POWERHOUSES, TAILRACES, INCLUDED AS PART OF THE PROJECT OR CONNECTED DIRECTLY TO IT

The Parr Shoals Dam is situated across the Broad River, oriented in a northeast-southwest direction, and consists of the northeast non-overflow section and integral powerhouse, the gated spillway, and the southwest non-overflow embankment.

The east non-overflow section is a concrete gravity structure that includes a non-overflow wall and the powerhouse. The 90-foot-long, non-overflow wall has an 8-foot-wide crest at elevation (El.) 271.1, a maximum structural height of approximately 61 feet, and a maximum base width of approximately 43 feet. The adjacent powerhouse is concrete with a steel-framed superstructure, and is approximately 60 feet wide by 300 feet long. The concrete foundation/substructure height is approximately 51 feet (from the draft tube invert to the generator floor); the superstructure rises an additional 58 feet for a total overall height of approximately 109 feet. The substructure has an integral intake, eight primary turbine bays and two smaller bays cast into the concrete. Six turbine-generator units occupy the primary bays, and the two bays nearest the shore are empty. The two smaller bays previously contained turbine-generators for excitation of the primary generators, but those are no longer required and have been decommissioned. A trash raking system mounted on the intake deck is used to clean debris from the forebay area and the trashracks. The trashrack is integral with the intake, which is integral with the powerhouse. Bar spacing consists of 2.25 inch clear space with 0.5 inch bars.

At the southwest end of the powerhouse, the gated spillway section of the dam extends for 2,000 feet across the river. Six abandoned sluice gate bays occupy the 112-foot section adjacent to the powerhouse. Two have been filled with concrete, and sedimentation in the impoundment prevents the use of the other four. The spillway dam is a concrete gravity structure approximately 37 feet high, with a permanent crest elevation of 257.0 feet. Ten bottom-hinged Bascule gates mounted on the crest of the dam are used to raise the impoundment to El. 266.0 feet.

The non-overflow earthen embankment at the southwest end of the spillway extends approximately 300 feet to the right abutment. The top of the embankment is at EL. 272.1 feet, and it has a maximum structural height of 45 feet. A concrete wing-wall retains the embankment, separating it from the adjacent spillway section.

The Fairfield Development consists of four earthen embankment dams that impound the upper Monticello Reservoir, an intake channel and structure in the upper impoundment, four penstocks, and the Fairfield powerhouse with a tailrace channel connected to the Parr Reservoir. There are also two highway relocation embankments and a freeboard protection dike located on the reservoir perimeter.

The four dams are constructed of random fill and have crests at El. 434.0 feet. Each has an impervious blanket on the reservoir side, as well as a low permeability clay core wall. Fairfield Dam A is located on the west side of the impoundment, and is oriented in the north-south direction. It has a crest length of 3,130 feet, and a maximum structural height of 85 feet. Dam B is located to the south of Dam A and also is oriented in the north-south direction; its south end abuts the north side of the intake structure. It is the largest of the four dams at a total length of 4,700 feet and a maximum height of 160 feet. Dam C abuts the south side of the intake structure and extends to the southeast for approximately 2,000 feet; it has a maximum height of 60 feet. Dam D is located just south of Dam C; a segment of land of naturally higher grade approximately 300 feet long separates them. Dam D also extends in the northwest-southeast direction. It has a crest length of approximately 1,300 feet and a maximum height of about 30 feet. All four dams have riprap protection on the upstream slopes from the crest down to approximately El. 414.0 feet.

In addition to the four main dams, two earth embankments carry S.C. Highways 99 and 215 over the northern and eastern extremities of Monticello Reservoir, respectively. The paved crest of the embankment for S.C. Highway 99 (Highway 99 Relocation Embankment) is maintained by the South Carolina Department of Transportation (SCDOT), while the upstream face, downstream face, and discharge structure are maintained by SCE&G. The upstream face of this embankment is vegetative covered, while the downstream face is protected by riprap. This embankment separates Monticello Reservoir from an approximately 300 acre recreation sub-impoundment, known as the Recreational Lake[1]. The SCDOT has responsibility for maintenance of the S.C. Highway 215 Relocation Embankment. An earth dike (Highway 215 Dike) located just south of the S.C. Highway 215 embankment provides freeboard protection for structures west of Highway 215. This embankment is approximately 3050 feet long with a maximum height of 31 feet and

[1] The 300 acre recreation sub-impoundment is referred to throughout this document as the Recreational Lake.

lies on the east side of the Monticello Reservoir. The dike is protected with riprap on the upstream face, and is maintained by SCE&G.

The intake feature in the Monticello Reservoir is located between Dam B and Dam C and consists of an open-channel intake and adjacent intake structure. The concrete-lined intake channel is approximately 300 feet long and 260 feet wide at the mouth, tapering to 132 feet wide at the interface with the intake structure; the tops of the channel sidewalls are at El. 435.0 feet, and the invert is at El. 360.0 feet. The reinforced concrete intake structure is 260 feet long; the first 225 feet consist of four separate water passages that taper uniformly from the upstream trash racks (at a total size of 132 feet wide by 50 feet high) down to the headgate end (115 feet by 30 feet). The final 40-foot length of the intake is a transitional section with 26-foot-diameter, concrete water passages at the gated end leading to the top of the penstocks. The trashracks, which are connected to the intake structures, consist of 6 inches of clear space and 1 inch bars.

The four steel penstocks are 26 feet in diameter and approximately 800 feet long and fan out horizontally as they extend down the embankment to the powerhouse on the Parr Reservoir. The penstocks are above ground, and the lower 270 feet are encased in concrete. The penstocks bifurcate within the encased section of the conveyance, transitioning to a total of eight water conveyances approximately 18.5 feet in diameter, each connected to a turbine scroll case in the powerhouse.

The powerhouse is a reinforced concrete structure approximately 520 feet long by 150 feet wide with a total structural height of 108 feet. The powerhouse has eight bays, each 65 feet wide and each containing one reversible pump-turbine unit. There are 16 draft tube gates at the downstream end of the elbow draft tubes, and center support piers split the draft tube exits. The powerhouse is mostly below grade; the top powerhouse deck is level with grade at El. 276.0 feet. A 185-ton gantry crane sits over the powerhouse, outdoors and above the surrounding grade.

3.3.2 Reservoir Normal Maximum Water Surface Area And Elevation And Gross Storage Capacity

The Parr Reservoir's normal maximum water level is at El. 266.0 feet, with a corresponding surface area of 4,400 acres. The gross storage is estimated to be 32,000 acre-feet. The normal maximum water level in Monticello Reservoir is El. 425.0 feet, which corresponds to a surface area of 6,800 acre-feet, and a gross storage of 400,000 acre-feet. An active storage of up to 29,000 acre-feet is transferred between the two reservoirs by the pumped storage operations.

3.3.3 Number, Type And Capacities Of Turbines And Generators, And Installed (Rated) Capacity Of Existing Turbines Or Generators

The Parr Shoals Development has six vertical-shaft Francis turbines, each rated at 3,600 horsepower (hp) under a net head of 35 feet. The maximum hydraulic capacity of each turbine is approximately 1,000 cubic feet per second (cfs), and the minimum unit turndown has an estimated flow of 150 cfs. Each turbine is directly coupled to a three-phase, 60 Hertz (Hz) generator with a synchronous speed of 100 revolutions per minute (rpm). Each generator has a rated power capacity of 2,480 kilowatts (kW), or 3,100 kilovolt-amperes (kVA) at 0.80 power factor (pf), and generates electricity at a potential of 2,300 volts (V). The Parr Shoals Development has a combined total installed capacity of 14.88 MW.

The Fairfield Pumped Storage Development powerhouse contains eight vertical-shaft reversible Francis pump turbines. The turbines each have a rated generating capacity of 95,375 hp at a minimum net head of 150 feet, and a maximum capacity of 108,570 hp at 167 feet of net head. The maximum hydraulic capacity of each pump-turbine in generating mode is 6,300 cfs, and the minimum turndown flow is approximately 2,500 cfs. In pumping mode, the turbines each have an average rated hydraulic capacity of 5,225 cfs across the total dynamic head range of 158 to 173 feet.

Each pump-turbine is directly coupled to a three-phase, 60 Hz motor-generator with a synchronous speed of 150 rpm in generating or pumping mode. The motor-generators each has a rated power generating capacity of 63,900 kW (71,000 kVA at 0.90 pf); operating as pump motors, they each have a capacity of approximately 100,000 hp (74,570 kVA at 1.0 pf). The Fairfield Pumped Storage Development has a combined total installed capacity of 511.2 MW.

The Parr Development has three 2.4/13.8 kV step-up transformers (each one connected to the leads of two generators) rated at 6,000/6,700 kVA with 55°C/65°C rise (OA), and 7,500/8,400 kVA with 55°C/65°C rise (FA). The transformers are connected to the switchyard just north of the powerhouse via 1,000-foot, 13.8-kV overhead conductors where the Project is interconnected with the local grid.

The Fairfield Development has four 13.8/230 kV step-up transformers (each one connected to the leads of two generators) rated at 160/80/80 MVA with 55°C rise, 179.2/89.6/89.6 MVA with 65°C rise (FOA). The grid interconnection is via a switchyard adjacent to the powerhouse deck, which contains two 230-kV buses, each of which is connected to two powerhouse step-up transformers.

3.3.4 NUMBER, LENGTH, VOLTAGE, AND INTERCONNECTIONS OF ANY PRIMARY TRANSMISSION LINES

Primary transmission lines associated with Parr Hydro include the generator leads and 2.3-kV lines for six units, the three 2.4/13.8-kV transformers at the hydro station, the 13.8-kV tie from the hydro station to the Parr Steam Plant 115 kV substation, the 13.8-kV tie from the hydro station to nearby 13.8/24.9-kV Parr distribution substation, the 24.9-kV – 12,000 kVA transformer bank at the Parr distribution substation, and appurtenant facilities at the existing Parr Hydroelectric Project. Primary transmission lines at the Fairfield Pumped-Storage Facility include the generator leads, the step-up facilities, the two 230-kV lines from Fairfield Powerhouse to the V.C. Summer Nuclear Station switchyard, and appurtenant facilities. All other lines connected to the V. C. Summer Nuclear Station switchyard are part of the Applicant’s interconnected system.

Single line drawings for the Project are included in Appendix K, which is filed as CEII.

3.3.5 ENERGY PRODUCTION (ESTIMATE OF DEPENDABLE CAPACITY, AVERAGE ANNUAL, AND AVERAGE MONTHLY ENERGY PRODUCTION)

The Project’s dependable capacity estimate is based on the Fairfield Development. Although adverse hydrology is a consideration for conventional hydro projects, the active storage provides a reliable resource for planned generation. In fact, only high inflows reduce the generating capacity of the development, and low-inflow conditions are typical during the summer months. Low-inflow conditions further diminish the contributions of the Parr Development, which depends upon hydrologic availability. Because of these factors, the dependable capacity of the Project is the capacity of Fairfield Development at the minimum head, which is 511.2 megawatts (MW), and which occurs at the end of a full generating cycle.

Listed below is a summary of the monthly and annual average generation values for both developments from October 1999 to September 2013 (in megawatt hours, or MWH).

	Monthly gross MWH		
	Fairfield	Parr	Sum
January	45,085	6,156	51,241
February	40,313	5,944	46,257
March	45,918	7,251	53,169
April	56,434	6,566	63,000
May	72,555	5,050	77,605
June	85,536	3,980	89,515
July	88,538	3,364	91,902
August	93,256	2,976	96,232
September	74,761	3,171	77,932
October	57,443	3,302	60,745
November	42,678	4,005	46,683
December	46,039	5,391	51,430
Annual	748,557	57,153	805,711

3.4 Current Project Operation, Including Any Daily Or Seasonal Ramping Rates, Flushing Flows, Reservoir Operations, And Flood Control Operations

The Parr Development generates using available inflows up to the maximum station hydraulic capacity of 6,000 cfs. When inflows are below 6,000 cfs, the Parr Development's turbines are operated to meet the minimum flow requirements. The minimum flow required to be released from the Project during the months of March, April, and May is the lesser of 1,000 cfs or daily average inflow (minus evaporative losses from both reservoirs). During the remainder of the year, the minimum flow requirements are 150 cfs instantaneous flow and 800 cfs daily average flow, or the daily average inflow (minus evaporative losses), whichever is less.

The Fairfield Development generates and pumps using an active storage of 29,000 acre-feet. During the generation cycle, active storage in the upper Monticello Reservoir is released from the powerhouse into the lower Parr Reservoir. During the pumping cycle, the active storage is transferred from the Parr Reservoir back into the Monticello Reservoir. This cycle occurs daily, and the transfer of the full active storage results in an upper reservoir maximum fluctuation of 4.5 feet, and a corresponding lower reservoir fluctuation of 10 feet.

When inflows to the Project are projected to exceed 6,000 cfs, the Bascule gates on the Parr spillway dam are systematically lowered to prevent the Parr Reservoir from exceeding the maximum elevation of 266.0 feet. Generation from the Fairfield Development is also partially curtailed during these conditions to prevent total project flow releases from contributing to downstream flooding. When inflows reach a threshold that causes flooding downstream of the Project, all spillway gates are fully lowered to pass natural inflows, and the Fairfield generation is completely suspended until flows recede. Fairfield pumping operations may occur with any flow in the Broad River. On the falling leg of a flood event, the gates are gradually raised to retain active storage while preventing the reservoir from exceeding the normal maximum elevation.

The summary of Parr and Monticello reservoir elevations for the past five years are included in Table 3-1 and Table 3-2. Parr Reservoir elevation information is collected from USGS gage 02160990 and Monticello Reservoir elevation information is collected from an SCE&G-owned gage located between dams C and D at the Fairfield Pumped Storage Facility.

TABLE 3-1: PARR RESERVOIR ELEVATION SUMMARY

YEAR	MINIMUM RECORDED RESERVOIR ELEVATION (FT. NGVD)	MAXIMUM RECORDED RESERVOIR ELEVATION (FT. NGVD)
2009	256.9	266.3
2010	256.1	266.3
2011	256.1	266.2
2012	256.5	266.4
2013	256.2	265.8

TABLE 3-2: MONTICELLO RESERVOIR ELEVATION SUMMARY

YEAR	MINIMUM RECORDED RESERVOIR ELEVATION (FT. NGVD)	MAXIMUM RECORDED RESERVOIR ELEVATION (FT. NGVD)
2009	420.6	425.0
2010	420.6	425.0
2011	420.5	425.0
2012	420.6	425.0
2013	420.9	425.0

3.5 CURRENT NET INVESTMENT

The current net investment for the Parr Hydroelectric Project as of December 31, 2013 is identified in Appendix J, which is filed as Privileged.

3.6 SUMMARY OF PROJECT GENERATION AND OUTFLOW RECORDS

For the past five years (2009 – 2013), total project gross generation has averaged 655,113 MWH, ranging annually from 510,850 to 766,499 MWH. The Fairfield Development accounted for 91% of the gross generation.

Flows released from the Parr Shoals Dam for the past five years have averaged 4,138 cfs, based on mean daily flow data from the USGS gage at Alston (02161000). The minimum instantaneous flow was 246 cfs, occurring on February 20, 2009. The peak flow measured at the Alston gage was 82,300 cfs, occurring on May 8, 2013.

3.7 CURRENT LICENSE REQUIREMENTS

The current License contains several Project-specific requirements in addition to the general L-form license articles required of all FERC licensees and those directly relating to the construction of the Fairfield Development. Project-specific requirements relating to operating the Project are detailed below.

Article 14: Requirement to maintain, except during March, April and May, a minimum flow of 150 cfs and a minimum daily average flow of 800 cfs, or the daily natural inflow to the Parr Reservoir (less evaporative losses from the Parr and Monticello reservoirs), whichever is the lesser amount; and discharge from Parr powerhouse during the striped bass spawning season in the months of March, April and May a minimum flow of 1,000 cfs or the average daily natural inflow into the Parr Reservoir (less evaporative losses from the Parr and Monticello reservoirs), whichever is the lesser amount.

Article 20: Requirement that SCE&G allow public access, to a reasonable extent, to Project waters and adjacent Project lands (with the exception of lands necessary for the protection of life, health, and property) for navigation and outdoor recreational purposes. This Article also allows SCE&G to grant permits for public access to the reservoirs subject to FERC approval.

Article 39: Requirement to operate the Project reservoirs in such a manner that releases from the lower reservoir during flood flows shall be no greater than flows, which would have occurred in the absence of the Project.

Article 43: Requirement for Licensee to consult and cooperate with the South Carolina Department of Health and Environmental Control, and comply with local regulations in planning and providing for the collection, storage, and disposal of solid wastes generated through public access and use of project lands and waters, and within one year after the commencement of operation of the Project, shall file with the Commission a solid waste management plan which has been approved by the Department of Health and Environmental Control. This plan shall provide (a) the location of solid waste receptacles to be provided at public areas including campgrounds, picnicking areas, and boat access areas; (b) schedules of collection for the above receptacles; (c) provisions for including in the subject plan any public use areas as they are developed; and (d) disposal sites and methods of disposal.

Article 44: Requirement for Licensee, following consultation and cooperation with the Bureau of Outdoor Recreation of the U.S. Department of the Interior; the South Carolina Wildlife and Marine Resources Department; the South Carolina Department of Parks, Recreation, and Tourism, shall study the feasibility of constructing recreation sub-impoundments (reservoirs with stable water surface elevations) with adjacent access or recreation areas at suitable locations on Cannon's and Heller's Creeks, or other arms of Parr Reservoir, in lieu of reserving and developing for recreational purposes the 180.5-acre parcel on Heller's Creek at County Road 28 and the 387-acre parcel opposite Fairfield Powerhouse, as shown on Exhibit R-3 (FPC No. 1894-45). Within one year following issuance of the license, Licensee shall file, for Commission approval, revisions of Exhibit R implementing findings of the study including, but not limited to, a schedule for development of (1) said 180.5-acre and 387-acre parcels for recreational purposes, or (2) said alternative recreation sub-impoundments and adjacent recreation areas for fishing, waterfowl hunting, sightseeing, and other uses. Such revisions of Exhibit R shall conform to the Commission's then existing Rules and Regulations, including the economic effect of such development on project operation.

Article 48: Licensee shall purchase in fee and include within the project boundary all lands necessary or appropriate for project operations, including lands for recreational use and shoreline control. The lands encompassed by the project boundary shall include, but not be limited to:

(a) All islands formed by the 266-foot contour[2] of the lower reservoir and by the 425-foot contour of the upper reservoir.

(b) Shoreline lands up to the 270-foot contour or up to 50-feet, horizontal measure, from the 266-foot contour of the lower reservoir, whichever is greater; and shoreline lands up to the 430-foot contour or up to 50-feet, horizontal measure, from the 425-foot contour of the upper reservoir, whichever is greater: Provided, that the project boundary except with respect to land necessary or appropriate for recreational purposes, shall not exceed 200 feet, horizontal measure, from the 266-foot or the 425-foot contour, unless satisfactory reasons to the contrary are given.

Provided further, that the project boundary in the area of V. C. Summer Nuclear Station shall be the 425-foot contour as shown on Sheet 8 (FPC No. l894), Exhibit K. Licensee within one year after completion of land acquisition shall file an Exhibit F and, for Commission approval, a revised Exhibit K.

Article 50: Licensee, for the purpose of monitoring and determining the quality of the aquatic environment of Parr Reservoir and Monticello Reservoir, including the 300-acre sub-impoundment, so as to realize its full recreational potential, shall conduct a water quality monitoring program at selected locations for a period of five years from the date of commencement of project operation. Sampling shall be done at least monthly and include measurements of dissolved oxygen, pH, conductivity, temperature profiles, carbon dioxide, total dissolved solids, total alkalinity, total hardness, chloride sulfate, phosphate, nitrate, BOD, COD, heavy metals, silica, calcium, magnesium, sodium, and turbidity. Annual progress reports and, within one year following conclusion of the monitoring program, a final report shall be filed showing the findings of this program together with recommendations of any need for further sampling or for proposals for maintenance or improvement of the aquatic environment to such reservoirs as shown to be desirable by the studies.

Article 51: Requirement to monitor on a continuous basis dissolved oxygen, temperature, stream flow, conductivity and pH, and on a monthly basis, turbidity and heavy metals, at its water quality station in the Broad River downstream of Parr Reservoir. To assist the personnel of the Columbia, South Carolina, water treatment plant in the early detection of musty odors in Broad

[2] The current license identifies elevation 226’ as the contour of the lower reservoir, however this is incorrect, as the top of the crest gates are at elevation 266’.

River waters, the Licensee shall include odor samples in its water quality monitoring program and, should musty odors be detected, promptly alert the Columbia water treatment plant personnel.

Article 52: The use of Monticello Reservoir as a source and repository of condenser cooling water for the 900 MW Unit 1 of the V.C. Summer Nuclear Station is hereby approved and authorized. If Licensee desires to use project lands or project waters for any other planned fossil fuel or nuclear steam-electric generating units, Licensee shall file for Commission approval an application for amendment of license, conforming to the then existing Rules and Regulations of the Commission, requesting authorization for such use of uses.

3.8 COMPLIANCE SUMMARY

Compliance with the Project specific license requirements are described below.

Article 14: The summary of operational compliance related to minimum flows is included in Table 3-3. Minimum flows are monitored by the USGS gage at Alston (02161000).

TABLE 3-3: PARR HYDRO MINIMUM FLOW COMPLIANCE SUMMARY

YEAR	LOWEST HOURLY PROJECT DISCHARGE DURING YEAR @ ALSTON GAUGE (CFS)	NUMBER OF DAYS DAILY AVERAGE DISCHARGE < (INFLOW MINUS EVAPORATION)	MINIMUM RECORDED DAILY INFLOW DURING YEAR (CFS)
2009	246	0	709
2010	340	0	486
2011	270	6[3]	290
2012	444	0	860
2013	788	0	1416

[3] In 2011, there were 6 deviations in minimum flow at Parr Hydro. The reasons for these deviations are as follows: May 3: the USGS had made a shift adjustment after this day and this data was over written with the adjustment which was considerably lower. July 5: 59 cfs below; System Control stated they were trying to keep the water close and flow increased at Carlisle late in the day, 2 of the Parr units would not start until on-call staff arrived at the plant. August 3: 8 cfs below; System Control stated they put on a unit at Parr at 21:53 to meet the minimum but it wasn't enough. August 10: 2 cfs below; did not verify with System Control since it was so slight. September 18: 1 cfs below; did not verify with System Control since it was so slight. October 1: 35 cfs below; an increase late in the evening at Carlisle yet generation at Parr was not modified. None of these deviations were considered violations by the FERC.

Article 20: To effectively administer this Article, SCE&G developed a Project Shoreline Management Plan. The history of the current shoreline management plan is outlined in Section 4.7.5.

Article 39: To comply with this Article's requirement, SCE&G has relied upon information detailing civil features downstream of the Project during the commissioning period (the late 1970's) and the interaction of flows from the Project.

In 1978, when both Developments went into operation, review of downstream civil features indicated that a low level roadway of State Secondary Route 28, located approximately 1.4 miles downstream of the Parr Dam, would begin to flood at Broad River flows of 40,000 CFS. In response, SCE&G implemented an operational guideline requiring the limiting of Fairfield Development operations and Parr Shoals Dam crest gate positioning such that Project releases would not contribute to increases in Broad River flows above 40,000 CFS. This consists of incrementally lowering spillway gates when inflow, as measured at the three upstream USGS gauging stations (Broad River near Carlisle, SC - 02156500, Tyger River near Delta, SC - 02160105 and Enoree River at Whitmire, SC – 02160700), is between 6,000 – 8,000 CFS and continuing until all ten gates are in the open (lowered) position by the time inflows reached 40,000 CFS. Also, incrementally curtailing generation of Fairfield Pumped Storage Development by the time inflows as measured at these three USGS gauges reached 40,000 CFS. As verification, all crest gates must have been lowered to the full open position and Fairfield Pumped Storage Development generation must have been curtailed by the time flows as measured at the USGS gauging station (Broad River at Alston, SC – 02161000) reached 40,000 CFS. However, pump back operations at Fairfield still may occur during high inflow events inasmuch as pump back operations, rather than contributing to downstream flows from Parr, reduce the amount of flow passing the Parr Shoals Development. This operational regime was designed to assure that only natural inflows above 40,000 CFS pass downstream of the Parr Shoals Development dam, and has accomplished those goals.

In 2006, the State Secondary Route 28 (S-36-28) downstream crossing was relocated so that roadway flooding potential that created the need for the current special operating guidelines was decreased significantly. In light of this civil modification, SCE&G reevaluated the threshold flow at which structures and lands downstream of the Project would begin to flood. This evaluation established that Broad River flows of just over 45,000 CFS may begin to inundate lands downstream of the Parr Shoals Dam. Thus, this evaluation has confirmed the previous study results and the current operational guidelines will continue to be implemented, supporting continued compliance with Article 39 of the existing license.

Article 43: The collection, storage, and disposal of solid wastes generated through public access and use of Project lands and waters is described in the Parr Recreation Use Plan filed with the Commission in accordance with license requirement.

Article 44: A recreation sub-impoundment (reservoir with stable water surface elevations) was developed on the north end of Monticello Reservoir. This is known as the Recreational Lake. In addition, recreational park sites were developed at Cannon's and Heller's Creeks, along with two waterfowl sub-impoundments on the Parr Reservoir which are shown on the Exhibit R and K drawings.

Article 48: All lands necessary or appropriate for Project operations were purchased or flowage rights were obtained as described on the Exhibit K drawings.

Article 50: This monitoring was performed and a final report filed with the FERC on January 10, 1984. Monitoring was discontinued.

Article 51: USGS gauge 02160991, Broad River near Jenkinsville, SC monitors dissolved oxygen, temperature, conductivity and pH on a continuous basis. Stream flow is measured on a continuous basis at the USGS gauge 20161000, Broad River at Alston, SC. The other downstream parameters (odor, turbidity and heavy metals) were originally included in the monitoring completed under Article 50 (1978 to 1982). Monitoring of these three parameters was discontinued after the Article 50 report was filed with the Commission in 1984. Concurrence was obtained from SCDHEC and FERC prior to filing the Article 50 report by letters dated November 24, 1982 and January 14, 1983, respectively.

Article 52: On October 7, 2010, SCE&G filed an application to amend license for two new nuclear plants use of Project lands and waters. On October 12, 2011, the FERC issues an Order Modifying and Approving Non-Project Use of Project Lands and Waters (137 FERC ¶ 62,033).

3.9 A Description Of Any New Facilities Or Components To Be Constructed, Plans For Future Development Or Rehabilitation Of The Project, And Changes In Project Operation

There are no current plans for additional facilities, or modification of existing Project structures or equipment. Additionally, no changes to currently licensed operations are planned for the Project. Studies in progress may result in modifications of Project features or operations, and any such plans will be submitted as part of the Final License Application.

4.0 EXISTING ENVIRONMENT AND RESOURCE IMPACTS [§ 5.6 (d)(3)(i)]

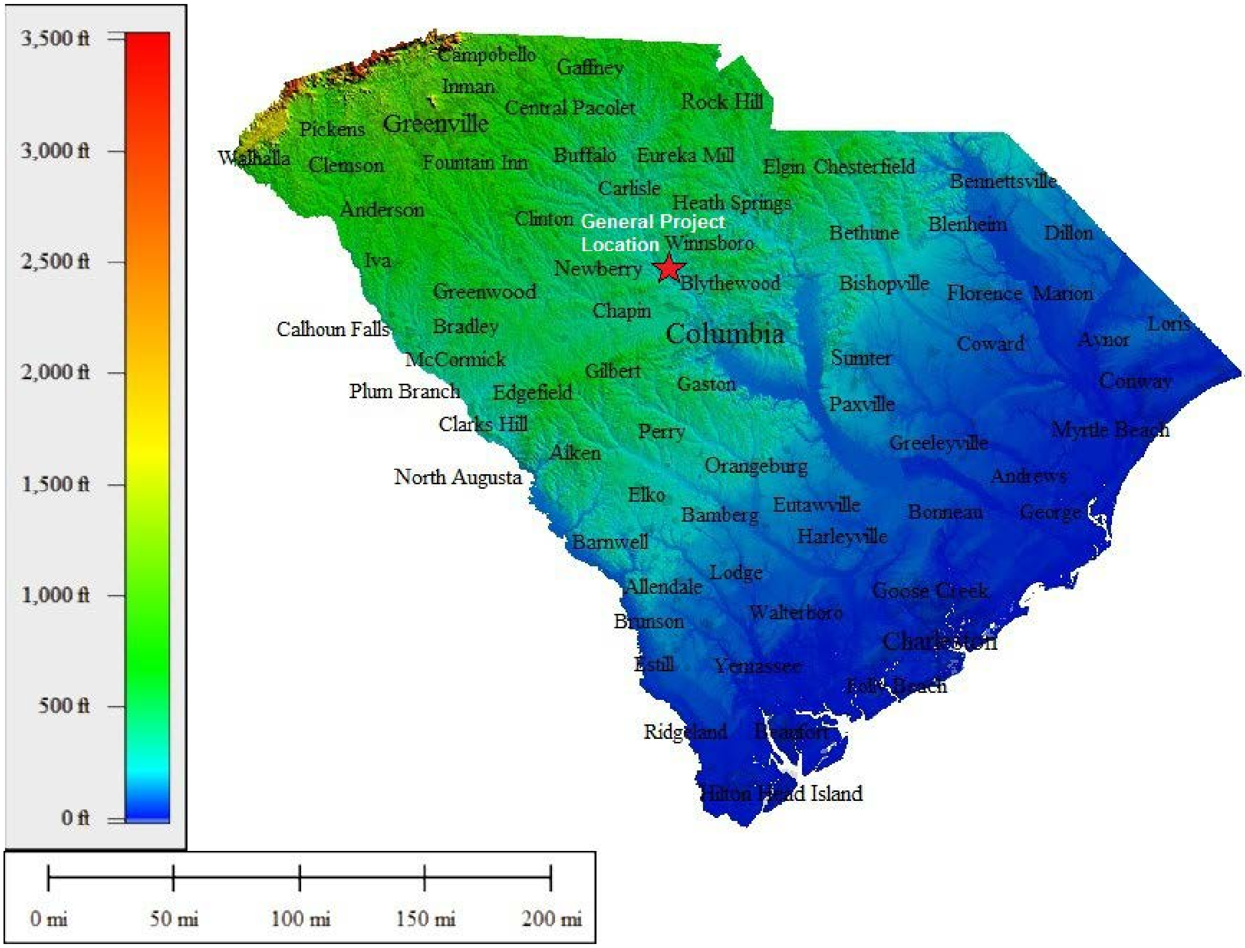
4.1 GEOLOGY AND SOILS [§ 5.6 (D)(3)(II)]

4.1.1 DESCRIPTION OF GEOLOGICAL FEATURES

The Project is located in both Fairfield and Newberry counties, South Carolina, in the Piedmont physiographic region. This region comprises gently rolling hills dissected by narrow stream and river valleys; forests, farms, and orchards dominate most of the landscape. The elevations range from approximately 400 feet to 1,000 feet (SCDNR 2014). Typical rock types associated within this region are gneiss, schist, and granite covered with deep saprolite and generally red, clayey subsoils (EOE 2014).

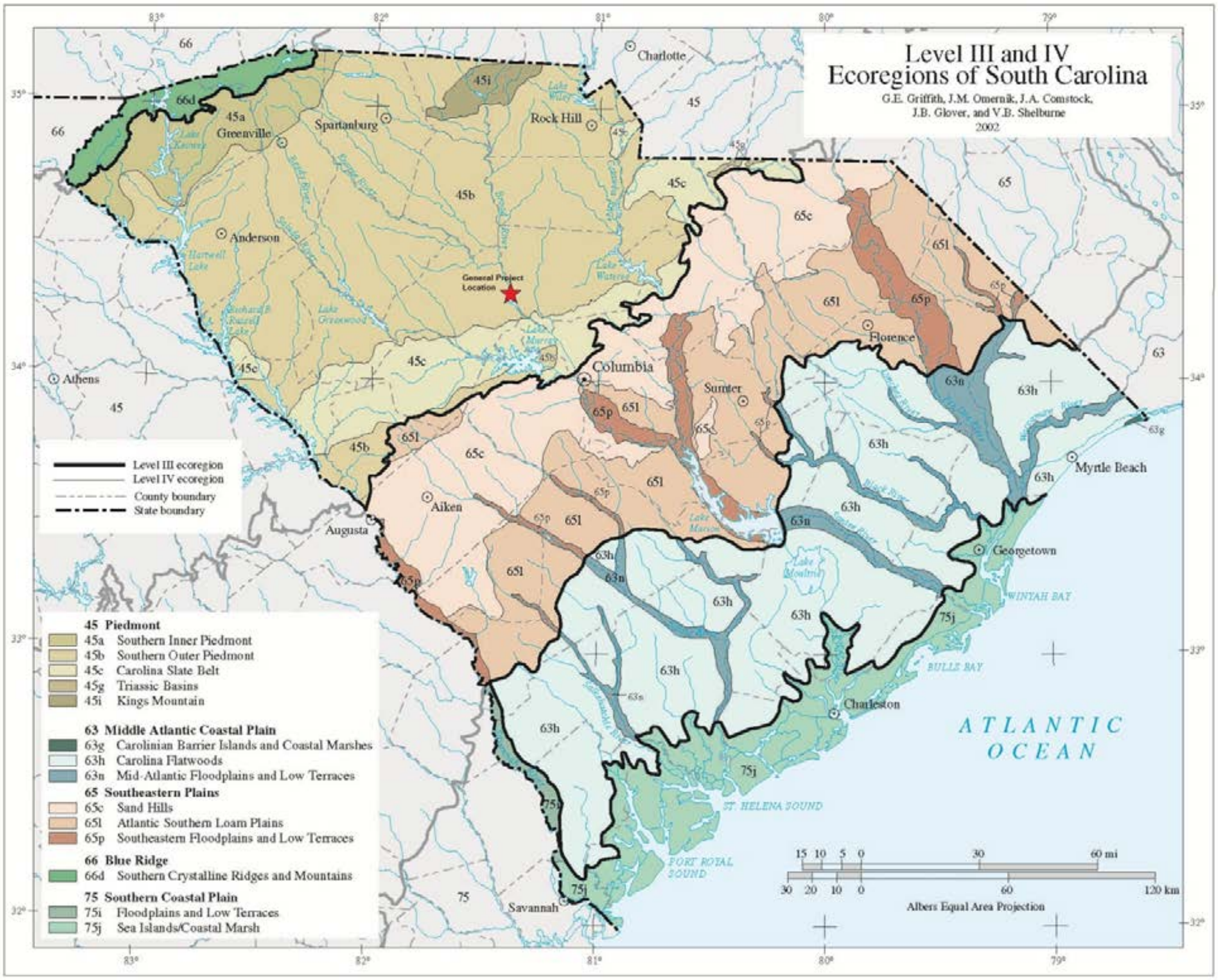
In South Carolina the Piedmont physiographic region is further divided into four unique ecoregions. The Project is located in the Southern Outer Piedmont ecoregion. In comparison to South Carolina's other Piedmont ecoregions, this region tends to have lower elevations, less relief, and irregular plains instead of plains with hills. This ecoregion is adjacent to the Carolina Slate Belt ecoregion, which comprises metavolcanic and metasedimentary rocks that are less metamorphosed than those in most Piedmont regions. Many areas of this region are more rugged and are distinguished by trellised drainage patterns with silt and silty clay soils, and streams that tend to desiccate (EOE 2014). Figure 4-1, Figure 4-2 and Figure 4-3 depict general topography, physiographic regions and ecoregions, and general geology surrounding the Project Area.

FIGURE 4-1: GENERAL TOPOGRAPHY SURROUNDING THE PROJECT



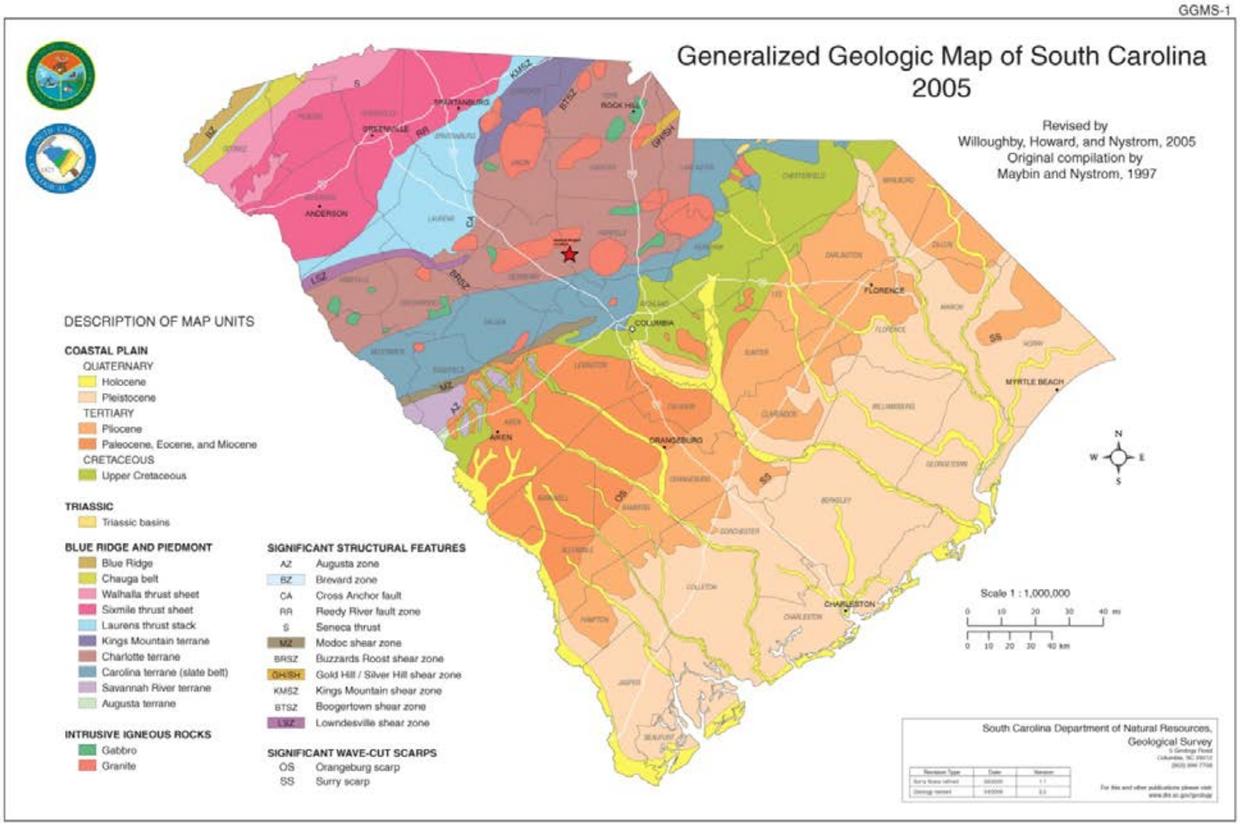
Source: http://topocreator.com/download_city_a.php#SC 2014

FIGURE 4-2: PHYSIOGRAPHIC REGIONS AND ECOREGIONS SURROUNDING THE PROJECT



Reference: (Griffith et. al 2002)

FIGURE 4-3: GENERAL GEOLOGY SURROUNDING THE PROJECT



4.1.2 DESCRIPTION OF SOIL TYPES

Table 4-1 and Figure 4-4 depict the soil types in the general area surrounding the Project. Generally, the soils surrounding the Project consist of sandy clay and sandy loams. The soils with the greatest representation within the Project Area include those from the Cecil, Pacolet, Hiwassee, Wynott-Winnsboro, Hard Labor, and Madison families. Cecil family soils, consisting of sandy clay and sandy loam, are well drained with a 2-percent to 15-percent slope. Pacolet family soils, consisting of sand, clay, and sandy clay loam, are well drained with a 10-percent to 50-percent slope. Hiawassee family soils, consisting of sandy clay and sandy loam, are well drained with a 2-percent to 10-percent slope. Wynott-Winnsboro family soils, consisting of sandy clay loam, are well drained with a 2-percent to 10-percent slope. Hard Labor family soils, consisting of sandy loam, are moderately well drained with a 2-percent to 10-percent slope. Madison family soils, consisting of sandy clay and sandy loam, are well drained with a 2-percent to 25-percent slope. Table 4-1 lists the various soil types in the area surrounding the Project and describes the extent to which they occur. In general, soils within the Project Area consist of sandy loams with slopes ranging from 0 percent to 50 percent with a slight to moderate erosion potential (NRCS 2014).

TABLE 4-1: LIST OF SOILS BY TYPE, SIZE (ACRES), AND PERCENT SURROUNDING THE PROJECT

FAIRFIELD COUNTY, SOUTH CAROLINA (SC039)			
MAP UNIT SYMBOL	**MAP UNIT NAME**	**ACRES IN AOI**	**PERCENT OF AOI**
ApB	Appling loamy sand, 2 to 6 percent slopes	95.9	0.20%
ApC	Appling loamy sand, 6 to 10 percent slopes	167.5	0.30%
CaB	Cataula sandy loam, 2 to 6 percent slopes	90.7	0.20%
CcC2	Cataula sandy clay loam, 6 to 10 percent slopes, eroded	585.6	1.20%
CeB	Cecil sandy loam, 2 to 6 percent slopes	142.4	0.30%
CnB2	Cecil sandy clay loam, 2 to 6 percent slopes, eroded	528.8	1.10%
CnC2	Cecil sandy clay loam, 6 to 10 percent slopes, eroded	1073.0	2.20%
Cw	Chewacla loam, 0 to 2 percent slopes, frequently flooded	1812.6	3.70%
DuB	Durham loamy sand, 2 to 6 percent slopes	31.2	0.10%
HaB	Helena sandy loam, 2 to 6 percent slopes	41.3	0.10%
HsB	Hiwassee sandy loam, 2 to 6 percent slopes	796.5	1.60%
HsC	Hiwassee sandy loam, 6 to 10 percent slopes	274.9	0.60%
HwB2	Hiwassee sandy clay loam, 2 to 6 percent slopes, eroded	1226.0	2.50%
HwC2	Hiwassee sandy clay loam, 6 to 10 percent slopes, eroded	1962.1	4.00%
IdB	Iredell fine sandy loam, 1 to 6 percent slopes	44.4	0.10%
MaB	Madison sandy loam, 2 to 6 percent slopes	445.7	0.90%
MdC2	Madison sandy clay loam, 6 to 10 percent slopes, eroded	546.9	1.10%
MdE2	Madison sandy clay loam, 10 to 25 percent slopes, eroded	1820.9	3.70%
MeB	Mecklenburg fine sandy loam, 2 to 6 percent slopes	179.2	0.40%
MkC2	Mecklenburg sandy clay loam, 6 to 10 percent slopes, eroded	140.2	0.30%
PaE	Pacolet sandy loam, 10 to 25 percent slopes	4007.4	8.10%
RnF	Rion loamy sand, 15 to 40 percent slopes	486.8	1.00%
To	Toccoa loam	1041.5	2.10%
UD	Udorthents, loamy and clayey	51.8	0.10%
VnC2	Vance sandy clay loam, 6 to 10 percent slopes, eroded	22.9	0.00%
W	Water	862.0	1.70%
WaD	Wateree-Rion complex, 6 to 15 percent slopes	21.7	0.00%
WaF	Wateree-Rion complex, 15 to 40 percent slopes	188.5	0.40%

Fairfield County, South Carolina (SC039)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
WkD	Wilkes sandy loam, 6 to 15 percent slopes	704.4	1.40%
WkF	Wilkes sandy loam, 15 to 40 percent slopes	1189.7	2.40%
WnB	Winnsboro sandy loam, 2 to 6 percent slopes	12.6	0.00%
WnC	Winnsboro sandy loam, 6 to 10 percent slopes	375.0	0.80%
WnE	Winnsboro sandy loam, 10 to 25 percent slopes	233.8	0.50%
Subtotals for Soil Survey Area		**21204.0**	**42.80%**

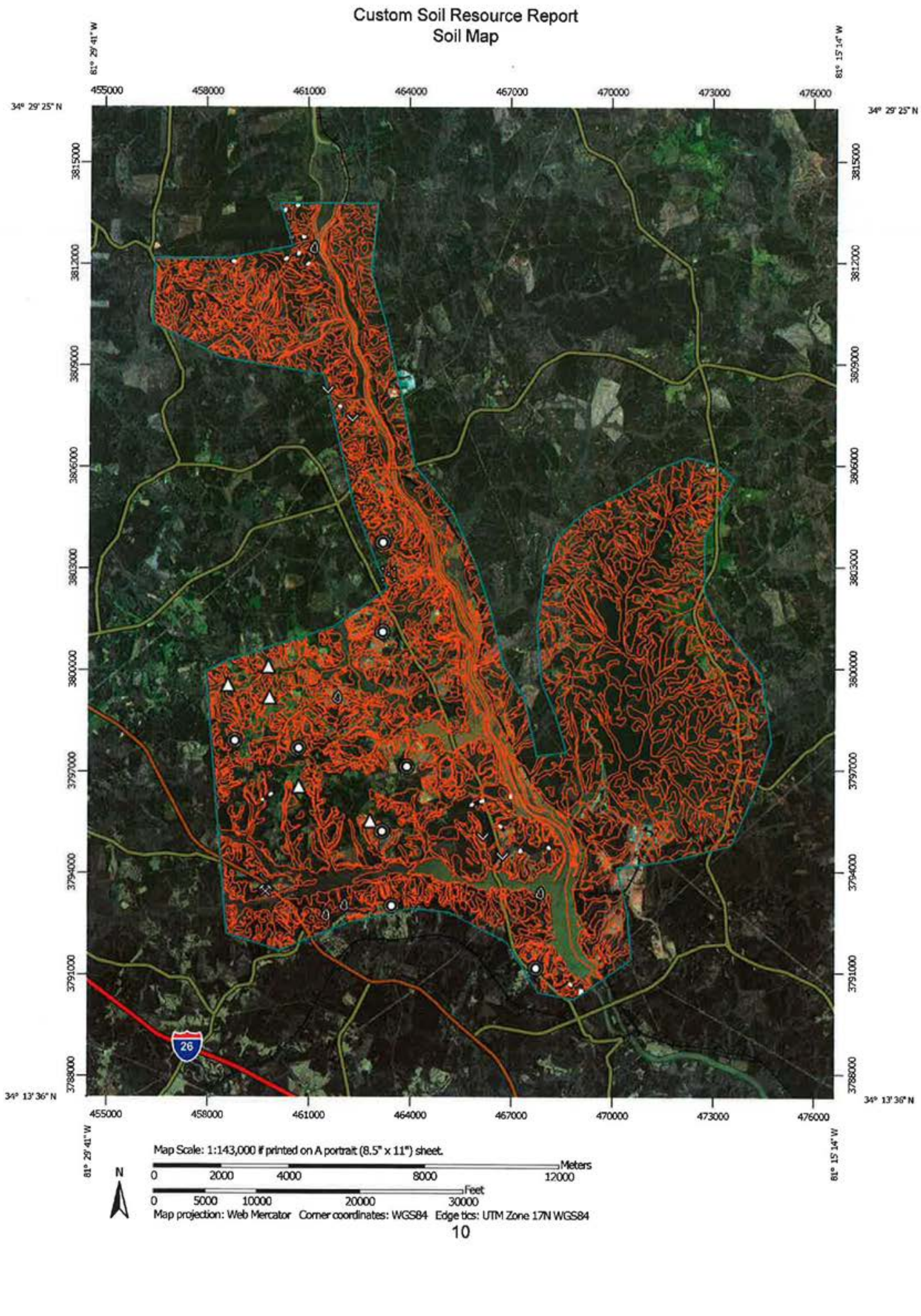
Newberry County, South Carolina (SC071)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1B	Appling loamy sand, 2 to 7 percent slopes	6.8	0.00%
5A	Cartecay sandy loam, 0 to 2 percent slopes, occasionally flooded	2.3	0.00%
8C2	Cataula sandy clay loam, 7 to 15 percent slopes, moderately eroded	9.2	0.00%
10B	Cecil sandy loam, 2 to 7 percent slopes	10.7	0.00%
11B2	Cecil sandy clay loam, 2 to 7 percent slopes, moderately eroded	425.1	0.90%
11C2	Cecil sandy clay loam, 7 to 15 percent slopes, moderately eroded	595.2	1.20%
12C3	Cecil clay loam, 7 to 15 percent slopes, severely eroded	1.0	0.00%
13A	Chenneby silt loam, 0 to 2 percent slopes, occasionally flooded	47.8	0.10%
15A	Shellbluff silty clay loam, 0 to 2 percent slopes, occasionally flooded	124.7	0.30%
23B2	Winnsboro sandy clay loam, 2 to 7 percent slopes, moderately eroded	11.6	0.00%
23C2	Winnsboro sandy clay loam, 7 to 15 percent slopes, moderately eroded	40.5	0.10%
23D2	Winnsboro sandy clay loam, 15 to 25 percent slopes, moderately eroded	50.6	0.10%
28B	Santuc loamy coarse sand, 2 to 7 percent slopes	18.8	0.00%
28C	Santuc loamy coarse sand, 7 to 15 percent slopes	38.2	0.10%
32B2	Hiwassee sandy clay loam, 2 to 7 percent slopes, moderately eroded	27.6	0.10%
40B	Mecklenburg sandy loam, 2 to 7 percent slopes	9.8	0.00%
41C2	Mecklenburg sandy clay loam, 7 to 15 percent slopes, moderately eroded	3.7	0.00%
44D2	Pacolet sandy clay loam, 15 to 25 percent slopes, moderately eroded	190.3	0.40%
44E3	Pacolet sandy clay loam, 25 to 50 percent slopes, moderately eroded	45.7	0.10%
45E4	Pacolet clay loam, 25 to 50 percent slopes, severely	22.6	0.00%

FAIRFIELD COUNTY, SOUTH CAROLINA (SC039)			
MAP UNIT SYMBOL	MAP UNIT NAME	ACRES IN AOI	PERCENT OF AOI
	eroded		
47C2	Rion sandy loam, 7 to 15 percent slopes, moderately eroded	70.6	0.10%
47D2	Rion sandy loam, 15 to 25 percent slopes, moderately eroded	275.1	0.60%
47E3	Rion sandy loam, 25 to 50 percent slopes, moderately eroded	98.0	0.20%
49A	Toccoa sandy loam, 0 to 2 percent slopes, occasionally flooded	60.4	0.10%
60D2	Wilkes sandy loam, 15 to 25 percent slopes, moderately eroded	2.5	0.00%
CcA	Cartecay sandy loam, 0 to 2 percent slopes, frequently flooded	6.3	0.00%
CdB2	Cataula sandy loam, 2 to 6 percent slopes, moderately eroded	5.3	0.00%
CdC2	Cataula sandy loam, 6 to 10 percent slopes, moderately eroded	1.0	0.00%
CeB	Cecil sandy loam, 2 to 6 percent slopes	35.6	0.10%
CfB2	Cecil sandy clay loam, 2 to 6 percent slopes, moderately eroded	6417.6	13.00%
CfC2	Cecil sandy clay loam, 6 to 10 percent slopes, moderately eroded	2685.9	5.40%
CfD2	Cecil sandy clay loam, 10 to 15 percent slopes, moderately eroded	2.8	0.00%
CnA	Chenneby silt loam, 0 to 2 percent slopes, frequently flooded	1536.0	3.10%
CyA	Chenneby silt loam, 0 to 2 percent slopes, ponded	275.0	0.60%
HaB	Hard Labor sandy loam, 2 to 6 percent slopes	1977.9	4.00%
HaC	Hard Labor sandy loam, 6 to 10 percent slopes	846.6	1.70%
HeB	Helena sandy loam, 2 to 6 percent slopes	605.0	1.20%
HeC	Helena sandy loam, 6 to 10 percent slopes	211.1	0.40%
HwB2	Hiwassee sandy loam, 2 to 6 percent slopes, moderately eroded	1.0	0.00%
MeB2	Mecklenburg sandy clay loam, 2 to 6 percent slopes, moderately eroded	2.3	0.00%
MeC2	Mecklenburg sandy clay loam, 6 to 10 percent slopes, moderately eroded	25.5	0.10%
PaD2	Pacolet sandy clay loam, 10 to 15 percent slopes, moderately eroded	419.5	0.80%
PaE2	Pacolet sandy clay loam, 15 to 25 percent slopes, moderately eroded	1303.2	2.60%
PaF2	Pacolet sandy clay loam, 25 to 50 percent slopes, moderately eroded	166.5	0.30%
PcC3	Pacolet clay loam, 6 to 10 percent slopes, severely eroded	1.2	0.00%
PmB	Prosperity-Bush River-Helena complex, 2 to 6	21.2	0.00%

FAIRFIELD COUNTY, SOUTH CAROLINA (SC039)			
MAP UNIT SYMBOL	MAP UNIT NAME	ACRES IN AOI	PERCENT OF AOI
	percent slopes		
PmC	Prosperity-Bush River-Helena complex, 6 to 10 percent slopes	197.8	0.40%
RnC2	Rion sandy loam, 6 to 10 percent slopes, moderately eroded	101.2	0.20%
RnD2	Rion sandy loam, 10 to 15 percent slopes, moderately eroded	209.7	0.40%
RnE2	Rion sandy loam, 15 to 25 percent slopes, moderately eroded	1145.5	2.30%
RnF2	Rion sandy loam, 25 to 50 percent slopes, moderately eroded	351.8	0.70%
SaB	Santuc loamy coarse sand, 2 to 6 percent slopes	79.8	0.20%
SaC	Santuc loamy coarse sand, 6 to 10 percent slopes	120.0	0.20%
ShA	Shellbluff silty clay loam, 0 to 2 percent slopes, frequently flooded	70.0	0.10%
ToA	Toccoa sandy loam, 0 to 3 percent slopes, frequently flooded	881.7	1.80%
W	Water	2056.2	4.20%
WnB	Winnsboro sandy loam, 2 to 6 percent slopes	244.6	0.50%
WwD2	Wynott-Wilkes complex, 10 to 15 percent slopes, moderately eroded	241.8	0.50%
WwE2	Wynott-Wilkes complex, 15 to 25 percent slopes, moderately eroded	804.5	1.60%
WyB2	Wynott-Winnsboro complex, 2 to 6 percent slopes, moderately eroded	1100.1	2.20%
WyC2	Wynott-Winnsboro complex, 6 to 10 percent slopes, moderately eroded	1948.4	3.90%
Subtotals for Soil Survey Area		**28288.3**	**57.20%**
Totals for Area of Interest		**49492.2**	**100.00%**

Source (NRCS 2014)

FIGURE 4-4: SOILS SURROUNDING THE PROJECT AREA OF INTEREST

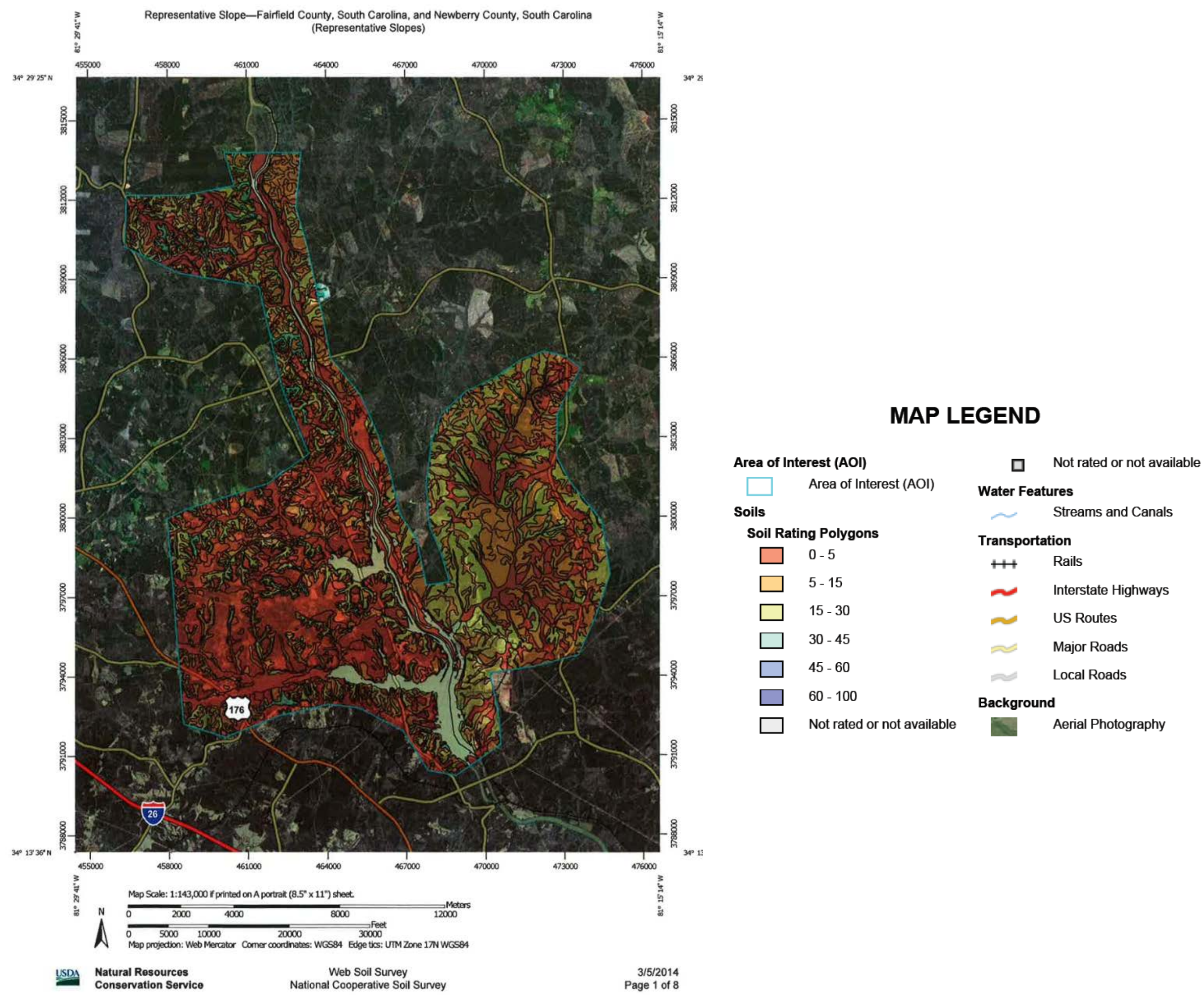


Source (NRCS, 2014)

4.1.3 DESCRIPTION OF RESERVOIR SHORELINES AND STREAM BANKS

Most of the Project Area consists of gradual slopes ranging from 0 percent to 15 percent, as depicted in Figure 4-5.

FIGURE 4-5: REPRESENTATIVE SLOPE RATINGS WITHIN THE PROJECT AREA OF INTEREST



(NRCS, 2014)

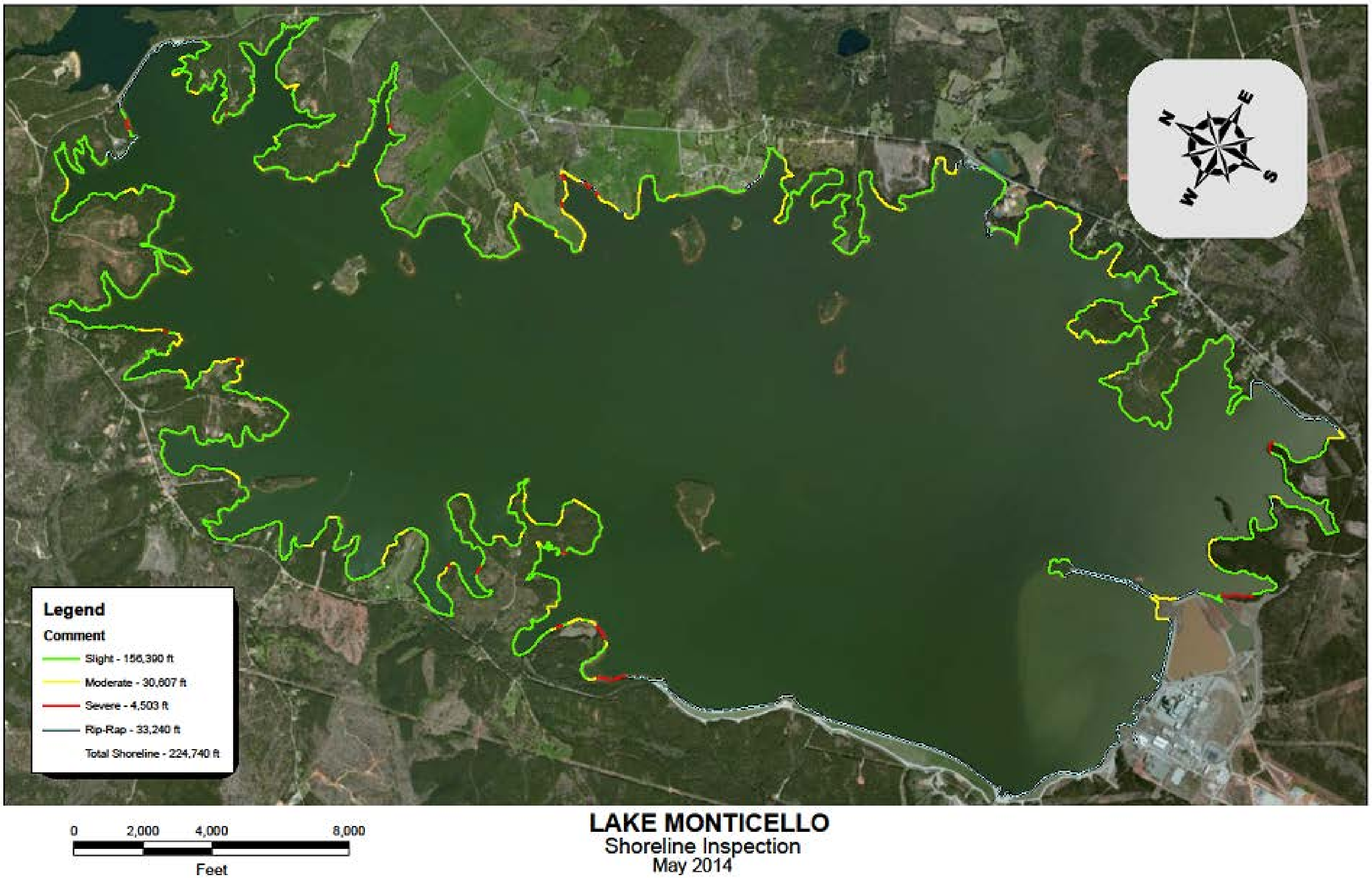
The shorelines within the Project Area are subject to anthropogenic disturbances, including roadways near the waterline and structures to support recreational and Project-related activities. Shorelines surrounding Project structures are armored with concrete embankments and rip-rap. Vegetation surrounding the Project Area varies, but forested shorelines are the most prevalent feature throughout most of the landscape. The eastern shoreline area of the Monticello Reservoir is more developed compared to the entire Project and has less forested area and more homes with grassy lawns.

4.1.4 EXISTING EROSION, MASS SOIL MOVEMENT, SLUMPING, OR OTHER FORMS OF INSTABILITY

SCE&G performs shoreline surveillance studies at Monticello Reservoir twice a year and at Parr Reservoir once a year, which identify and classify areas of erosion along the shorelines. Areas of erosion are classified into one of three categories: severe, moderate or slight. Areas with heavy vegetation, no recent down trees, roots holding shoreline together and little or no erosion are classified as slight. Areas with some vegetation and vertical or sloped erosion are classified as moderate and areas with little or no vegetation and undercut erosion are classified as severe. Shoreline that is covered in rip rap is also identified.

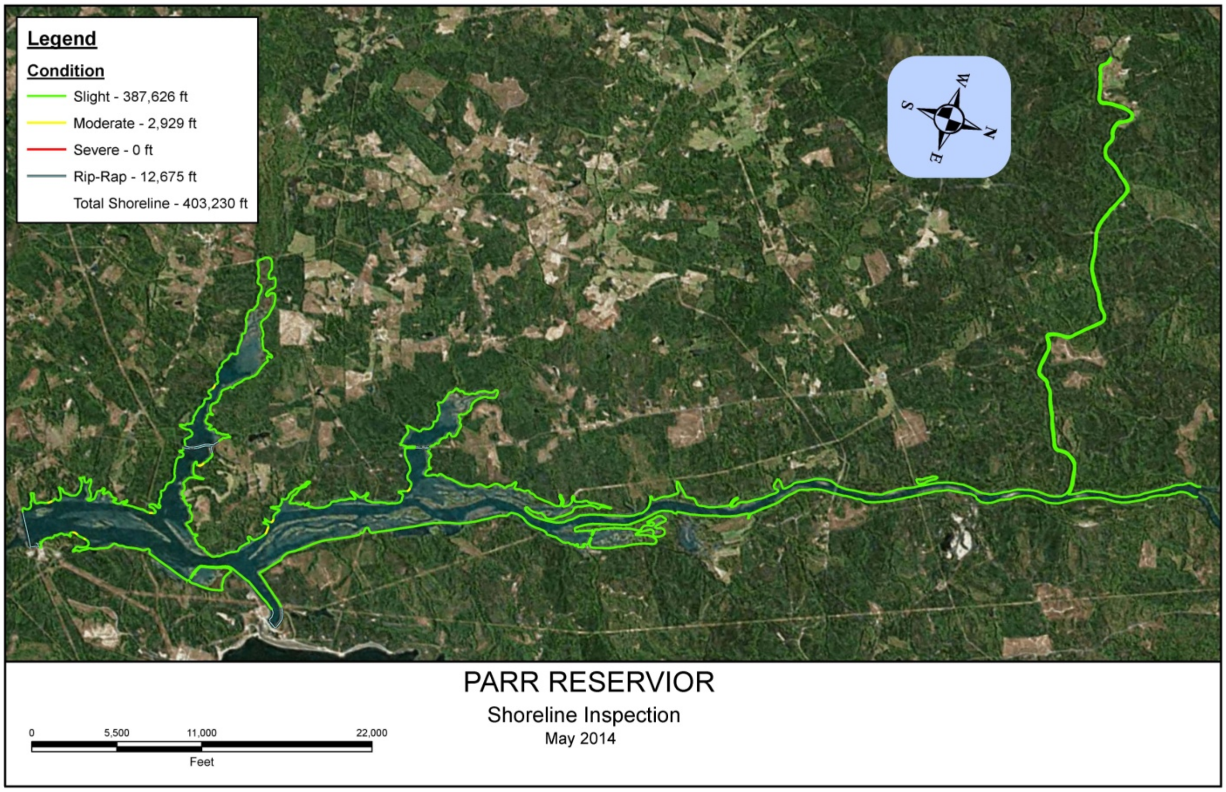
On May 20, 2014 the shoreline at Monticello Reservoir was inspected. Results showed that conditions remained much the same as reported during the previous inspection in November 2013. There were no areas of erosion beyond the PBL however some areas of the shoreline will be monitored closely during future inspections. Just over 85 percent of the shoreline showed some signs of erosion, with 69.6% classified as slightly eroded, 13.6% classified as moderately eroded, and 2.0% classified as severely eroded. **Error! Reference source not found.** shows the distribution of erosion at Monticello Reservoir.

FIGURE 4-6: SHORELINE SURVEILLANCE AT MONTICELLO RESERVOIR, MAY 2014



On May 21st, 22nd, and 28th of 2014 the shoreline at Parr Reservoir was inspected for signs of erosion. Results showed that approximately 99.25% of the shoreline at Parr shows slight erosion and only 0.75% of the shoreline is moderately eroded. There are no areas of severe erosion at Parr Reservoir. Visual inspection showed that the majority of the river bank and backwater shoreline is well vegetated with a variety of aquatic species and mature timber. Figure 4-7 shows the distribution of erosion at Parr Reservoir.

FIGURE 4-7: SHORELINE INSPECTION AT PARR RESERVOIR, MAY 2014



4.1.5 POTENTIAL ADVERSE EFFECTS AND ISSUES

The fluctuations of Parr Reservoir and Monticello Reservoir caused by the operation of the Fairfield Pumped Storage Development do contribute to some shoreline erosion at each reservoir. As discussed, the Applicant monitors the shorelines of Parr and Monticello reservoirs annually for signs of beginning or worsening erosion. Rip-rap has been placed in some areas more susceptible to this erosion, and the Applicant maintains it. The Applicant intends to study reservoir fluctuation at Parr and Monticello reservoirs to assess the amount of area that is exposed during fluctuation and identify any mitigation measures that may be considered as part of relicensing.

4.1.6 PROPOSED MITIGATION AND ENHANCEMENT MEASURES

Although no mitigation or enhancement measures relating to geology and soils are planned at this time, the Applicant may consider some measures to deal with shoreline erosion pending the outcome of the reservoir fluctuation study. If any major structural changes of the Project are planned, construction will comply with appropriate sediment erosion control requirements; however, no structural changes to the Project are proposed at this time.

4.1.7 REFERENCES

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4.2 WATER RESOURCES [§ 5.6 (D)(3)(III)]

4.2.1 DRAINAGE AREA

The drainage area for the Parr Shoals Development is 4,750 square miles, and the drainage area for the Fairfield Development is 15 square miles.

4.2.2 FLOW STATISTICS

The monthly mean, minimum and maximum flows for the Project are listed below. Flows are recorded downstream of the Project (by the USGS gage at Alston, 02161000) as total releases, and therefore evaporation that occurs from the reservoirs is already accounted for in the statistics.

TABLE 4-2: MONTHLY MEAN, MAXIMUM AND MINIMUM DATA FOR THE USGS GAGE AT ALSTON (02161000), FOR WATER YEARS 1981-2013, BY WATER YEAR (WY) (IN CUBIC FEET PER SECOND)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	3,565	4,016	5,650	7,252	7,877	9,023	6,606	5,033	3,791	3,198	3,475	2,760
MAX	17,360	14,500	14,190	17,790	16,960	21,560	18,040	14,830	8,909	12,440	10,210	14,740
(WY)	(1991)	(1993)	(2010)	(1993)	(1990)	(1993)	(2003)	(2003)	(2003)	(2013)	(1995)	(2004)
MIN	638	725	1,251	2,106	1,985	3,170	2,821	1,783	763	600	546	624
(WY)	(2008)	(2008)	(2008)	(2011)	(2009)	(2006)	(2012)	(201)	(2008)	(2008)	(2002)	(2007)

Source: USGS, 2014

Appendix A contains Flow Duration Curves.

4.2.3 EXISTING AND PROPOSED USES OF PROJECT WATERS

Private development along the Parr and Fairfield developments is minimal and generally consists of rural communities (FERC, 2011). The primary use of Project waters, excluding hydropower, is for a cooling water system at the Virgil C. Summer Nuclear Generating Station (V.C. Summer Station). SCE&G applied for a renewal of its National Pollutant Discharge Elimination System (NPDES) permit for the V.C. Summer Station and the new permit was issued on May 7, 2014 (effective June 1, 2014). The V.C. Summer Station uses a once-through cooling water system that withdraws water from the Monticello Reservoir into its condensers. After the water cools the condensers, the heated water is transferred to a discharge bay and then flows back into the Monticello Reservoir via a 1,000-foot-long discharge channel (SCE&G, 2012). Approximately

1,190 cfs is withdrawn and returned to Monticello Reservoir through this once-through operation.

Currently, SCE&G is expanding their V. C. Summer Station with the construction of two new nuclear units (NRC 2012). Once these units are online, there will be a daily withdrawal of 83 cfs from Monticello Reservoir for use in the cooling towers. Sixty-two cfs will be lost through evaporation and drift, and a daily discharge of 21 cfs will be released into Parr Reservoir (NRC 2010).

4.2.4 EXISTING INSTREAM FLOW USES OF STREAMS IN THE PROJECT AREA THAT WOULD BE AFFECTED BY PROJECT OPERATION

The existing Project license requires a minimum flow release into the Broad River from the Parr Shoals Development of 1,000 cubic feet per second (cfs), or the average daily natural inflow into the Parr Reservoir, whichever is the lesser amount, during the months of March, April, and May. During all other months of the year the license requires a minimum flow of 150 cfs and a minimum daily average flow of 800 cfs, or the daily natural inflow into Parr Reservoir, whichever is the lesser amount (FERC, 2011). Existing minimum flows are designed to protect instream flow uses of the Broad River, which include recreation, navigation, and aquatic resources.

4.2.5 RELEVANT FEDERALLY APPROVED WATER QUALITY STANDARDS APPLICABLE TO PROJECT WATERS

Project waters are classified as freshwater and SCDHEC identifies freshwaters (FW) as the following; suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with SCDHEC requirements; suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and suitable for industrial and agricultural uses. Table 4-3 and Table 4-4 list the SCDHEC water quality standards applicable to Project waters (SCDHEC, 2012a).

TABLE 4-3: SCDHEC WATER QUALITY STANDARDS FOR FRESHWATERS

PARAMETER[1]	STANDARD
Temperature	The water temperature of all freshwaters which are free flowing shall not be increased more than 5°F (2.8°C) above natural temperature conditions and shall not exceed a maximum of 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard as provided in C.12. Has been established, a mixing zone as provided in C.10. Has been established, or a Section 316(a) determination under the Federal Clean Water Act has been completed.
pH	Between 6.0 and 8.5
Dissolved oxygen	Daily average not less than 5.0mg/l with a low of 4.0 mg/l
Turbidity (reservoirs only)	Not to exceed 25 NTUs provided existing uses are maintained
Turbidity (excluding reservoirs)	Not to exceed 50 NTUs provided existing uses are maintained
E. coli	Not to exceed a geometric mean of 126/100 ml based on at least four samples collected from a given sampling site over a 30 day period, nor shall a single sample maximum exceed 349/100 ml.
Garbage, cinders, ashes, oils, sludge, or other refuse	None allowed.
Treated wastes, toxic wastes, deleterious substances, colored or other wastes except garbage, cinders, ashes, oils, sludge, or other refuse	None alone or in combination with other substances or wastes in sufficient amounts to make the waters unsafe or unsuitable for primary contact recreation or to impair the waters for any other best usage as determined for the specific waters which are assigned to this class.
Stormwater, and other nonpoint source runoff, including that from agricultural uses, or permitted discharge from aquatic farms, concentrated aquatic animal production facilities, and uncontaminated groundwater from mining.	Allowed if water quality necessary for existing and classified uses shall be maintained and protected consistent with anti-degradation rules.

[1]Water quality standards for toxic pollutants can be found in Section E and the appendix of the SCDHEC R. 61-68, Water Classifications & Standards

Source: SCDHEC, 2012a

TABLE 4-4: SCDHEC NUTRIENT STANDARDS FOR WATERS IN THE PIEDMONT AND SOUTHEASTERN PLAINS ECOREGIONS[1]

PARAMETER	STANDARD
Total nitrogen	≤1.50 mg/l
Total phosphorus	≤0.06 mg/l
Chlorophyll *a*	≤40 ug/l

[1]Listed are the nutrient standards for lakes and reservoirs. Currently, there are no nutrient standards for streams and rivers.

Source: SCDHEC, 2012a

SCDHEC has also identified several "core indicator" metals considered to be essential for indicating the ability of a body of water to support aquatic life:

- cadmium
- chromium
- copper
- lead
- mercury
- nickel
- zinc

Federal and state water quality standards for the state of South Carolina are guided through implementation of Sections 303(d) and 305(b) of the Clean Water Act (CWA). The CWA directs individual states to monitor and report on the condition of their water resources. The South Carolina Department of Health and Environmental Control (SCDHEC) is charged with monitoring water quality for the state. Pursuant to section 305(b) of the CWA, the SCDHEC prepares a biennial integrated report on its assessment of the condition of water quality and water pollution control programs. It also publishes a companion document containing a list of waters impaired, as required by section 303(d) (SCDHEC, 2012b, 2012c). Water bodies not meeting standards are included on South Carolina's list of water bodies impaired as required by section 303(d). South Carolina has a program for water bodies listed as impaired that establishes total maximum daily loads (TMDLs) (which includes point and non-point sources and controls) that are managed through the NPDES permitting program, with the objective of bringing water quality to within set criteria.

4.2.6 PROJECT EFFECTS ON SEASONAL VARIATION OF WATER QUALITY DATA

In the most recent 303(d) list for the state of South Carolina, several point locations in both the Parr and Monticello reservoirs were listed as impaired. SCDHEC lists point locations based on water quality sampling stations but specifies that the impairment is considered to extend to the surrounding waters upstream and downstream of the sampling station. Table 4-5 lists the impaired waters in the Project Area along with the cause for the impaired listing (SCDHEC, 2012b). Figure 4-8, Figure 4-9 and Figure 4-10 are maps of the SCDHEC monitoring stations at the Project.

TABLE 4-5: SCDHEC MONITORING STATIONS LISTED AS IMPAIRED WITHIN THE PROJECT BOUNDARY AND DOWNSTREAM OF PARR SHOALS DAM

STATION	LOCATION	USE	CAUSE FOR IMPAIRMENT LISTING	TARGET YEAR FOR TMDL DEVELOPMENT
B-327	Monticello Lake[4] - lower impoundment between large islands	Aquatic life	pH	2019
RL-04370	Monticello Lake- 1.7 miles northwest of Monticello	Aquatic life	pH	2019
RL-04374	Monticello Lake- 3.5 miles north of Jenkinsville	Aquatic life	pH	2019
B-346 (inactive site)	Parr Reservoir- 4.8 kilometers north of dam, upstream Monticello Lake	Aquatic life	Total phosphorus	2019
B-236 (inactive site)	Broad River at So. Railroad Trestle, 0.5 miles downstream of SC213	Aquatic Life	Copper	2020
B-151	Hellers Creek at SR 97	Aquatic Life	Bio (macroinvertebrate)	2015

Source: SCDHEC, 2012b

[4] SCDHEC defines a lake as any water of the State that is a freshwater pond, reservoir, impoundment, or similar body of water located wholly or partially within the state (SCDHEC, 2012a). Therefore, SCDHEC classifies Monticello Reservoir as a lake.

FIGURE 4-8: SCDHEC MONITORING STATIONS WITHIN THE PROJECT BOUNDARY AT PARR RESERVOIR

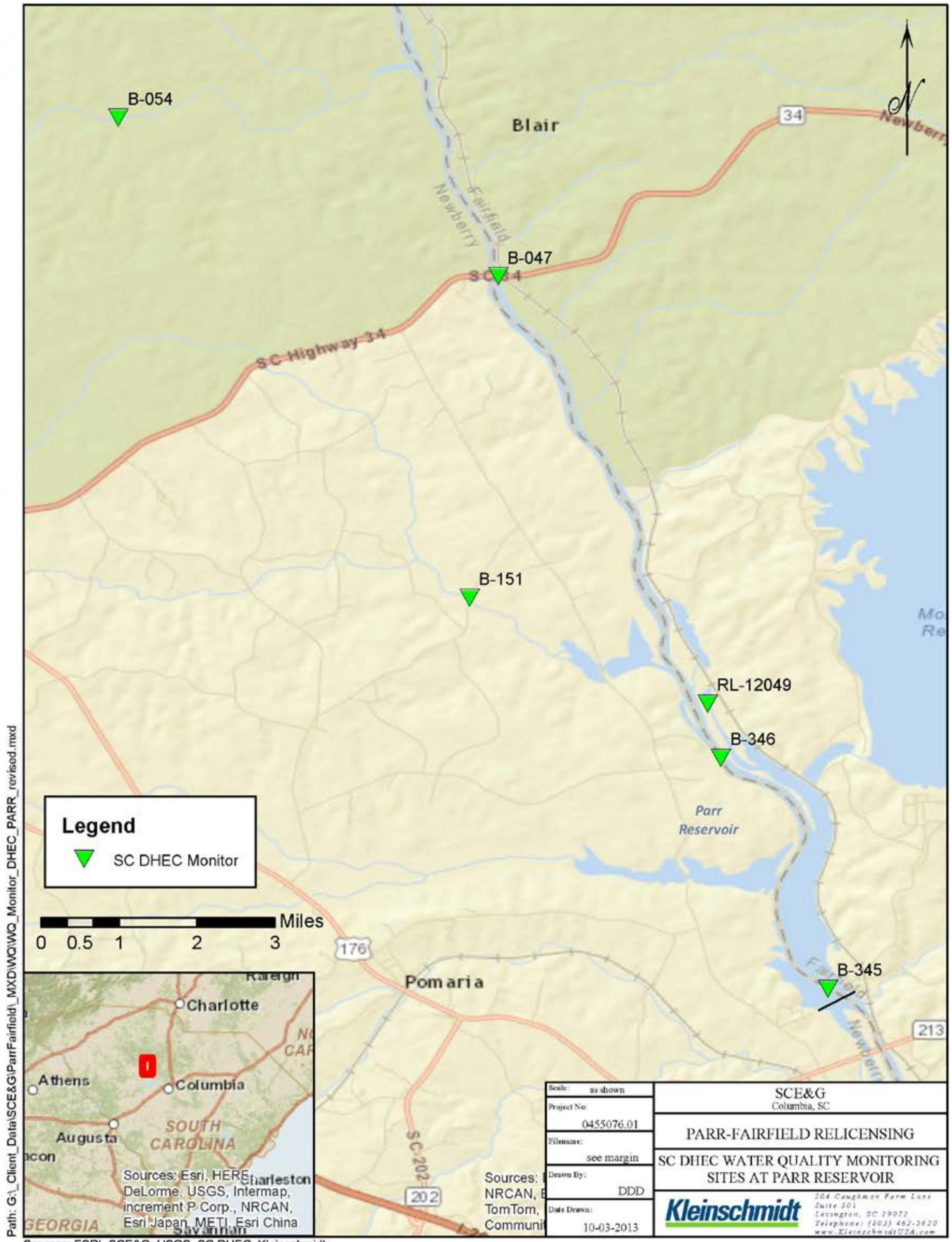

FIGURE 4-9: SCDHEC MONITORING STATIONS WITHIN THE PROJECT BOUNDARY AT MONTICELLO RESERVOIR

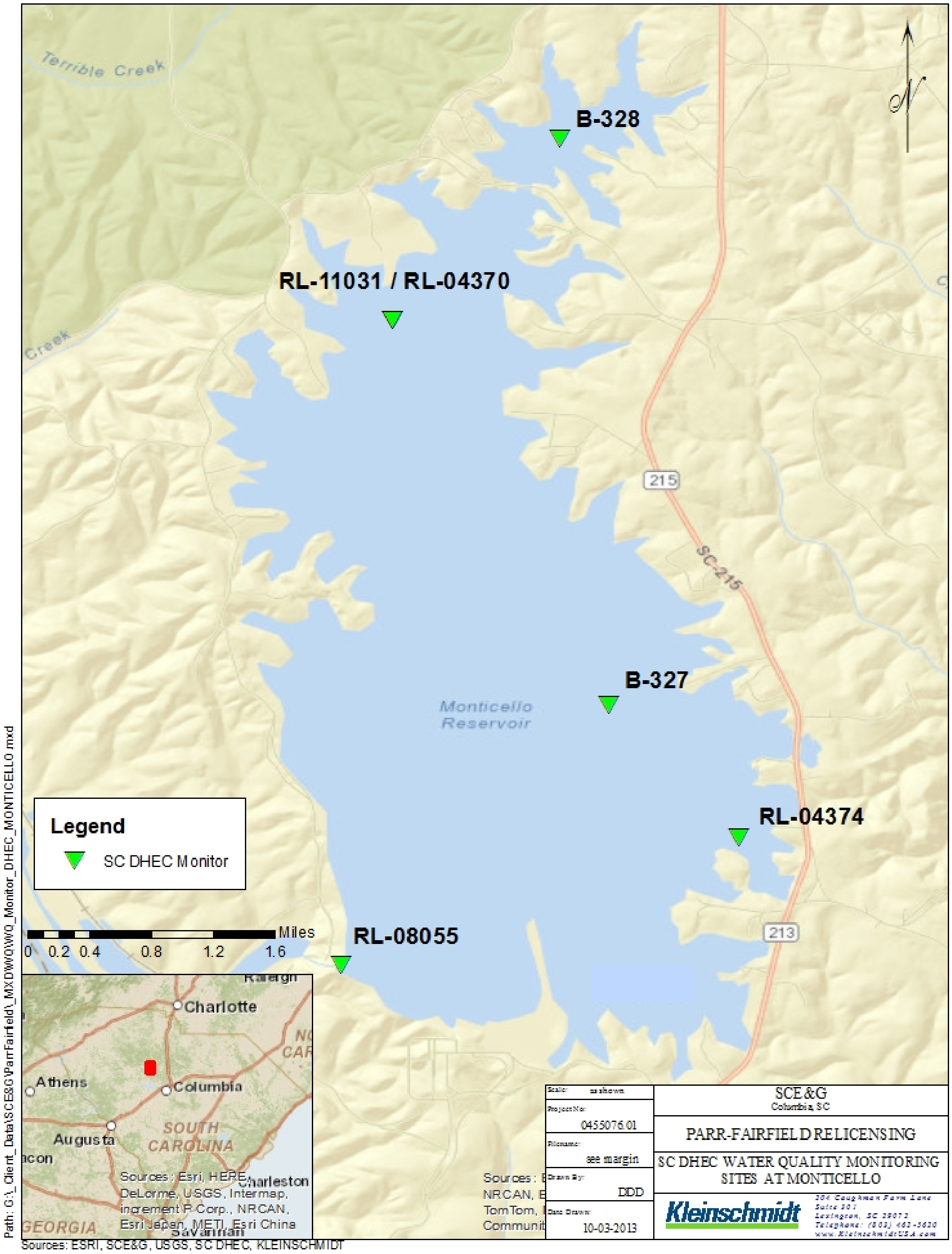

FIGURE 4-10: SCDHEC MONITORING STATIONS ON THE BROAD RIVER DOWNSTREAM OF PARR SHOALS DAM

Sources: ESRI, SCE&G, USGS, SC DHEC, KLEINSCHMIDT

In January 2014, SCE&G prepared a *Baseline Water Quality Report* in anticipation of relicensing the Parr-Fairfield Hydroelectric Project (Appendix E). The report uses existing water quality data available for the waters associated with the Project to establish a water quality baseline for the Project and identify any water quality trends that may be associated with Project operations. The report focuses on the following indicators of water quality:

- dissolved oxygen
- conductivity
- pH
- turbidity
- nitrogen and phosphorus
- chlorophyll *a*
- metals

The *Baseline Water Quality Report* includes a detailed analysis of the water quality data and will be filed with FERC.

4.2.7 EFFECTS OF PROJECT OPERATIONS ON EXISTING WATER QUALITY

The *Baseline Water Quality Report* includes analysis of upstream and downstream waters associated with the Project along with the Project waters and concludes that Project operations could affect water quality below Parr Shoals Dam. At the Water Quality TWC meeting on February 4, 2014, the TWC noted that the Baseline Water Quality Report identified period excursions of DO levels below 4.0 mg/l in the Parr Shoals Dam tailrace, as reported by the USGS station 02160991. In June of 2011, the USGS installed a new sensor at the station 02160991. From January 2011 through August 2014, there have been approximately 13 hourly excursions in DO. Accordingly, since the USGS replaced its sensor at station 02160991, the hourly DO readings have dropped below the SCDHEC instantaneous standard of 4.0 mg/l approximately 0.04 percent of the time. SCE&G is currently in the process of assessing whether project operations are causing these excursions, and if so, how they might offset the effects to water quality.

4.2.8 RESERVOIR SURFACE AREA, VOLUME, AND SUBSTRATE COMPOSITION

Parr Reservoir has a surface area of approximately 4,400 acres and a total storage capacity of approximately 32,000 acre-feet. Monticello Reservoir has a surface area of approximately 6,800 acres with a total storage capacity of approximately 400,000 acre-feet. Substrates are generally composed of sandy clay and sandy loams.

4.2.9 Gradient of Affected Downstream Reaches

The Broad River is approximately 2,000 feet wide near the Project, and its depth varies from 2 feet to 15 feet. The gradient of the Broad River near the Parr Development is approximately 0.0007 (3.7 ft per mile) based on the average gradient of the river from the confluence of the Enoree River, upstream of the Project, to the Richtex USGS station, downstream of the Project (SCE&G, 2010).

4.2.10 Potential Adverse Effects And Issues

As mentioned, SCE&G is investigating the DO excursions identified in the Parr Shoals Dam tailrace. Although no formal study plan has been developed, SCE&G, in consultation with the Water Quality TWC, is working to address this issue by attempting to identify and eliminate the cause of these excursions.

Additionally, during initial meetings conducted prior to relicensing, SCDNR staff requested a study of the west channel of the Broad River immediately downstream of the Parr Shoals Dam to examine potential Project effects on dissolved oxygen levels and temperature in the area; the draft study plan is included in Appendix H.

4.2.11 Proposed Mitigation And Enhancement Measures

Currently there are no mitigation and enhancement measures regarding water resources proposed at this time.

4.2.12 References

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4.3 FISH AND AQUATIC RESOURCES [§ 5.6 (D)(3)(IV)]

The waters encompassed by the Parr Hydroelectric Project include two reservoirs, Parr Reservoir and Monticello Reservoir, as well as the Piedmont river environments of the Broad River. The naturally varied river habitats and Project Areas of the two impoundments collectively provide habitats for a diverse aquatic community.

4.3.1 FISH COMMUNITIES

The Broad River basin supports a diverse fish community representative of Piedmont rivers in South Carolina. A recent basin-wide inventory documented 51 species from 9 families; Cyprinidae contributed the most species (14), followed by Centrarchidae (10 species) and Catostomidae (10 species) (Bettinger et al. 2003). The Broad River also supports a smallmouth bass (*Micropterus dolomieu*) fishery unique among Piedmont rivers in South Carolina. The SCDNR first introduced smallmouth bass to the Broad River in South Carolina in 1984 to enhance sport fishing opportunities (Bettinger et al. 2003); however, stocking has been curtailed recently due to significant natural reproduction.[5] Smallmouth growth rates in the Broad River are comparable to the rates in other Piedmont systems in the Southeast (Bettinger et al. 2003). The following sections describe the fishery resources occurring in the Project Vicinity; greater detail is available in the *Baseline Fisheries Report* (Appendix F).

4.3.1.1 PARR AND MONTICELLO RESERVOIRS

Parr and Monticello Reservoirs support warm-water fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent studies have documented 30 species in Parr Reservoir and 24 in Monticello Reservoir (Table 4-6). Although some seasonal variations in community structure have been documented, the fish communities within the two reservoirs are generally similar. Gizzard shad, blue catfish, bluegill, channel catfish and white perch often are the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). Both reservoirs appear to support relatively large numbers of gizzard shad during the summer months (often numerically dominating the population); however, data suggest that these populations decline rapidly during the fall and winter, presumably due to high levels of predation, seasonal die-offs, or both.

[5] Hal Beard (SCDNR), personal communication, August 22, 2013

TABLE 4-6: FISH SPECIES DOCUMENTED AT PARR AND MONTICELLO RESERVOIRS

COMMON NAME	SCIENTIFIC NAME	PARR	MONTICELLO
black crappie	*Pomoxis nigromaculatus*	x	x
blue catfish	*Ictalurus furcatus*	x	x
bluegill	*Lepomis macrochirus*	x	x
channel catfish	*Ictalurus punctatus*	x	x
flat bullhead	*Ameiurus platycephalus*	x	x
flathead catfish	*Pylodictis olivaris*	x	
gizzard shad	*Dorosoma cepedianum*	x	x
golden shiner	*Notemigonus chrysoleucas*	x	x
highfin carpsucker	*Carpoides velifer*	x	
largemouth bass	*Micropterus salmoides*	x	x
longnose gar	*Lepisosteus osseus*	x	
northern hogsucker	*Hypentelium nigricans*	x	x
notchlip redhorse	*Moxostoma collapsum*	x	x
pumpkinseed	*Lepomis gibbosus*	x	x
quillback	*Carpoides cyprinus*	x	x
redbreast sunfish	*Lepomis auritus*	x	x
redear sunfish	*Lepomis microlophus*	x	x
robust redhorse	*Moxostoma robustum*	x	x
sandbar shiner	*Notropis scepticus*	x	
shorthead redhorse	*Moxostoma macrolepidotum*	x	x
smallmouth bass	*Micropterus dolomieu*	x	x
snail bullhead	*Ameiurus brunneus*		x
spottail shiner	*Notropis hudsonius*	x	x
threadfin shad	*Dorosoma petenense*	x	x
warmouth	*Lepomis gulosus*	x	
white bass	*Morone chrysops*	x	
white catfish	*Ameiurus catus*	x	x
white perch	*Morone americana*	x	x
whitefin shiner	*Cyprinella nivea*	x	x
yellow bullhead	*Amierus natalis*	x	x
yellow perch	*Perca flavescens*	x	x

(Source: Normandeau 2007, 2008, 2009; SCANA 2013)

4.3.1.2 Broad River Downstream of Parr Shoals Dam

Boat electrofishing data from an ongoing SCDNR fish community study suggest significantly greater diversity in the Broad River downstream of the Parr Shoals Dam compared to the two Project reservoirs (i.e., 54 species compared to 24 to 30 in the Parr and Monticello reservoirs) (Table 4-7). Since 2009, this study has sampled three reaches extending from the Parr Shoals Dam to the headwaters of the Columbia Hydroelectric Project (FERC No. 1895) impoundment (see Figure 4-11). Study Reach 1 extends from the Project dam to the Palmetto Trail trestle crossing and is delineated into two sub-reaches: the Project tailrace (labeled 1t in Table 4-7) and the channel located on the western side of Hampton Island immediately downstream of the dam, or the "west channel" (labeled 1b in Table 4-7). The next downstream reach extends from the Palmetto Trail trestle crossing to the downstream terminus of Huffman Island and is labeled Reach 2a on Table 4-7. The lowermost reach (2b on Table 4-7) extends from the downstream terminus of Huffman Island to the downstream terminus of Boatrights Island.

The SCDNR data indicate an increase in diversity with increased distance from the dam, although redbreast sunfish, whitefin shiner, bluegill, and snail bullhead generally dominate from a relative abundance standpoint in all of the study reaches (Table 4-7). The fish community within Reach 1 differs significantly between the Project tailrace (Study Reach 1t) and the west channel (Study Reach 1b). The west channel exhibits relatively low diversity and is dominated by sunfishes, with redbreast and bluegill accounting for more than 85% of the catch during recent sampling. Conversely, the tailrace channel side of Reach 1 supports a much more robust fish community and approached what would be expected in a Piedmont river. Most notably, an abundance of riverine suckers (Catostomids) has been documented in the reach, and it is thought to represent a potential spawning area for robust redhorse. Downstream of the Palmetto Trail trestle crossing, the fish communities appear to stabilize, and the two remaining SCDNR sample reaches upstream of the Columbia impoundment (Reaches 2a and 2b) have very similar compositions at the family level. These reaches support a balanced community primarily consisting of Centrarchids, Cyprinids, Ictalurids and Catostomids; redbreast sunfish, whitefin shiner, bluegill, and snail bullhead are dominant species. The diverse fish community occurring in the reach may provide abundant fish hosts for native freshwater mussels. As documented in a recent survey by Alderman and Alderman (2012), the greatest freshwater mussel diversity in the Broad River sub-basin in North and South Carolina upriver from the Columbia Project occurs immediately downstream of the Parr Shoals Dam.

Bettinger and colleagues (2003) also sampled a site downstream of the Parr Shoals Dam (just below Bookman Island) as part of a basin-wide aquatic resource inventory (listed as Site 1 in Figure 4-12). Their results were generally similar to those of the current SCDNR effort; 34 species were documented. Boat electrofishing samples were dominated by redbreast sunfish, redear sunfish, whitefin shiner, sandbar shiner. Redbreast sunfish, margined madtom, Piedmont darter, whitefin shiner and seagreen darter dominated backpack electrofishing samples (Table 4-8).

TABLE 4-7: PRELIMINARY RESULTS FROM LOWER BROAD RIVER FISH COMMUNITY STUDY, FALL 2009 THROUGH SPRING 2013

		Total		Parr West Channel		Parr Tailrace		Upper Natural		Lower Natural	
Common Name	Scientific Name	n	Relative abundance (RA)	1B	RA	1T	RA	2A	RA	2B	RA
redbreast sunfish	*Lepomis auritus*	5455	30.21%	595	60.59%	505	15.99%	1090	28.65%	1701	28.75%
snail bullhead	*Ameiurus brunneus*	2884	15.97%	81	8.25%	604	19.13%	830	21.81%	1026	17.34%
whitefin shiner	*Cyprinella nivea*	1824	10.10%			134	4.24%	305	8.02%	1042	17.61%
bluegill	*Lepomis macrochirus*	1440	7.97%	253	25.76%	86	2.72%	156	4.10%	138	2.33%
brassy jumprock	*Scartomyzon sp. (1-27-06)*	774	4.29%	1	0.10%	521	16.50%	153	4.02%	90	1.52%
sandbar shiner	*Notropis scepticus*	585	3.24%			18	0.57%	236	6.20%	294	4.97%
largemouth bass	*Micropterus salmoides*	446	2.47%	3	0.31%	93	2.94%	79	2.08%	87	1.47%
margined madtom	*Noturus insignis*	415	2.30%			10	0.32%	208	5.47%	144	2.43%
spottail shiner	*Notropis hudsonius*	414	2.29%			51	1.61%	85	2.23%	181	3.06%
longnose gar	*Lepisosteus osseus*	345	1.91%			156	4.94%	78	2.05%	93	1.57%
notchlip redhorse	*Moxostoma collapsum*	315	1.74%			130	4.12%	78	2.05%	77	1.30%
shorthead redhorse	*Moxostoma macrolepidotum*	294	1.63%			236	7.47%	33	0.87%	16	0.27%
Piedmont darter	*Percina crassa*	285	1.58%	3	0.31%	21	0.66%	46	1.21%	180	3.04%
redear sunfish	*Lepomis microlophus*	275	1.52%	9	0.92%	55	1.74%	54	1.42%	47	0.79%
flat bullhead	*Ameiurus platycephalus*	212	1.17%	17	1.73%	19	0.60%	66	1.73%	86	1.45%
channel catfish	*Ictalurus punctatus*	188	1.04%			122	3.86%	16	0.42%	28	0.47%
v-lip redhorse	*Moxostoma pappillosum*	161	0.89%			64	2.03%	41	1.08%	43	0.73%
smallmouth bass	*Micropterus dolomieu*	159	0.88%			11	0.35%	46	1.21%	78	1.32%
bluehead chub	*Nocomis leptocephalus*	145	0.80%					10	0.26%	11	0.19%
threadfin shad	*Dorosoma petenense*	140	0.78%			5	0.16%	7	0.18%	128	2.16%
coastal shiner	*Notropis petersoni*	126	0.70%			23	0.73%	17	0.45%	75	1.27%
gizzard shad	*Dorosoma cepedianum*	114	0.63%			57	1.80%	44	1.16%	5	0.08%

			Total	Parr West Channel		Parr Tailrace		Upper Natural		Lower Natural	
Common Name	Scientific Name	n	Relative abundance (RA)	1b	RA	1t	RA	2a	RA	2b	RA
American shad	*Alosa sapidissima*	109	0.60%			19	0.60%	30	0.79%	25	0.42%
northern hogsucker	*Hypentelium nigricans*	102	0.56%			27	0.85%	15	0.39%	50	0.85%
greenfin shiner	*Cyprinella chloristia*	85	0.47%			2	0.06%	18	0.47%	38	0.64%
blue catfish	*Ictalurus furcatus*	67	0.37%			65	2.06%	2	0.05%		
seagreen darter	*Etheostoma thalassinum*	55	0.30%			10	0.32%	31	0.81%	12	0.20%
thicklip chub	*Cyprinella labrosa*	51	0.28%							49	0.83%
tessellated darter	*Etheostoma olmstedi*	51	0.28%	9	0.92%	3	0.09%	1	0.03%	34	0.57%
highback chub	*Hybopsis hypsinotus*	46	0.25%					4	0.11%	42	0.71%
mosquitofish	*Gambusia affinis*	43	0.24%	5	0.51%			1	0.03%	17	0.29%
green sunfish	*Lepomis cyanellus*	36	0.20%							33	0.56%
warmouth	*Lepomis gulosus*	32	0.18%	2	0.20%	2	0.06%			4	0.07%
spotted sucker	*Minytrema melanops*	29	0.16%	1	0.10%			1	0.03%	12	0.20%
quillback	*Carpoides cyprinus*	26	0.14%			22	0.70%			4	0.07%
white perch	*Morone americana*	26	0.14%			26	0.82%				
white catfish	*Ameiurus catus*	19	0.11%	3	0.31%	12	0.38%				
robust redhorse	*Moxostoma robustum* ##	18	0.10%			14	0.44%	4	0.11%		
American eel	*Anguilla rostrata*	17	0.09%			10	0.32%	5	0.13%	2	0.03%
striped jumprock	*Moxostoma rupiscartes*	17	0.09%					2	0.05%	13	0.22%
black crappie	*Pomoxis nigromaculatus*	14	0.08%			3	0.09%	3	0.08%	4	0.07%
swallowtail shiner	*Notropis procne*	14	0.08%			14	0.44%				
carp	*Cyprinus carpio*	11	0.06%			4	0.13%	4	0.11%		
flathead catfish	*Pylodictis olivaris*	9	0.05%			1	0.03%	1	0.03%	5	0.08%
blackbanded darter	*Percina nigrofasciata*	3	0.02%							1	0.02%
grass carp	*Ctenopharyngodon idella*	2	0.01%					2	0.05%		
striped bass	*Morone saxatilis*	2	0.01%			2	0.06%				

			Total	Parr West Channel		Parr Tailrace		Upper Natural		Lower Natural	
Common Name	Scientific Name	n	Relative abundance (RA)	1B	RA	1T	RA	2A	RA	2B	RA
tadpole madtom	*Noturus gyrinus*	2	0.01%					2	0.05%		
creek chubsucker	*Erimyzon oblongus*	1	0.01%					1	0.03%		
Santee chub	*Hybopsis zanema*	1	0.01%							1	0.02%
white bass	*Morone chrysops*	1	0.01%			1	0.03%				
yellow perch	*Perca flavescens*	1	0.01%			1	0.03%				

(Source: Ron Ahle, SCDNR Freshwater Fisheries Region 3, data unpublished)

TABLE 4-8: RELATIVE ABUNDANCE OF FISH SPECIES COLLECTED BY BOAT AND BACKPACK ELECTROFISHING BELOW BOOKMAN ISLAND

SPECIES	BOAT	BACKPACK
longnose gar	0.8	
gizzard shad	0.1	
threadfin shad	0.4	
greenfin shiner	0.1	0.4
whitefin shiner	6.4	9
common carp	0.1	
eastern silvery minnow	0.1	
thicklip chub		4.3
bluehead chub		1.7
spottail shiner	0.5	0.9
yellowfin shiner	0.2	1.3
sandbar shiner	8.3	3.2
silver redhorse	4.8	
shorthead redhorse	0.1	
striped jumprock	0.2	
brassy jumprock	3.6	
snail bullhead	0.9	7.7
flat bullhead	0.6	1.0
channel catfish	0.2	0.1
margined madtom	0.2	13.6
white perch	0.3	
white bass	0.1	
flier	0.1	
redbreast sunfish	41.8	35.9
pumpkinseed	0.1	
warmouth	0.8	
bluegill	16.2	0.3
redear sunfish	7.5	
largemouth bass	4.2	0.5
black crappie	0.4	
tessellated darter	0.1	1.0
yellow perch	0.8	
seagreen darter		8.3
Piedmont darter	0.1	10.6
	100%	100%

(Source: Bettinger et al. 2003)

FIGURE 4-11: SCDNR FISH COMMUNITY SAMPLING SITES FROM THE LOWER BROAD RIVER FISH COMMUNITY STUDY, FALL 2009 THROUGH SPRING 2013

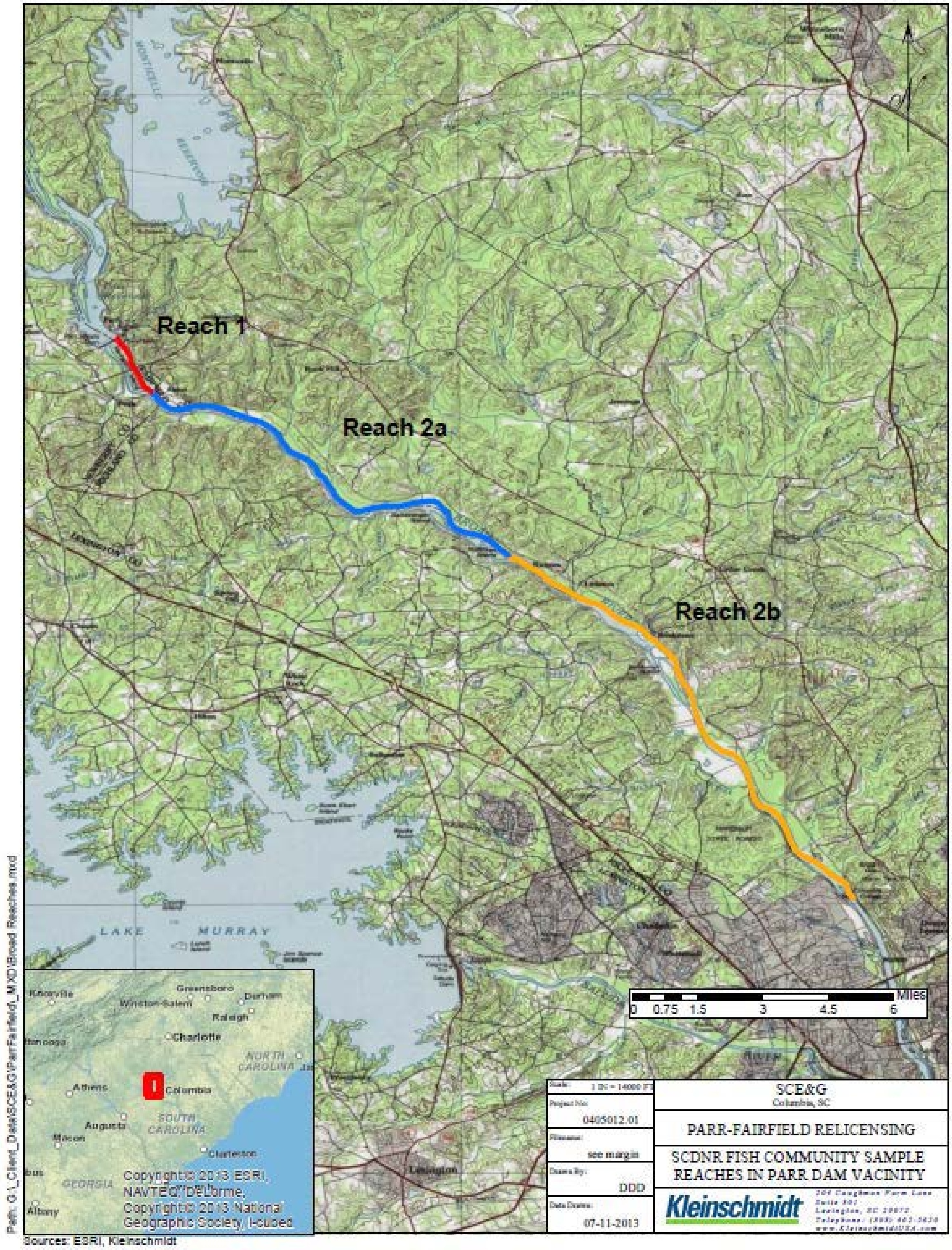
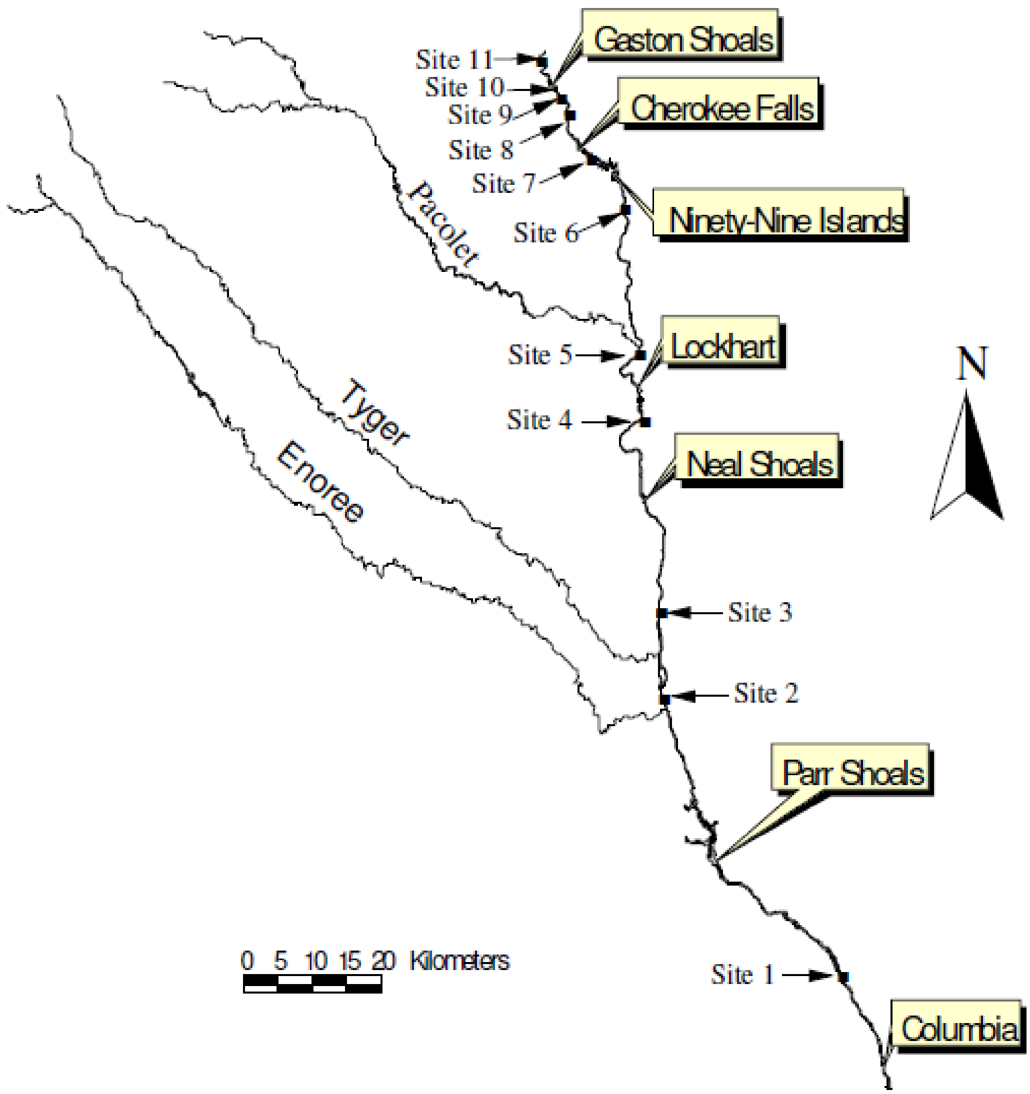


FIGURE 4-12: SITES SAMPLED DURING THE BROAD RIVER FISHERIES INVENTORY



4.3.1.3 Rare, Threatened, and Endangered Species

No fish species that are listed as threatened or endangered by the state or federal governments have been documented in Monticello or Parr reservoirs or in the downstream reach of the Broad River between Parr Shoals Dam and the Columbia Project impoundment; however, the survey data summarized in Table 4-7 and Table 4-8 suggest that 16 species considered to be priority species in the SCDNR's (2005) *Comprehensive Wildlife Conservation Strategy* are found in the Project Vicinity (Table 4-9). The robust redhorse, which SCDNR (2006) considers a species of highest conservation concern and is a USFWS at-risk species, has been documented in limited numbers in both reservoirs and in the downstream reach of the Broad River. Robust redhorse is discussed in greater detail in Section 4.6 (Rare, Threatened and Endangered Species). Similarly, American shad, an SCDNR species of highest concern, and American eel, an SCDNR species of highest concern and USFWS at-risk species, occur in varying numbers downstream of the Parr Shoals Dam and are discussed in greater detail in Section 4.3.1.4 (Diadromous Fish).

TABLE 4-9: SOUTH CAROLINA SCDNR PRIORITY FISH SPECIES OCCURRING IN THE PROJECT VICINITY

					SCDNR DOWNSTREAM STUDY REACHES			
COMMON NAME	SCIENTIFIC NAME	PRIORITY STATUS	PARR	MONTICELLO	1B	1T	2A	2B
American eel[1]	*Anguilla rostrata*	Highest				X	X	X
American shad	*Alosa sapidissima*	Highest				X	X	X
flat bullhead	*Ameiurus platycephalus*	Moderate	X	X	X	X	X	X
greenfin shiner	*Cyprinella chloristia*	Moderate				X	X	X
highfin carpsucker	*Carpoides velifer*	Highest	X					
notchlip redhorse	*Moxostoma collapsum*	Moderate	X	X		X	X	X
Piedmont darter	*Percina crassa*	High			X	X	X	X
quillback	*Carpoides cyprinus*	High	X	X		X		X
robust redhorse[2]	*Moxostoma robustum*	Highest	X			X	X	
Santee Chub	*Hybopsis zanema*	High						X
seagreen darter	*Etheostoma thalassinum*	High				X	X	X
snail bullhead	*Ameiurus brunneus*	Moderate		X	X	X	X	X
striped bass	*Morone saxatilis*	Moderate				X		
thicklip chub	*Cyprinella labrosa*	Moderate						X
v-lip redhorse	*Moxostoma pappillosum*	Moderate				X	X	X
white catfish	*Ameiurus catus*	Moderate	X	X	X	X		

[1]American eel is also a USFWS at-risk species.
[2]Robust redhorse is also a USFWS at-risk species.

4.3.1.4 DIADROMOUS FISH

Historically, many rivers in the Santee River Basin, including the lower Broad River where the Project is located, supported diadromous fish populations. Species that occurred prior to the construction of dams on the Broad River included anadromous American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), hickory shad (*Alosa mediocris*), striped bass (*Morone saxatilis*) and shortnose sturgeon (*Acipenser brevostrum*), as well as the catadromous American eel (*Anguilla rostrata*) (Newcome and Fuller 2001). Currently, only American shad, striped bass and American eel are known to occur in the Broad River (Kleinschmidt 2013a). Striped bass occurring in the lower Broad River are part of the dam-locked Santee-Cooper lakes population (Rohde et al. 2009) and thus are not truly anadromous. Additional detail regarding the status of American shad and American eel in the lower Broad River downstream of the Project is provided below.

The Broad River is considered a priority basin for diadromous fish restoration in the *Santee Cooper Basin Diadromous Fish Passage Restoration Plan* (USFWS et al. 2001). Accordingly, a fishway, designed to restore passage for American shad and blueback herring[6], was constructed at the Columbia Project by SCE&G in 2006[7]. In addition, SCE&G is a signatory to the Santee River Basin Accord for Diadromous Fish Protection, Restoration and Enhancement (Accord). The Accord is a cooperative program between USFWS, SCDNR, North Carolina Wildlife Resources Commission, SCE&G and Duke Energy Carolinas aimed at protecting, restoring and enhancing American shad, blueback herring, and American eel populations in the Santee River Basin[8]. Pursuant to the Accord, a Fish Passage Feasibility Assessment, which includes an evaluation of the upstream and downstream passage alternatives and their conceptual designs, will be conducted by SCE&G upon attainment of specific biological triggers set forth in the Accord (CAP, 2008). The Fish Passage Feasibility Assessment will commence within one year following passage of 50 percent of adult anadromous American shad or adult anadromous blueback herring target restoration numbers upstream for any three years in a five-year period at the Columbia Diversion Dam Fish Passage Facility. Construction of a fish passage facility at Parr Shoals Dam will be initiated within one year and completed within three years following

[6] Currently, blueback herring do not occur in the Project Vicinity, however the construction of the Columbia Fishway allows for the possibility of this species to occur in the Project Vicinity during the term of the new license.
[7] SCE&G conveyed ownership of the Columbia Hydroelectric Project to the City of Columbia, SC, in 2002. In 2011 Lockhart Power Company became the operator for the hydro facility.
[8] NMFS is not a signatory to the Accord.

passage of 75 percent of the identified species target restoration numbers upstream for any three years in a five year period at the Columbia Diversion Dam Fish Passage Facility. The target restoration number at Parr Shoals Dam for American shad is 128,150 and for blueback herring is 640,750 (CAP, 2008).

Results of selected Accord-funded diadromous fish studies are summarized below and in the Baseline Fisheries Report (Appendix F).

American Shad

Recent sampling conducted in the lower Broad River from 2009 through 2013 by SCDNR documented small numbers of American shad at several locations in the lower Broad River, including the Parr Shoals tailrace (SCDNR unpublished data, as summarized in Kleinschmidt 2013a). The most recent monitoring data suggest that an estimated 843 American shad were passed upstream of the Columbia Project during the 2014 migration season, which is down from the previous year where 1730 American shad passed (Kleinschmidt 2014). Although American shad passage numbers at the Columbia Fishway have generally increased with time (see Table 4-10), Accord-funded telemetry research suggests that the majority of Santee Basin shad (76% of tagged fish in 2010) terminate their annual upstream migration somewhere between the Congaree/Wateree confluence and the Interstate 95 Bridge crossing on the Santee River (Post 2010). This reach is located approximately 70 miles below the Project.

TABLE 4-10: AMERICAN SHAD PASSAGE AT COLUMBIA PROJECT

YEAR	SHAD OBSERVED (N)	FIELD EFFORT (HRS)	CPUE	ESTIMATED TOTAL SHAD PASSAGE	ST. STEPHENS PASSAGE
2007	15	122	0.12	224	328,828
2008	7	152	0.05	102	29,000
2009	35	314	0.11	243	389,000
2010	45	308	0.15	323	348,300
2011	77	234	0.33	615	272,961
2012	240	380	0.63	7782	150,082
2013	183	198	0.92	1730	324,984
2014	163	274	0.60	843	42,535

In addition to passage through the fishway at the Columbia Project, the SCDNR has stocked American shad fry in the lower Broad downstream of the Project annually since 2009, with more than 7 million fry having been stocked to date in the Broad River and more than 2 million in

2013 (Rose 2013). However, recent Accord-funded otolith analyses suggests very low hatchery contribution to the Santee Basin shad population, with only 0.08 to 2.8% percent of fish captured during 2010 through 2012 being of hatchery origin (Gibbons and Post 2013).

American Eel

Similar to the findings for American shad, SCDNR data from 2009 through 2013 document the occurrence of American eel downstream of Parr Shoals Dam, but in extremely low numbers (SCDNR unpublished data, as summarized in Kleinschmidt 2013). This finding is consistent with eel ramp and backpack electrofishing sampling conducted by SCDNR at the Columbia Project fishway as part of the Accord, which captured only 13 eels during a three year period from January 2010 through December 2012 (Bulak and Bettinger 2013).

4.3.2 MACROINVERTEBRATE SPECIES AND HABITATS

In 2013, SCE&G compiled existing data on macroinvertebrates within the Project area, collected during studies performed in 2008, 2009, and 2012 by Carnagey Biological Services, LLC and SCANA Services personnel, into the *Macroinvertebrate and Mussel Report*. The following sections summarize the data collected and presented in the above mentioned studies and report. For a comprehensive discussion of the data, please see Appendix G.

4.3.2.1 MONTICELLO RESERVOIR

Studies in Monticello Reservoir were undertaken by Carnagey Biological Services, LLC and SCANA Services, Inc. in June 2008, September 2008, January 2009, and April 2009 (Carnagey Biological Services, LLC, 2008a, 2008b, 2009a, and 2009b). These consisted of 5 petite Ponar grab samples at each of 3 stations. Based on ANOVA analyses these showed very few significant differences across stations or through time.

Table 4-11 is a list of the macroinvertebrate specimen and taxa collected in each of the studies. It should be noted that the North Carolina Biotic Index and SCDHEC bioclassification scores should not be used to compare these studies to those conducted in flowing streams, because the metrics were designed for different collection protocols.

TABLE 4-11: TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN MONTICELLO RESERVOIR

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	341	27
September 18, 2008	262	24
January 22-23, 2009	277	16
April 27, 2009	405	24

The bioassessment metrics from June 18, 2008 indicate few differences between the sample locations (control, new water treatment intake, and new raw intake). The control sample point was predominately collector-filters, but did include one replicate with a majority of scrapers. The control SCDHEC bioclassification values were the same as the other two stations when replicates were averaged. The Raw Intake point had all "fair" bioclassification ratings and had a majority (4 out of 5) of collector feeders. The Water Treatment Intake point had three "fair" and two "good-fair" bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in all five replicates.

The Monticello Reservoir sample points from June 18, 2008 indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Percentage of dominant taxon (p-value = 0.01879), EPT abundance (p-value = 0.04360), NCBI values (p-value = 0.04624), and SCDHEC bioclassification values (p-value = 0.01450) indicate significant difference between the stations. All other metrics show no significant difference.

According to the bioassessment metrics from September 18, 2008 the control sample point feeding types showed mixed dominant feeders. Collector-filters and scrapers were the largest ratio in two replicates each, and predators were majority of one. The control SCDHEC bioclassification values were the lowest of the three stations. The Raw Intake point received two "fair" and three "good-fair" bioclassification ratings. The Raw intake point contained a majority (4 out of 5) of predator feeders. Parallel to the previous sample date, the Water Treatment Intake point had three "fair" and two "good-fair" bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in three replicates, and predators in two.

The September 18, 2008 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Taxa richness (p=0.01234), total abundance (p-value = 0.04412), EPT Index value (p-value=0.00676), EPT abundance (p-value = 0.00050), NCBI values (p-value = 0.00361), and SCDHEC bioclassification values (p-value = 0.00172) indicate significant difference between the stations. All other metrics show no significant difference.

On January 22-23, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

The January 22-23, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. EPT Index value (p-value=0.00041), and EPT abundance (p-value = 0.00097) indicate significant difference between the stations. All other metrics show no significant difference.

According to the bioassessment metrics from April 27, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

The April 27, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison (Table). Taxa richness (p-value = 0.04737), EPT Index value, EPT abundance (p-value = 0.00001), and SCDHEC bioclassification values (p-value = 0.04309) indicate significant difference between the stations. All other metrics show no significant difference.

4.3.2.2 PARR RESERVOIR AND PARR TAILRACE

Studies in Parr Reservoir were undertaken by Carnagey Biological Services, LLC and SCANA Services, Inc. in June 2008, September 2008, January 2009, August 2009, September 2012, and August 2014 (Carnagey Biological Services, LLC, 2008a, 2008b, 2009a, 2009b, 2012, 2014). Those collected in 2008 and 2009 consisted of five petite Ponar grab samples at two stations. Those collected in 2012 consisted of five petite Ponar grab samples at three sampling points along two transects. The three 2012 sampling points include one in the tailrace below Parr Shoals Dam. The other two sampling locations within Parr Reservoir from 2012 are in roughly the same area as those from the 2008 and 2009 studies. In 2014, three sites were sampled including one site below Henderson Island, one site just downstream of the Parr Shoals Dam, and one site near the downstream end of Bookman Island. Based on ANOVA analyses these showed very few significant differences across stations or through time. Table 4-12 is a list of the macroinvertebrate specimens and taxa collected in each of the studies.

TABLE 4-12: TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN AND AROUND PARR RESERVOIR[1]

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	400	26
September 18, 2008	321	13
January 22-23, 2009	254	19
April 27, 2009	201	12
September 11-12, 2012	1051	51
August 28-29, 2014	1424	66

[1] Monitoring locations sampled in September 11-12, 2012 include two sites within Parr Reservoir and one site on the Broad River, downstream of Parr Shoals Dam. In 2014, one sampling location was located within Parr Reservoir, and two sites were located downstream of Parr Shoals Dam.

The bioassessment metrics conducted by Carnagey on June 18, 2008 indicated some differences between the two sampling locations on Parr Reservoir. The control location was dominated by scrapers in two of the replicates and by collector-filterers in three of the replicates. The blowdown discharge location was dominated by collector-filterers in all five replicates.

On September 18, 2008, bioassessment metrics indicated that the Parr Reservoir control point and the discharge were similar. The EPT index values for the blowdown discharge point were somewhat higher than at the control. The control had three replicates at 0 and two replicates with indices of 1, while the blowdown discharge point had three replicates with a value of 1 and two replicates with values of 2. All five replicates at the Parr Reservoir control were collector-filterers. At the blowdown discharge point, two replicates were majority collector-filterers, two scrapers and one predator. The blowdown discharge also showed a correspondingly higher EPT abundance.

One-way ANOVA results from June 18, 2008 show significant differences in bioassessment metrics in SCDHEC bioclassification (p-value = 0.0482), and NCBI rating (p-value = 0.0333) at the Parr Reservoir blowdown discharge point. All other metrics show no significant difference.

One-way ANOVA results from September 18, 2008 show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.0194), EPT Index values (p-value = 0.0187), EPT abundance (p-value = 0.0005) at the Parr Reservoir control point. All other metrics show no significant difference.

On January 22-23, 2009, the bioassessment metrics indicated very few differences between sampling locations. The control was dominated by predators in three of the replicates and by collector-filterers in two replicates. The blowdown discharge point was dominated by collector-filterers in four replicates and predators in one.

One-way ANOVA results from January 22-23, 2009 show significant differences in bioassessment metrics in NCBI (p-value = 0.0429), and percentage of dominant taxon (p-value = 0.0065) at the Parr Reservoir control point. All other metrics show no significant difference.

The bioassessment metrics from the April 27, 2009 survey indicated very few differences between sample locations. The control was dominated by scrapers in four of the replicates and by collector-filterers in one replicate. The blowdown discharge location was dominated by scrapers in all five replicates.

One-way ANOVA results from April 27, 2009 show no significant differences in bioassessment metrics between the points. The control point was dominated by scrapers in four of the five replicates and collector-filterers in one. The blowdown discharge point was dominated by scrapers in all five replicates.

The bioassessment metrics from September 11-12, 2012 indicated that the two sampling locations within Parr Reservoir were similar. The Parr Reservoir upstream location had much lower taxa richness than the discharge location. Bioassessment metrics for Parr Tailrace downstream of Parr Reservoir were also calculated using instream benthic macroinvertebrate community rapid bioassessment. Due to the different bioassessment sampling protocol, and environment, the metrics were not compared to those at the upstream and discharge locations.

One-way ANOVA results from the September 11-12, 2012 sampling show significant differences in bioassessment metrics in taxa richness (p-value = 0.00009), and percentage of dominant taxon (p-value = 0.000001) at the Parr Reservoir upstream location. At the Parr Reservoir discharge point, ANOVA results show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.03499), EPT Index values (p-value = 0.00592), EPT abundance (p-value = 0.00010). All other metrics show no significant difference.

The sampling effort from August 28-29, 2014 at the Parr Reservoir site had a South Carolina Bioclassification score of 3.9, which indicates a “good” reading. The dominant functional feeding group was the scrapers, which contributed 46% of the collection. The site located downstream of Parr Shoals Dam had a South Carolina Bioclassification score of 3.8, which also indicates a “good” reading for this site. The dominant functional feeding group was the collector-gatherers, which contributed 31% of the collection. The site located downstream of Bookman Shoals had a South Carolina Bioclassification score of 4.2, which is also a “good” rating. The dominant functional feeding group was the scrapers, contributing 41% of the collection. Overall, the three sites indicated that the river is fully supporting of aquatic life.

4.3.3 UNIONID SPECIES

Price (2010) surveyed freshwater mussels at 60 locations in the Broad River and documented four species each in the Parr Reservoir and in the downstream reach between the Parr Shoals Dam and the Columbia Project diversion dam (Table 4-13). Although diversity was limited, Price (2010) noted dense mussel populations and excellent mussel habitat throughout the downstream reach. Similarly, Alderman and Alderman (2012) surveyed the Parr tailrace and documented the greatest freshwater mussel diversity in the Broad River sub-basin in North and South Carolina upriver from the Columbia dam (Table 4-13). In addition, they found the most upriver occurrence of the yellow lampmussel recorded to date and the largest extant population of eastern creekshell in the Santee Basin (Alderman and Alderman 2012). Finally, Roanoke slabshell juveniles, which are thought to require an anadromous fish host, were documented in the tailrace (Alderman and Alderman 2012). None of the species found in the Parr Reservoir or in the downstream reach of the Broad River are listed as threatened or endangered; however, SCDNR (2006) has classified several as priority species (Table 4-13). No mussel data are available for the Monticello Reservoir; therefore, the reservoir will be surveyed during relicensing as outlined in the *Monticello Reservoir Freshwater Mussel Reconnaissance Study Plan* (Appendix H).

TABLE 4-13: FRESHWATER MUSSELS DOCUMENTED IN PARR RESERVOIR AND BROAD RIVER

COMMON NAME	SCIENTIFIC NAME	Parr Reservoir[1]	Broad River[1]	Parr Tailrace[2]	Priority Status[3]
common elliptio	*Elliptio complanata*	x	x	x	Moderate
Roanoke slabshell	*E. roanokensis*			x	High
variable spike	*E. icterina*			x	Moderate
Carolina lance	*E. angustata*			x	Moderate
northern lance	*E. fisheriana*			x	High
yellow lance	*E. lanceolata*	x	x		
Florida pondhorn	*Uniomerus carolinianus*	x	x	x	
paper pondshell	*Utterbackia imbecillis*			x	
eastern creekshell	*Villosa delumbis*	x	x	x	Moderate
yellow lampmussel	*Lampsilis cariosa*			x	Highest

[1] Source: Price 2010
[2] Source: Alderman and Alderman 2012
[3] Source: SCDNR 2006

4.3.4 INVASIVE AQUATIC SPECIES

Of the invasive aquatic species considered to be of concern in South Carolina, two plant species, three fish species, and two mollusk species are known to occur in the Project Area (Table 4-14). Alligatorweed and water primrose are well established in the Parr Reservoir and were documented during a recent survey (Quattlebaum 2008). Flathead catfish are known to occur in the Parr Reservoir and Broad River. White perch and blue catfish occur in both Parr and Monticello reservoirs and were often among the dominant species encountered during recent fish community sampling (Normandeau 2007, 2008, 2009; SCANA 2013). White perch and blue catfish also occur in the Broad River downstream of the Parr Shoals Dam but are less dominant than in the reservoirs (Table 4-14). The Asiatic clam has been documented in the Parr Reservoir, Monticello Reservoir, and in the reach of the Broad River downstream of the Parr Shoals Dam. Additionally, the Japanese mysterysnail is known to occur in the Monticello Reservoir and possibly Parr Reservoir[9]. The invasive attributes of these species and their occurrence in the Project Vicinity are summarized in Table 4-14.

TABLE 4-14: AQUATIC INVASIVE SPECIES DOCUMENTED TO OCCUR IN THE VICINITY OF THE VCSNS SITE

COMMON NAME	SCIENTIFIC NAME	TYPE	INVASIVE ATTRIBUTES	OCCURRENCE AT THE VCSNS SITE
alligatorweed	*Alternanthera philoxeroides*	Freshwater plant	Aggressive, rapid colonizing plant, affects flow and uptake of water	Parr Reservoir
water primrose	*Ludwigia uruguayensis*	Freshwater plant	Rhizomatous, chokes shorelines, affects water use and access, decreases flow, clogs water-intake structures	Parr Reservoir
flathead catfish	*Pylodictis olivaris*	Freshwater fish	Can tolerate a range of environmental conditions, piscivorous, competes for prey resources with native catfish	Parr Reservoir
blue catfish	*Ictalurus furcatus*	Freshwater fish	Can tolerate a range of environmental conditions, piscivorous, competes for prey resources with native catfish	Parr Reservoir, Monticello Reservoir
white perch	*Morone americana*	Freshwater fish	Competes with recreationally important fish such as white bass and crappie	Parr Reservoir, Monticello Reservoir
Asiatic clam	*Corbicula fluminea*	Freshwater clam	Competes with native mollusks for food and space, alters substrate conditions; high densities clog water-intake structures. May undergo massive seasonal die-offs that can alter water chemistry	Parr Reservoir, Monticello Reservoir
Japanese mysterysnail	*Bellamya japonica*	Freshwater snail	Ecological and economic impacts of this species are not well known at this time	Monticello Reservoir

Sources: SCDNR 2008; SCE&G 2010a
Survey efforts included multiple sample methodologies and spanned multiple spatial and temporal scales

[9] David Eargle (SCDHEC); personal communication, October 9, 2014

4.3.5 Identification Of Essential Fish Habitat As Defined Under The Magnuson-Stevens Fishery Conservation And Management Act And Established By The National Marine Fisheries Service

No identified fish habitats within the Project Area fit the definition of the Magnuson-Stevens Fishery Conservation and Management Act.

4.3.6 Potential Adverse Impacts And Issues

During preliminary relicensing discussions, state and federal resource agencies and other stakeholders requested additional information regarding the impacts of daily reservoir fluctuations on littoral spawning for fish in Parr and Monticello reservoirs. Similarly, impacts of instream flows on the fisheries resources downstream of Parr Shoals Dam were raised as an issue. Accordingly, SCE&G developed the *Reservoir Fluctuation Study Plan* and *Instream Flow Incremental Methodology (IFIM) Study Plan* (Appendix H) to evaluate these issues.

Other study plans requested by stakeholders concerning fish and aquatic resources include the *American Eel Abundance Study Plan*, the *Broad River Spiny Crayfish Study Plan*, the *Monticello Reservoir Freshwater Mussel Reconnaissance Survey Study Plan* and the *Desktop Fish Entrainment Study Plan* (all study plans are found in Appendix H).

4.3.7 Proposed Mitigation And Enhancement Measures

No PM&E measures related to fish and aquatic resources are being proposed at this time.

4.3.8 References

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4.4 WILDLIFE AND BOTANICAL RESOURCES [§ 5.6 (D)(3)(V)]

The Project is located in the Southern Outer Piedmont Ecoregion of South Carolina (Griffith et al. 2002). This region is characterized by gently rolling hills with broad, relatively shallow stream-cut valleys and elevations that range from 375 feet to 1,000 feet msl (SCDNR 2005a). A subtropical climate prevails in this area marked by high summer humidity, moderate winters, and relatively high rainfall, which results in a vegetative growing season in the range of 250 days annually (Messina and Conner 1998; Bailey 1995). Common vegetation communities in the ecoregion include mixed oak forest and oak-hickory-pine forest (Griffith et al. 2002). The landscape in the Piedmont has a long history of forest/wood clearing and other economic uses that date back to the earliest European settlements, resulting in a contemporary mosaic dominated by agricultural land, managed woodlands, and forests (SCDNR 2005a). These habitats support wildlife typical of the Piedmont including white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), wild turkey (*Meleagris gallopavo*), mourning dove (*Zenaida macroura*), box turtle (*Terrapene carolina*), copperhead (*Agkistrodon contortrix*), and American toad (*Bufo americanus*) (DeGraaf and Rudis 1986; Conant and Collins 1998). The following sections provide additional detail regarding the wildlife and botanical communities found in the Project Area and Vicinity.

4.4.1 UPLAND HABITAT(S) IN THE PROJECT VICINITY

Upland habitats in the Project Area and Vicinity are primarily forested; some limited pasturelands and residential development occur around Monticello Reservoir. Although site-specific data are not available for the Project Area, recent surveys on the adjacent V.C. Summer Nuclear Station provide significant data describing the upland habitats and associated wildlife occurring in the Project Vicinity (SCE&G 2010). Primary cover types occurring in the Project Vicinity include planted pine, naturally vegetated pine, mixed pine-hardwood, and hardwood forests. Pine forests are primarily second-growth stands of either naturally propagated or planted loblolly pine (*Pinus taeda*); older stands are characterized by presence of hardwoods such as white oak (*Quercus alba*). Hardwood-dominant stands occur mainly along streams and side slopes (SCE&G 2010).

<u>Pine Forests</u>

Natural and planted pine forests in the Project Vicinity consist mostly of naturally vegetated and cultivated loblolly pine. These forests are early successional, even-aged stands that produce a closed canopy with little to no understory of either woody or herbaceous cover (FPC 1974). Because much of this forest type consists of planted pines, it is generally poor wildlife habitat, lacking in both food and cover needed by native wildlife (SCDNR 2005a).

Mixed Pine-Hardwood Forest

Mixed pine-hardwood forests occurring in the Project Vicinity consist primarily of loblolly pine and longleaf pine (*Pinus palustris*) accompanied by a variety of other species, including tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), winged elm (*Ulmus alata*), persimmon (*Diospyros virginiana*), eastern redcedar (*Juniperus virginiana*), black gum (*Nyssa sylvatica*), American beech *(Fagus grandifolia*), American holly (*Ilex opaca*), black cherry (*Prunus serotina*), and sweetgum (*Liquidambar styraciflua*) (SCE&G 2002; Nelson 2006).

Hardwood Forest

Hardwood forests are located predominately along stream bottoms and in ravines and make up a relatively small portion of the forested communities in the Project Vicinity (USNRC 2004). Typical canopy species present include white oak, southern red oak (*Quercus falcata*), black gum, and some American beech (Nelson 2007). Flowering dogwood (*Cornus florida*) is a dominant understory species, and herbaceous species such as hepatica (*Hepatica americana*), golden alexander (*Zizia trifoliata*), sanicle (*Sanicula marilandica*), Christmas fern (*Polystichum acrostichoides*), and little nut-rush (*Scleria oligantha*) are common along small streams (SCE&G 2002).

Wetlands

As discussed in greater detail in Section 4.5, wetlands in the Project Vicinity are typical of those found in the South Carolina Piedmont and include both palustrine (marshes, bogs, fens, etc.) and lacustrine (on the shores of lakes and reservoirs) wetlands. Species typical of forested wetlands in the Project Vicinity include those in the mixed pine-hardwood and hardwood cover types described previously, as well as tulip poplar, sweetgum, white ash (*Fraxinus americana*), black cherry, sedge (*Carex* spp.), and red maple. Limited freshwater marsh habitat occurs in shallow backwaters along Parr Reservoir; the marsh habitat contains emergent wetland species, such as cattail (*Typha latifolia*), bulrushes (*Scirpus* spp.), rushes (*Juncus* spp.), sedges, smartweed (*Polygonum hydropiperoides*), pickerelweed (*Pontederia cordata*), lizard's tail (*Saururus cernuus*), water primrose (*Ludwigia* spp.), and water pennywort (*Hydrocotyle* spp.) (SCE&G 2010).

4.4.2 WILDLIFE

A variety of wildlife species typical of the Southern Outer Piedmont ecoregion of South Carolina inhabit the forested, wetland, and open water habitats of the Project Vicinity, including amphibians, reptiles, birds, and mammals.

Mammals

Mammals that occur in the Project Vicinity include those typically found in the Piedmont, such as white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), muskrat (*Ondatra zibethica*), bobcat (*Lynx rufus*), beaver (*Castor canadensis*), opossum (*Didelphis virginiana*), hispid cotton rat (*Sigmodon hispidus*), eastern mole (*Scalopus aquaticus*), house mouse (*Mus musculus*), whitefooted mouse (*Peromyscus leucopus*), gray fox (*Urocyon cinereoargenteus*), and eastern spotted skunk (*Spilogale putorius*) (SCDNR 2005b).

Amphibians and Reptiles

The Piedmont of South Carolina is not as rich in herpetofauna as other parts of the state (SCDNR 2005a); however, several species of reptiles and amphibians are known to occur in the Project Vicinity. These include black racer snake (*Coluber constrictor*), ringneck snake (*Diadophis punctatus*), and rat snake (*Elaphe obsolete*); lizards such as the Carolina anole (*Anolis carolinensis*), and fence lizard (*Sceloporus undulates*); and various skinks and toads (FPC 1974; SCE&G 2010).

Birds

Birds that occur in the Project Vicinity are typical of the Piedmont. Various species of dabbling ducks such as wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), and green-winged teal (*Anas carolinensis*) use the freshwater marsh habitat in Parr Reservoir, and Monticello Reservoir supports a resident population of Canada geese (*Branta Canadensis leucopareia*). Bald eagles (*Haliaeetus leucocephalus*) nest near the site and are observed frequently, and a variety of wading birds, songbirds, birds of prey, and other migratory and nonmigratory birds are expected to occur in the Project Vicinity. Table 4-15 lists avian species observed during recent surveys on the adjacent V.C. Summer Nuclear Station.

TABLE 4-15: AVIAN SPECIES OBSERVED IN THE PARR-FAIRFIELD HYDROELECTRIC PROJECT VICINITY (USNRC 2011).

WADING BIRDS, SHOREBIRDS, AND OTHER WATER BIRDS	PASSERINES AND OTHER BIRDS (CONTINUED)
blue-winged teal (*Anas discors*)	mourning dove (*Zenaida macroura*)
mallard (*Anas platyrhynchos*)	blue jay (*Cyanocitta cristata*)
black duck (*Anas rubripes*)	yellow-rumped warbler (*Dendroica coronata*)
great egret (*Ardea alba*)	**prairie warbler (*Dendroica discolor*)**
great blue heron (*Ardea herodias*)	pine warbler (*Denrdroica pinus*)
Canada goose (*Branta canadensis*)	pileated woodpecker (*Dryocopus pileatus*)
green heron (*Butorides virescens*)	**dark-eyed junco (*Junco hyemalis*)**
kildeer (*Charadrius vociferus*)	**loggerhead shrike (*Lanius ludovicianus*)**
little blue heron (*Egretta caerulea*)	belted kingfisher (*Megaceryle alcyon*)
herring gull (*Larus argentatus*)	red-bellied woodpecker (*Melanerpes carlinus*)
double-crested cormorant (*Phalacrocorax auritus*)	wild turkey (*Meleagris gallopavo*)
Birds of Prey and Soaring Birds	song sparrow (*Melospiza melodia*)
Cooper's hawk (*Accipiter cooperii*)	northern mockingbird (*Mimus polyglottos*)
red-tailed hawk (*Buteo jamaicensis*)	great crested flycatcher (*Myiarchus crinitus*)
red-shouldered hawk (*Buteo lineatus*)	tufted titmouse (*Parus bicolor*)
turkey vulture (*Cathartes aura*)	Carolina chickadee (*Parus carolinensis*)
black vulture (*Coragyps atratus*)	indigo bunting (*Passerina cyanea*)
bald eagle (*Haliaeetus leucocephalus*)	downy woodpecker (*Picoides pubescens*)
Passerines and Other Birds	rufous-sided towhee (*Pipilo erythrophthalmus*)
red-winged blackbird (*Agelaius phoeniceus*)	summer tanager (*Piranga rubra*)
ruby-throated hummingbird (*Archilochus colubris*)	**golden-crowned kinglet (*Regulus satrapa*)**
great horned owl (*Bubo virginiana*)	eastern phoebe (*Sayornis phoebe*)
northern cardinal (C*ardinalis cardinalis*)	eastern bluebird (*Siala sialis*)
pine siskin (*Carduelis pinus*))	**brown-headed nuthatch (*Sitta pusilla*)**
northern bobwhite (*Colinus virginianus*)	yellow-bellied sapsucker (*Sphyrapicus varius*)
yellow-bellied cuckoo (*Coccyzus americanus*)	northern rough-winged swallow (*Steigidopteryx serripennis*)
northern flicker (*Colaptes auratus*)	barred owl (*Strix varia*)
eastern wood pewee (*Contopus virens*)	Carolina wren (*Thryothorus ludovicianus*)
American crow (*Corvus brachyrhynchos*)	brown thrasher (*Toxostoma rufum*)
white-throated sparrow (*Zonotrichia albicollis*)	white-eyed vireo (*Vireo griseus*)
red-eyed vireo (*Vireo olivaceus*)	

Sources: SCDNR 2005a; SCE&G 2010a
Note: Taxa in **bold** are South Carolina Priority Species (SCDNR 2005b)

4.4.3 EXOTIC UPLAND PLANT AND WILDLIFE SPECIES

Exotic upland wildlife species known to occur in the Project Vicinity include feral hogs and dogs, and coyotes (SCDNR 2005b); additionally, exotic upland plants are prevalent in the Piedmont ecoregion and are likely to occur within the Project Area and Vicinity. Data collected by the U. S. Forest Service for the Forest Inventory Analysis indicate that almost three quarters of sampled plots within the Piedmont ecoregion contain at least one exotic plant (SCDNR 2005a). The South Carolina Exotic Pest Plant Council (SCEPPC) identifies several plants as severe exotic plant pest species in the Piedmont ecoregion (Table 4-16). Although no site-specific data are available, any of the species listed in Table 4-16 could occur in the Project Area, and several of the more ubiquitous species (e.g., kudzu, mimosa, Japanese honeysuckle, and *Wisteria* spp.) are likely to occur in abundance.

TABLE 4-16: SEVERE EXOTIC PLANT PEST SPECIES OCCURRING IN THE PIEDMONT ECOREGION

COMMON NAME	SCIENTIFIC NAME
TREES	
tree of heaven	*Ailanthus altissima*
mimosa, silktree	*Albizia julibrissin*
chinaberry	*Melia azedarach*
princess tree/royal paulownia	*Paulownia tomentosa*
Chinese tallow tree	*Triadica sebifera*
SHRUBS	
thorny olive	*Elaeagnus pungens*
autumn olive	*Elaeagnus umbellata*
two-color bush clover, shrub lespedeza	*Lespedeza bicolor*
Japanese privet	*Ligustrum japonicum*
Chinese privet	*Ligustrum sinense*
Japanese knotweed	*Polygonum cuspidatum*
multiflora rose	*Rosa multiflora*
VINES	
English ivy	*Hedera helix*
Japanese climbing fern	*Lygodium japonicum*
Japanese honeysuckle	*Lonicera japonica*
kudzu	*Pueraria montana*
Asian/Japanese wisteria	*Wisteria floribunda*
Chinese wisteria	*Wisteria sinensis*
bigleaf periwinkle	*Vinca major*
common periwinkle	*Vinca minor*
GRASSES/SEDGES	
tall fescue	*Lolium arundinaceus*
Japanese stilt grass, Nepalese browntop	*Microstegium vimineum*
Chinese silvergrass	*Miscanthus sinensis*
bahia grass	*Paspalum notatum*
golden bamboo, fishpole bamboo	*Phyllostachys aurea*
Johnson Grass	*Sorghum halepense*
HERBS	
tropical spiderwort, Bengal dayflower	*Commelina bengalensis*
wart removing herb, marsh dewflower, aneilema	*Murdannia keisak*
tropical soda apple	*Solanum viarum*

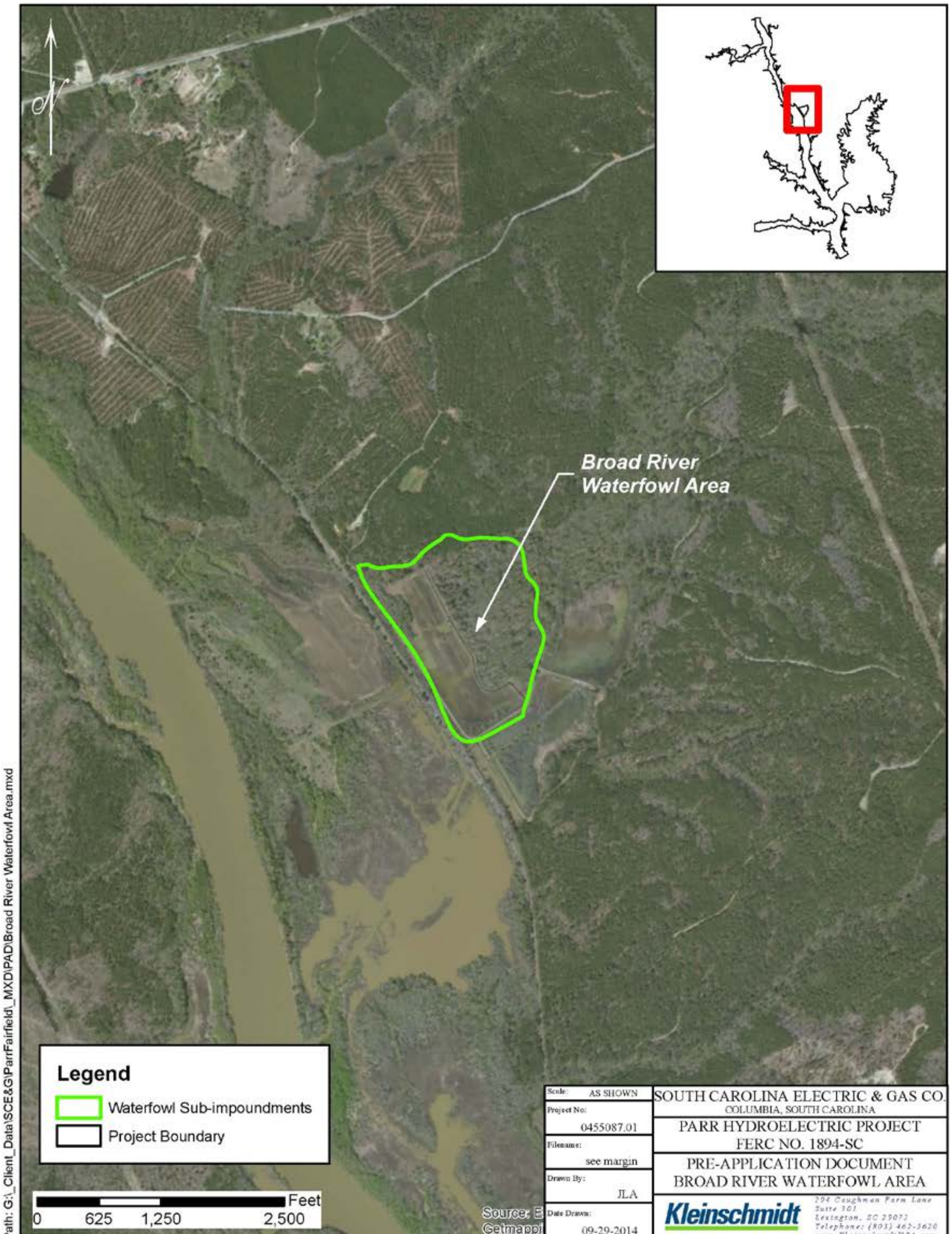
Source: SCEPPC 2008

4.4.4 TEMPORAL OR SPECIAL DISTRIBUTION OF COMMERCIALLY, RECREATIONALLY, OR CULTURALLY IMPORTANT SPECIES

The Broad River and Enoree River Waterfowl Management Areas are located in the northern portion of the Project Area, and provide important habitat for overwintering waterfowl, as well as recreational waterfowl hunting opportunities that are important to the local economy. Both areas were established in the late 1970s as mitigation when Parr Reservoir was expanded during construction of the Fairfield Pumped Storage Development and are currently managed by the SCDNR.

The Broad River Waterfowl Management Area includes five impoundments totaling approximately 130 acres of waterfowl habitat. The area includes one greentree reservoir with a total oak canopy; the remaining four impoundments are planted in corn or millet and flooded seasonally. Over 500 acres of the remaining area are either upland or uncontrolled backwater. Although a wide variety of duck species may be present, the primary species harvested are ring-necked ducks (*Aythya collaris*), wood ducks, mallards and green-winged teal. Mallards were the primary species present for many years, but their numbers have decreased due to flyway migration changes (SCDNR 2007a).

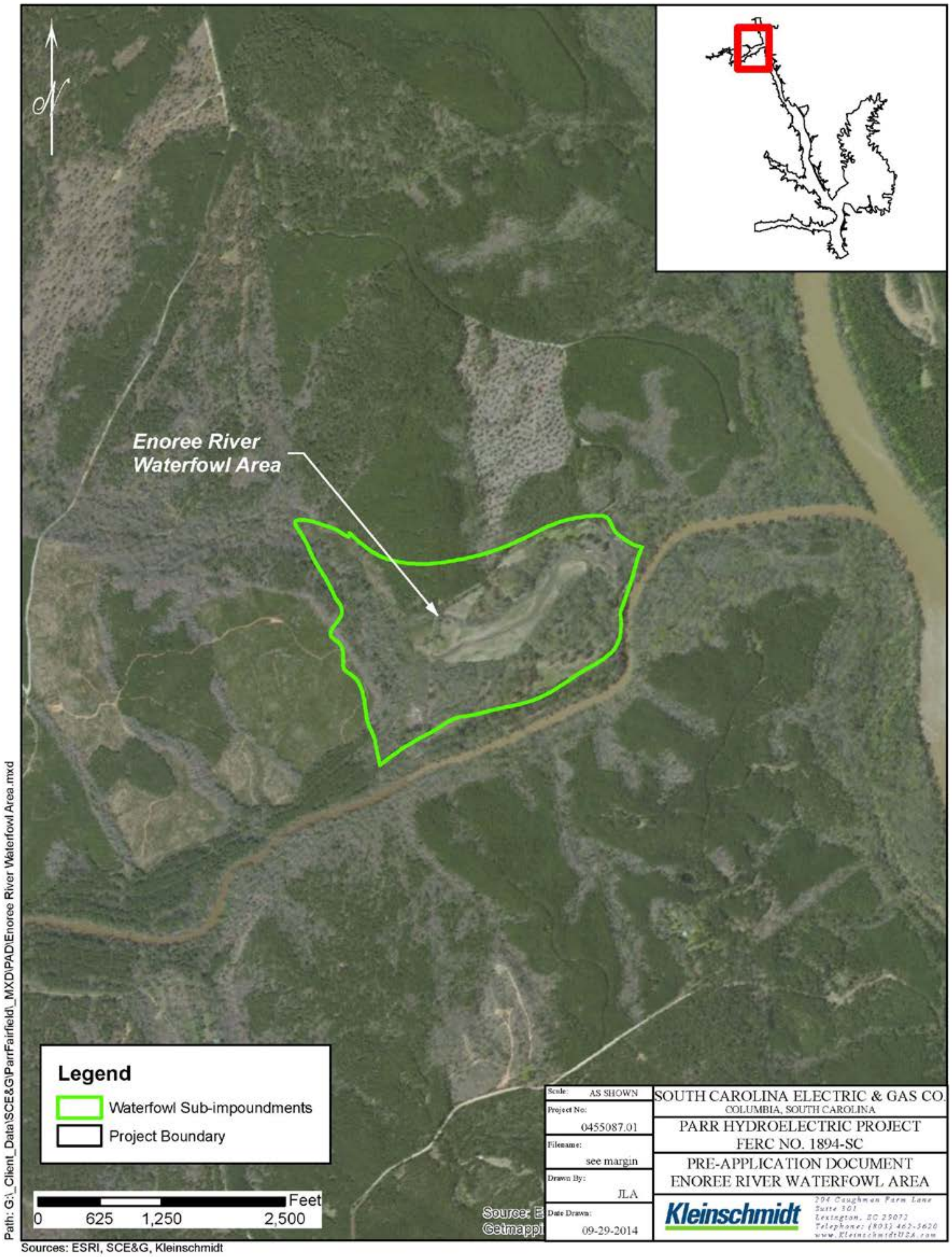
FIGURE 4-13: BROAD RIVER WATERFOWL MANAGEMENT AREA



Sources: ESRI, SCE&G, Kleinschmidt

The Enoree River Waterfowl Management Area includes a combination of open field agriculture (planted seasonally in corn and millet) and flooded hardwood forest. Subers Creek is used to flood a 50-acre greentree impoundment. Wood ducks, ring-necked ducks, and green-winged teal are the primary species harvested on the Enoree River Waterfowl Management Area (SCDNR 2007b).

FIGURE 4-14: ENOREE RIVER WATERFOWL MANAGEMENT AREA



Sources: ESRI, SCE&G, Kleinschmidt

4.4.5 Potential Adverse Effects and Issues

No adverse effects or issues related to wildlife and botanical resources have been identified. During initial meetings conducted prior to relicensing, however, SCDNR staff cited the need for additional aerial survey data characterizing use of the Project Area by overwintering waterfowl. SCE&G subsequently developed the *Waterfowl Survey Study Plan* in consultation with the Fisheries TWC; the Final Draft of the Study Plan is included in Appendix H.

4.4.6 Proposed Mitigation and Enhancement Measures

No measures related to wildlife or botanical resources have been identified.

4.4.7 References

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4.5 FLOODPLAINS, WETLANDS, RIPARIAN, AND LITTORAL HABITAT [§ 5.6(D)(3)(VI)]

4.5.1 MAP OF WETLANDS, RIPARIAN, AND LITTORAL HABITAT

The USFWS maintains the National Wetlands Inventory (NWI) that provides reconnaissance level information on the location, type, and size of wetlands and deepwater habitats (USFWS, 2014). The NWI indicates that wetland and deepwater habitats occurring within the Project Vicinity include freshwater emergent, freshwater forested and shrub wetlands, freshwater ponds and lakes, and riverine habitat (Figure 4-15). Most of the mapped wetland in the Project Area is classified as L1UBHh, which is a lacustrine system. The Project Area is bordered by palustrine emergent, palustrine forested and/or palustrine shrub, and palustrine unconsolidated bottom systems.

The lacustrine (i.e., freshwater lake) habitat in the Project Vicinity comprises permanently flooded/impounded habitat located above the Parr and Fairfield dams. This classification is typical of deepwater habitats formed by dammed river channels and is defined as having less than 30 percent vegetative cover (USGS, 2013a).

Palustrine habitat is defined as all freshwater wetlands including freshwater emergent wetlands, freshwater forest and shrub wetlands, and freshwater ponds (defined as a freshwater body of water with an area of less than 20 acres). Palustrine wetlands often occur along the shores of lakes or rivers and are defined as having a water depth of less than 2 meters and salinity of less than 0.5 percent (USGS, 2013b).

4.5.2 LIST OF PLANT AND ANIMAL SPECIES, INCLUDING INVASIVE SPECIES, THAT USE THE WETLAND, LITTORAL, AND RIPARIAN HABITAT

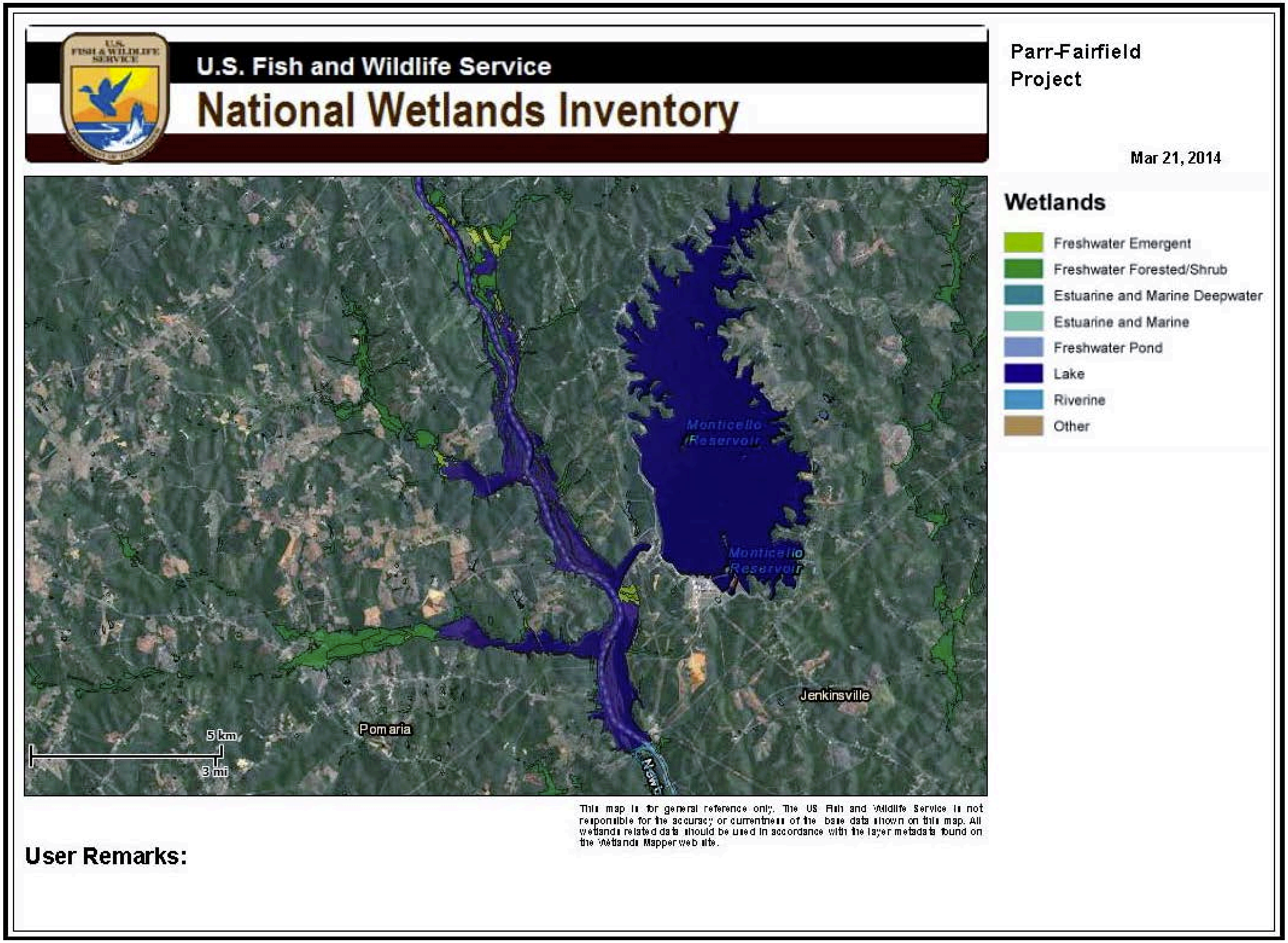
A variety of plant and animal species are expected to occur in the littoral, wetland, and riparian habitats of the Project Vicinity. Some of these species are listed by the federal or state government as endangered or threatened or as a species of special concern (Section 4.6). Table 4-17 lists species that are known or have the potential to occur in these habitats.

TABLE 4-17: SPECIES EXPECTED TO OCCUR IN LITTORAL, WETLAND, AND RIPARIAN HABITATS IN THE PROJECT VICINITY

COMMON NAME	SCIENTIFIC NAME	STATE PRIORITY FOR CONSERVATION
Mammals		
Northern river otter	*Lontra canadensis*	High
mink	*Neovison vison*	
Birds		
prothontary warbler	*Protonaria citrea*	
Acadian flycatcher	*Empidonax virescens*	High
wood duck	*Aix sponsa*	
Reptiles		
spotted turtle	*Clemmys guttata*	
yellowbelly slider	*Trachemys scripta scripta*	High
common snapping turtle	*Chelydra serpentina*	
Amphibian		
Eastern narrowmouth toad	*Gastrophyrne carolinensis*	
Freshwater Fishes		
American eel	*Anguilla rostrata*	Highest
Plants		
American chaffseed	*Schwalbea americana*	Endangered (state and federal lists)
golden canna	*Canna flaccida*	
swamp tupelo	*Nyssa biflora*	
willow oak	*Quercus phellos*	
loblolly pine	*Pinus taeda*	

Sources: SCDNR, 2005, 2008

FIGURE 4-15: PROJECT VICINITY WETLAND HABITAT – PARR HYDRO PROJECT



4.5.3 Potential Adverse Impacts And Issues

There is the potential for continued Project operations to impact littoral and riparian areas within the Project Boundary. Fluctuations in reservoir levels due to operation of the Project may contribute to erosion and loss of aquatic habitat. To determine the degree of these impacts, the Applicant is planning a Reservoir Fluctuation Study at Parr and Monticello reservoirs.

4.5.4 Proposed Mitigation And Enhancement Measures

Although no mitigation or enhancement measures relating to floodplains, wetlands, littoral and riparian areas are planned at this time, the Applicant may consider some measures to minimize shoreline erosion and loss of aquatic habitat pending the outcome of the Reservoir Fluctuation Study.

4.5.5 References

South Carolina Department of Natural Resources (SCDNR). 2005. 2005 Comprehensive Wildlife Conservation Strategy. [Online] URL: http://www.dnr.sc.gov/cwcs/overview.html. Accessed March 20, 2014.

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U.S. Fish and Wildlife Service (USFWS). 2014. National Wetlands Inventory Mapper. [Online] URL: http://www.fws.gov/wetlands/Data/Mapper.html. Accessed March 4, 2014.

U.S. Geological Survey (USGS). 2013a. Classification of Wetlands and Deepwater Habitats of the United States- Lacustrine System. [Online] URL: http://www.npwrc.usgs.gov/resource/wetlands/classwet/lacustri.htm. Accessed March 20, 2014.

U.S. Geological Survey (USGS). 2013b. Classification of Wetlands and Deepwater Habitats of the United States- Palustrine System. [Online] URL: http://www.npwrc.usgs.gov/resource/wetlands/classwet/palustri.htm. Accessed March 20, 2014.

4.6 RARE, THREATENED, AND ENDANGERED SPECIES [§ 5.6 (D)(3)(VII)]

During consultation with federal and state agencies and other stakeholders, we identified a list of rare, threatened, and endangered species and species of concern that would be analyzed during relicensing. Part of this identification included the review of the USFWS and SCDNR county-level listings for the Project Area (Fairfield and Newberry counties). A third county (Richland) was also included because Project flows may affect the Broad River downstream of the Parr Project.

4.6.1 FEDERALLY LISTED SPECIES

Fourteen species that are either federally listed as threatened or endangered, are candidates for such listing, or are an "at risk species" were identified by the USFWS for the three counties of interest (Table 4-18). None of the federally listed species on Table 4-18 have critical habitat designated in the study area. Life history information, habitat requirements, as well as known presence within the Project Area are summarized below for each species.

TABLE 4-18: FEDERALLY LISTED AND CANDIDATE SPECIES OCCURRING IN RICHLAND, FAIRFIELD, AND NEWBERRY COUNTIES, SOUTH CAROLINA (SOURCE: USFWS 2013A; SCDNR 2012)

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[1, 3]	STATE STATUS[2]	COUNTIES
Birds				
bald eagle	*Haliaeetus leucocephalus*	P	T	Newberry, Fairfield, Richland
red-cockaded woodpecker	*Picoides borealis*	E	E	Richland
wood stork	*Mycteria americana*	E	E	Newberry, Richland
Fish				
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	E	Richland
shortnose sturgeon	*Acipenser brevirostrum*	E	E	Richland
American eel	*Anguilla rostrata*	ARS		Richland
Invertebrates				
Carolina heelsplitter	*Lasmigona decorata*	E		Newberry, Fairfield, Richland
Little River (Broad River spiny) crayfish	*Cambarus spicatus*	ARS		Fairfield
Plants				
Canby's dropwort	*Oxypolis canbyi*	E		Richland
Georgia aster	*Symphyotrichum georgianus*	C		Fairfield, Richland

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[1, 3]	STATE STATUS[2]	COUNTIES
rough-leaved loosestrife	*Lysimachia asperulaefolia*	E		Richland
smooth coneflower	*Echinacea laevigata*	E		Richland

[1] Federal Status – E (listed as Endangered under ESA); T (listed as Threatened under ESA); C (Candidate for Federal listing); SC (Federal Species of Concern); P (Federally protected).
[2] State Status – E (state listed as endangered); T (state listed as threatened)
[3] ARS – At-Risk-Species, Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

Bald Eagle

The bald eagle was removed from the federal list of threatened species in 2007 (USFWS 2007) but remains protected as a state endangered species under the South Carolina Nongame and Endangered Species Conservation Act, and under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (16 U.S.C.668-668d) (72 FR 37345-37372). Bald eagles are found throughout North America, typically around water bodies, where they feed primarily on fish and carrion. Studies suggest that reservoirs, especially those associated with hydroelectric facilities, are particularly attractive to foraging bald eagles (Brown 1996). Eagles nest in large trees near water and typically use the same nest for several years, repairing it annually (Degraaf and Rudis 1986). In South Carolina, the distribution of eagle nesting has expanded from the coast to encompass more inland areas; this expansion has been attributed to the construction of approximately 491,000 acres of large reservoirs in the state since the early 1900s (Wilde et al. 2003). In South Carolina, the number of estimated nesting pairs has increased from 13 in 1977 to 181 in 2003 (Wilde et al. 2003). Bald eagles are commonly observed in the Project Area (SCE&G 2010), and nine bald eagle nests are known in the Project Vicinity (SCE&G unpublished data).

Red-cockaded Woodpecker

The red-cockaded woodpecker (RCW) is endemic to open, mature, and old growth pine ecosystems in the southeastern United States (USFWS 2003). Over 97% of the pre-colonial era RCW population has been eradicated, leaving only roughly 14,000 RCWs living in about 5,600 colonies scattered across eleven states, including South Carolina. RCW decline is generally attributed to a loss of suitable nesting and foraging habitats, including longleaf pine systems, due to logging, agriculture, fire suppression, and other factors (USFWS 2003). Suitable nesting habitat generally consists of open pine forests and savannahs with large, older pines and minimal hardwood midstory or overstory. Living trees, especially older trees that are susceptible to red-heart disease making them more easily excavated, provide the RCWs preferred nesting cavities. Suitable foraging habitat consists of open-canopy, mature pine forests with low densities of small pines, little midstory vegetation, limited hardwood overstory, and abundant bunchgrass and forb groundcover (USFWS 2003). There are no known reports of RCWs in areas surrounding the Project or along the lower Broad River. Further, there is no known longleaf pine savanna habitat in the study area. Based on the lack of suitable habitat, it is very unlikely that this species occurs in the study area.

Wood Stork

The wood stork is a large, colonial wading bird and is the only stork species that breeds in the United States (USFWS 1996). It was federally listed as endangered in 1984, primarily due to loss of wetland habitat throughout its range, but recently its status has been proposed for downlisting from endangered to threatened due to significant population recovery (USFWS 2012b). It uses a variety of wetlands for nesting, feeding, and roosting. Areas hosting nesting colonies (rookeries) in South Carolina are typically surrounded by extensive palustrine forested wetlands. Nests are usually located in the upper branches of large black gum or cypress trees, and several nests typically are located in each tree. Like most wading birds, storks feed primarily on small fish. Shallow, open water is required for successful foraging, and depressions where fish become concentrated during periods of falling water levels are particularly attractive sites. Currently, nesting of the species in the United States is thought to be limited to the coastal plain of South Carolina, North Carolina, Georgia, and Florida (Murphy and Hand 2013). The two waterfowl management areas associated with Parr Reservoir have not been surveyed for wood storks. As mentioned, nesting of this species has not been documented outside of the Coastal Plain, which suggests that any potential activity in the Project vicinity would be limited to sporadic use by non-nesting individuals. This assumption is consistence with extensive aerial surveys conducted at the nearby Saluda Hydro Project. The Saluda Hydro surveys documented periodic foraging by small numbers of storks in ephemeral floodplain pools and wetlands along the Saluda River above Lake Murray, but no nesting. Foraging was observed during the post-dispersal period during the late-summer months, when storks often move through inland areas to exploit ephemeral food sources (Kleinschmidt 2005). Shallow backwaters in the Project Area, particularly in the upper reaches of the Parr Reservoir, may provide foraging habitat for transient wood storks.

Atlantic Sturgeon

The Atlantic sturgeon is a large (up to 5.5m in length), long-lived (up to 60 years) anadromous species that was historically present in the Santee Basin at least as far inland as the fall line (Newcomb and Fuller 2001). The Carolina Distinct Population Segment of Atlantic sturgeon, which includes the Santee Basin population, is federally listed as endangered (77 FR 5914), primarily due to overharvesting for flesh and eggs (caviar) during the early to mid-20th Century, as well as habitat degradation and blockage of access to historical spawning grounds (NMFS1998a).

The Atlantic sturgeon is considered estuarine anadromous, spending most of it life in estuarine and ocean environments and undertaking spawning migrations into riverine systems during late-winter and spring months (NMFS 1998a; Marcy et al. 2005). Spawning typically occurs over hard bottoms of clay, rubble, or gravel, with flowing water and temperatures of 14 - 24°C. After spawning, females typically return to estuarine environments within 4 to 6 weeks, while males may remain in the river through the fall. Juveniles of this species remain in the natal rivers for 3 to 5 years before migrating to the ocean (Marcy et al. 2005).

Atlantic sturgeon were historically present at least as far inland as the fall line (Newcomb and Fuller 2001). Current upstream distribution in the Santee Basin is thought to be limited by the lack of passage for Atlantic sturgeon at the Santee Cooper Dams[10]. This information indicates that this species does not occur in the Project study area.

Shortnose Sturgeon

The shortnose sturgeon is federally listed as endangered and is thought to have occurred historically in the reach of the Broad River encompassed by the Project (Welch 2000, Newcomb and Fuller 2001). Shortnose sturgeon are amphidromous (semi-anadromous) spending portions of their life cycle in low salinity estuaries and portions in freshwater rivers (NMFS 1998b; Kynard 1997; Buckley and Kynard 1985). Shortnose sturgeon begin migrating to spawning areas of inland riverine reaches in the spring (typically mid-February through March in South Carolina) when water temperatures rise above 9 °C (Kynard 1997, Hall et al. 1991). Shortnose sturgeon spawning has been documented in the Congaree River near the City of Columbia over

[10] Bill Post (SCDNR), personal communication, April 24, 2014.

substrates of sand, gravel and rock, at temperatures ranging from 9.7-15.6°C, and dissolved oxygen concentrations of 10.6-12.5 mg/L (Collins et al. 2003).

Population groups of shortnose sturgeon are known from downstream of the Santee-Cooper dams in the lower reaches of the Santee-Cooper Basin (Collins et al. 2003). An additional dam-locked spawning population of shortnose sturgeon has been documented in the Santee-Cooper lakes (with Lake Marion and its tributaries harboring the most significant number of fish) and upstream in the Congaree River. Radio-telemetry studies have documented migration of shortnose sturgeon as far upstream on the Congaree as the Blossom Street Bridge adjacent to the City of Columbia (Finney et al. 2006). However, consultation with SCDNR Diadromous Fish Program staff suggests that this occurrence was based on a small number of observations (2 fish) and that their radiotelemetry data suggest that shortnose sturgeon activity is primarily limited to areas downstream of Granby Lock and Dam[11]. Granby Lock and Dam is located approximately one mile downstream of the Blossom Street Bridge and approximately 5 miles downstream of the Columbia Hydroelectric Project Fishway (fishway). The fishway was designed to provide passage of blueback herring and American shad to historic spawning grounds in the Broad River downstream of Parr Shoals Dam and was intended to be "sturgeon friendly". Shortnose sturgeon have not been documented upstream of the Blossom Street Bridge in recent history, nor have any been documented passing into the study area through the fishway since annual monitoring began in 2007.

<u>American Eel</u>

The American eel, *Anguilla rostrata*, is a catadromous species known to occur within river systems in South Carolina. Mature American eels spawn in the ocean and the egg and pre-larval stages mature into the leptocephalus stage, where they drift with ocean currents for approximately a year before metamorphosing into the glass eel stage. Glass eels migrate across the continental shelf, eventually entering estuaries and tidal rivers, where they mature into elvers. Elvers migrate primarily at night and are able to overcome obstacles that often times prevent passage of other aquatic species. Vertical obstacles, such as a dam, can be traversed by small eels as long as the surface of the structure is textured and remains wet. As the small eels continue to mature into yellow eels, they may gradually move upstream over many years, with the greatest movement occurring during the moderate water temperatures of spring and fall (ASMFC 2000).

[11] Bill Post (SCDNR), personal communication, April 24, 2014.

Although the American eel currently does not have special status under state or federal regulations, it has been identified by the South Carolina Department of Natural Resources (SCDNR) as a priority species (SCDNR 2005). The federal status of this species has been further reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service several times over the past decade and the species is considered “at risk”. American eel are also listed as a target species in the Columbia Fishway Prescription. Currently, an area potentially conductive to eel passage exists along the west corner of the Columbia Dam. The status and distribution of this species will be further investigated according to the *American Eel (Anguilla rostrata) Abundance Study Plan* (Appendix H).

<u>Carolina Heelsplitter</u>

The Carolina heelsplitter is the only South Carolina freshwater mussel currently listed as federally endangered (Price 2006). Although it was once found in large rivers and streams, the Carolina heelsplitter is now restricted to cool, clean, shallow, heavily shaded streams of moderate gradient. Stable streambanks and channels, with pool, riffle and run sequences, little or no fine sediment, and periodic natural flooding, appear to be required for the Carolina heelsplitter. Carolina heelsplitter is known to occur in isolated populations distributed in the Savannah, Pee Dee, and Catawba drainages and is not known to occur in the Broad River Basin (Price 2006) or within the study area.

<u>Broad River Spiny Crayfish</u>

The Broad River spiny crayfish is a federal at-risk species; its distribution is thought to be limited to lotic environments in the Broad River drainage (Eversole 1990). Although collections are limited, Broad River spiny crayfish have been found in association with leaf litter and other organic debris located along stream banks, primarily over unstable sandy substrates that lack rooted aquatic vegetation. In the Project Vicinity, this species has been collected in the Little River, a tributary to the Broad River, in Fairfield County (Eversole 1990). The status and distribution of this species will be further investigated according to the *Broad River Spiny Crayfish Study Plan* (Appendix H).

<u>Canby’s Dropwort</u>

Canby’s dropwort is a perennial plant that grows in coastal plain habitats including wet meadows, wet pineland savannas, ditches, sloughs, and around the edges of cypress-pine ponds (USFWS 2010). The healthiest populations seem to occur in open bays or ponds, which are wet most of the year and have little or no canopy cover. Ideal soils for Canby's dropwort have a medium to high organic content and a high water table. They are also acidic, deep, and poorly drained. No populations of Canby's dropwort have been documented in the study area. The prime habitat for this species is coastal plain habitat and thus this species would not be expected to occur in the study area.

Georgia Aster

Georgia aster is classified as a candidate for federal listing as threatened or endangered by the USFWS (2013b). Habitat for this species consists of dry, rocky woodlands, woodland borders, roadbanks, and powerline rights-of-way (Weakley 2012). It is thought to be a relict species of the post oak-savanna communities that existed in the southeast prior to fire suppression. Although no site-specific occurrence data are available for the Project area, Nelson (2006, 2007) found no Georgia aster on the adjacent V.C. Summer Nuclear Station but concluded that suitable habitat exists on the site. Georgia aster is also known from several locations on the nearby Sumter National Forest (USDA 2010).

Rough-Leaved Loosestrife

Rough-leaved loosestrife generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands, and on shallow organic soils overlaying sand (NatureServe 2013). Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin). The grass-shrub ecotone, where rough-leaved loosestrife is found, is fire-maintained, as are the adjacent plant communities (longleaf pine-scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally occurring fire in these ecotones, results in shrubs increasing in density and height and expanding to eliminate the open edges required by this plant. The pine pocosin and Carolina bay environments required by this species do not occur in the Piedmont; therefore, rough-leaved loosestrife is extremely unlikely to occur in the study area.

Smooth Coneflower

Smooth coneflower is typically found in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium and calcium rich soils associated with amphibolite, dolomite or limestone (in Virginia), gabbro (in North Carolina and

Virginia), diabase (in North Carolina and South Carolina), and marble (in South Carolina and Georgia) (USFWS 2012a). Smooth coneflower occurs in plant communities that have been described as xeric hardpan forests, diabase glades, or dolomite woodlands. Optimal sites are characterized by abundant sunlight and little competition in the herbaceous layer. Natural fires, as well as large herbivores, historically influenced the vegetation in this species' range. Many of the herbs associated with smooth coneflower are also sun-loving species that depend on periodic disturbances to reduce the shade and competition of woody plants. The diabase glade habitat required by this species is not known to occur in areas around Monticello and Parr reservoirs or along the lower Broad River. Although no site-specific surveys have been performed, surveys by Nelson (2006, 2007) failed to document smooth coneflower on the adjacent V. C. Summer Nuclear Station Project area and concluded that appropriate habitat for the species does not occur on the site.

4.6.2 State Listed Species

Four species that are state-listed as threatened, endangered, or rare were identified by the SCDNR for the three counties of interest (Table 4-19). Life history information, habitat requirements for these species, as well as their status within the study area are summarized below.

Table 4-19: State-Listed Species Occurring in Richland, Fairfield, and Newberry Counties, South Carolina

Common Name	*Scientific Name*	State Status[1]	Counties
Amphibians			
Pine Barrens tree frog	*Hyla andersonii*	T	Richland
Mammals			
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	E	Richland
Fish			
Carolina darter	*Etheostoma collis*	T	Fairfield, Richland
Plants			
rocky shoals spider lily	*Hymenocallis coronaria*	Rare	Richland

[1] State Status – E (state listed as endangered); T (state listed as threatened)

Pine Barrens Tree Frog

The pine barrens tree frog inhabits the swamps, bogs, and acidic brownwater streams of the New Jersey Pine Barrens, as well as the pocosins (shrub bogs) of the Carolinas (Conant and Collins

1991). This species is intolerant of closed-canopy conditions and is restricted to localized wetlands such as hillside seepage bogs within dry uplands, pine barrens, and headwater swamps and disperses along drainages within these areas (NatureServe 2013). Non-breeding habitat generally is in pine-oak areas adjacent to breeding habitat. Important egg-laying and larval habitats include open cedar swamps and sphagnaceous, shrubby, acidic, seepage bogs on hillsides below pine-oak ridges.

For southeastern populations, typical habitats are characterized by the topography, soils, and vegetation of the Carolina Sandhills, with pocosin or evergreen shrub swamps established along seeps and small streams within the surrounding longleaf pine-oak forest. Breeding habitat in South Carolina has been described as low vegetation with dense growth of Sphagnum mosses. Cely and Sorrow (1983) found that occurrences in South Carolina appeared to be restricted to the Fall Line Sandhills at elevations ranging between 61 and 122 m. The area surrounding the Project lacks the Carolina sandhills habitat and associated bogs and pocosins required by this species; therefore it is extremely unlikely that Pine Barren tree frog would occur in the study area.

Rafinesque's Big-eared Bat

Rafinesque's big-eared bat is a colonial bat species native to the southeastern U.S. Two subspecies are recognized in South Carolina, *Corynorhinus rafinesquii rafinesquii* in the mountains and *Corynorhinus rafinesquii macrotis* along the Coastal Plain (Bunch et al. 2006). Rafinesque's big-eared bat is nocturnal, feeding primarily on moths by echolocation. Coastal plain and sandhills populations of the species utilize I-beam and T-beam bridges for roosting. Roosting in mountainous regions of the state occurs in large hollow trees (typically large tulip poplars), abandoned buildings and mines, rock shelters, and caves. Habitat in the Blue Ridge Mountains includes rock outcrops, mesic and cove hardwood forests, forested bottomlands, bottomland agricultural fields, dry deciduous forests, pine woodlands, and forested riparian areas. Coastal zone and sandhills habitats include black gum stands, bald cypress swap forests, maritime forests, and mature hardwood and mixed forests (Bunch et al. 2006).

The range of Rafinesque's big-eared bat in South Carolina includes the coastal plain and sandhills regions and the extreme northwestern Blue Ridge, with the piedmont representing a gap in the species' distribution (Bunch et al. 2006). As such, it is extremely unlikely that this species would occur in the study area.

Carolina Darter

The Carolina darter exists only in the Piedmont region from south-central Virginia through North Carolina into north-central South Carolina (Hayes and Bettinger 2006); it is state-listed as threatened and a federal species of concern. It occurs in small to moderately sized streams in areas of low current velocity, typically in backwaters among submerged tree roots or under leaves, where it feeds primarily on Chironomid larvae and micro-crustaceans. Preferred substrates are usually characterized by mud, sand, and sometimes bedrock (Rohde et al. 2009).

The Carolina darter has been collected at several locations in the lower Broad River, including one that appears to be a tributary to Parr Reservoir (Rohde et al. 2009). However, extensive sampling by SCE&G and SCDNR in both Parr and Monticello reservoirs and in the downstream reach have failed to document this species (Kleinschmidt 2013), suggesting that it may not occur in the study area or occurs in extremely low numbers not detected by previous sampling. The status of this species in the Project Vicinity is not fully known at this time and will be evaluated during relicensing as part of the *Rare, Threatened, and Endangered Species Assessment* (Appendix H).

Rocky Shoals Spider Lily

Rocky shoals spider lily, also referred to as Cahaba lily, is a flowering perennial that typically inhabits large streams and rivers at or above the fall line (Davenport 1996). These areas usually consist of rocky shoals and bedrock outcrops, substrates that provide anchor points for the plant's roots and bulbs (Patrick et al. 1995). The rocky shoals spider lily grows best in constantly flowing water with relatively low sediment loads and water depths (to bulb) of 4 to 12 inches (Aulbach-Smith 1998). The decline of the species has been attributed to loss of shoals habitat due to construction of impoundments and other channel modifications (Davenport 1996). Although it is not state or federally listed as threatened or endangered, the rocky shoals spider lily is considered rare by the SCDNR and is among the species tracked by the agency’s Heritage Trust Program.[12] The rocky shoals spider lily is known to occur at several locations downstream of the Parr Shoals Dam; these populations will be further documented pursuant to the *Rocky Shoals Spider Lily Study Plan* (Appendix H).

[12] Julie Holling (SCDNR), personal communication, April 14, 2014.

4.6.3 SELECTED SOUTH CAROLINA CONSERVATION PRIORITY SPECIES

Eight species that are considered state conservation priority species were also added to the analysis based on consultation with SCDNR and USFWS staff (Table 4-20). Life history information and habitat requirements and presence near the Project for these species are summarized below.

TABLE 4-20: STATE CONSERVATION PRIORITY SPECIES ADDED AT THE REQUEST OF SCDNR AND USFWS

COMMON NAME	SCIENTIFIC NAME	STATE PRIORITY LEVEL[1]	FEDERAL STATUS[2]
Newberry burrowing crayfish	*Distocambarus youngineri*	Highest	ARS
robust redhorse	*Moxostoma robustum*	Highest	ARS
Piedmont darter	*Percina crassa*	High	
seagreen darter	*Etheostoma thalassinum*	High	
highfin carpsucker	*Carpiodes velifer*	Highest	
quillback	*Carpiodes cyprinus*	High	
Santee chub	*Hybopsis zanema*	High	
striped bass	*Morone saxatilis*	Moderate	
Yellow lampmussel	*Lampsilis cariosa*	Highest	
Roanoke slabshell	*Elliptio roanokensis*	High	

[1] Refers to conservation priority level as listed in SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2005).

[2] ARS – At-Risk-Species. Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

<u>Newberry Burrowing Crayfish</u>

The Newberry burrowing crayfish is a terrestrial crayfish of the genus *Distocambarus* and is endemic to South Carolina (Eversole and Welch 2006). Although knowledge of its habitat requirements is limited, Newberry burrowing crayfish has typically been found in poorly drained areas where the ground is saturated during the rainy season (November – March) (Eversole and Welch 2006; Hobbs and Carlson 1985). The species has been documented from a range of site types including low, moist woodlands, a machine-maintained powerline, and a manicured lawn. Sites are generally isolated from floodplains and streams, although some have been found in low moist areas near the headwaters of streams (colluvial valleys). Analyses performed by Welch and Eversole (2002) found a close association between occurrence of Newberry burrowing crayfish and the presence of a perched water-table, as well as presence of Chewacla, Worsham, Toccoa-Cartecay, Enon, and Sedgefield soil types (Eversole and Welch 2006).

Currently, the Newberry burrowing crayfish is known from only 14 sites, all of which are located in Newberry County (Eversole and Welch 2006). The known range of the species encompasses portions of the Tyger, Enoree, Lower Broad, and Saluda River basins. Because this species is generally isolated from floodplains and streams, it is not expected to occur in the Project Area or in the downstream reach of the Broad River influenced by the Project.

Robust Redhorse

The robust redhorse is a large, heavy-bodied sucker which was presumed extinct until being "rediscovered" during the initial stages of relicensing at Georgia Power's Sinclair Hydroelectric Project (FERC No. 1951). Fisheries scientists knew little about its life history and habitat requirements. As a result, Georgia Power Company, along with state and federal resource agencies, other hydropower interests, and the Georgia Wildlife Federation, formed the Robust Redhorse Conservation Committee (RRCC) in 1995 to guide recovery efforts for the species in lieu of listing under the ESA. Subsequent research has produced valuable information about the robust redhorse and its habitat requirements. However, much research is still needed, as little is known about the habitat preferences of juvenile robust redhorse.

Based on recent studies, it appears that adult robust redhorse typically inhabit areas of the river where the current is moderately swift. Preferred habitat is riffle areas or in/near outside bends, where depths are greater and accumulations of logs and other woody debris are present (Evans 1997). Spawning typically occurs at water temperatures from 18 to 24° C, usually over gravel substrate in both deep and shallow water (Hendricks 1998). Robust redhorse have been documented in both Parr and Monticello reservoirs, as well as the downstream reach of the Broad River. Habitat for robust redhorse is potentially affected by Project flow releases and will be assessed as part of the proposed *Instream Flow Incremental Methodology (IFIM) Study* (Appendix H).

Piedmont Darter

The piedmont darter is one of two species in the genus *Percina* found in South Carolina (Hayes and Bettinger 2006). It is typically found in cool to warm moderately-sized streams and rivers, usually in riffles with gravel or rock substrates (Rohde et al. 2009). Though a riffle dweller, this darter does not seem to favor extremely strong currents. The piedmont darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area. Habitat for piedmont darter is potentially affected by Project flow releases and will be assessed as part of the proposed IFIM Study.

Seagreen Darter

The seagreen darter is restricted to the Santee River drainage of the Carolinas (Hayes and Bettinger 2006). This species inhabits lower elevation tributaries in the mountain regions and is also found over a broad area of the upper piedmont in the Carolinas. It is less frequently found below the fall line in tributaries of the Congaree River. The seagreen darter favors a habitat of rock, rubble or gravel riffles in large creeks and rivers with moderate to swift currents, but has adapted to wide variations in temperature and water clarity. The seagreen darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area. Habitat for seagreen darter is potentially affected by Project flow releases and will be assessed as part of the proposed IFIM Study.

Highfin Carpsucker

The highfin carpsucker is distributed throughout the Lake Michigan drainage and Mississippi River Basin from Pennsylvania south to Louisiana (Self and Bettinger 2006). It also occurs on the Atlantic Slope from the Cape Fear River to Savannah River drainages and Gulf Slope drainages from Choctawhatchee River, Alabama and Florida to the Pearl River, Louisiana and Mississippi. The Atlantic Slope and Gulf Slope populations likely differ at the species level from those of the Mississippi and Lake Michigan drainages. In South Carolina, the highfin carpsucker occurs in the Broad and Congaree rivers in the upper Santee River Basin and the Savannah River. Historically the highfin carpsucker also occurred in the Pee Dee River; however, that population may have since been extirpated. The highfin carpsucker inhabits rivers in areas with moderate or swift current over sand or a gravel substrate (Rohde et al. 2009).

Highfin carpsucker population size and trends are not well known (Self and Bettinger 2006). There appear to be healthy populations with recruitment in the Broad River, Congaree River, and Savannah River. Preservation of populations in the Santee River is extremely important to the global preservation of the species given declining populations in the Cape Fear River and Pee Dee River (Self and Bettinger 2006). This species has been documented in both Parr Reservoir and the reach of the Broad River downstream of the Project. Habitat for highfin carpsucker is potentially affected by Project flow releases and will be assessed as part of IFIM Study.

Quillback

The quillback is found in warm, low- to moderate-gradient reaches of most major rivers, including upper portions of associated reservoirs (Lamprecht and Bettinger 2006). Quillback occur over varied substrates in rivers, but seldom over mud. They tend to occupy calm water; however, quillback may shift to swifter and deeper depths during low water. Quillback reportedly spawn in riffles, calm stream reaches and in floodplain bayous, laying eggs on gravel, sand, mud and organic matter. Quillback feed on insect larvae and other benthic organisms.

The quillback is distributed from the Great Lakes region in the St. Lawrence River, Hudson Bay and Mississippi River basins from Quebec to Alberta, Canada; south to Louisiana and west to Wyoming in the United States (Lamprecht and Bettinger 2006). It also occurs on the Atlantic slope from the Delaware River, New York, to the Altamaha River, Georgia. In gulf slope drainages, it occurs from the Apalachicola River in Florida and Georgia to the Pearl River in Louisiana. The southern Atlantic slope populations in South Carolina are reported in the upper portions of the three major South Carolina drainages: the Pee Dee, Santee, and Savannah. Fish from these populations are likely distinct from those of the interior basin and gulf slope drainages (Lamprecht and Bettinger 2006). Quillbacks have been documented in both Parr and Monticello reservoirs, as well as the downstream reach of the Broad River. Habitat for quillback is potentially affected by Project flow releases and will be assessed as part of the proposed IFIM Study.

<u>Santee Chub</u>

The Santee chub is restricted to the Santee River drainage within South Carolina, primarily in the piedmont and Blue Ridge foothills (Hayes and Bettinger 2006). A few populations of Santee chub found in the coastal plain represent an undescribed species known as the “thinlip” chub. Outside of South Carolina, “thinlip” chub is also found in the Cape Fear River drainage of North Carolina. The Santee chub inhabits small to medium sized streams with sand and rocky runs or current-swept pools. This species seems to be able to tolerate more turbid and warm waters than its close relative, the big-eye chub, *Hybopsis amblops*. Santee chub has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area. Habitat for Santee chub is potentially affected by Project flow releases and will be assessed as part of the proposed IFIM Study.

<u>Striped Bass</u>

Striped bass occur in most of South Carolina's larger rivers and reservoirs and are present in the Project vicinity (Ahle, unpublished). Although the species currently appears stable in South Carolina, there are populations of concern in the lower Santee and Cooper rivers, as well as other coastal rivers (Sessions et al. 2006). Striped bass have been intensively managed in the Santee River basin after landlocked populations were discovered in the Santee Cooper lakes. They prefer to occupy areas with clean sandy bottoms, fine gravel and rock (NatureServe 2004). Adult striped bass have a thermal tolerance of 6 to 27° C (Merriman 1941), but seek temperatures between 18 to 25°C when available (Coutant and Carroll 1980; Crance 1984).

Spawning migrations of striped bass in the Santee River basin occur in the spring, generally from March through May. Upstream migrations of striped bass have been observed at the St. Stephen fish lock, the Pinopolis Navigation lock, and the Columbia fishway; but the extent to which the coastal river populations (lower Santee and Cooper rivers) use the Broad River is unknown. During spawning, striped bass occupy shallow rocky and gravely areas with strong turbulent water flow. Striped bass eggs are semibouyant; they drift and sink slowly requiring moderate current to keep the eggs from settling to the bottom and dying before they are hatched in one to three days. Optimum water temperatures for successful striped bass egg hatching and survival is 17 to 18°C (Sessions et al. 2006). The spawning success of striped bass in the Broad River may be affected by Project flow releases, and their flow needs will be assessed as part of the proposed IFIM Study.

<u>Roanoke Slabshell</u>

The Roanoke slabshell mussel is found primarily in large rivers and occasionally in small creeks. It is able to tolerate large variations in flow levels and higher water temperatures, making it able to survive in some locations near dams and hydroelectric plants (Price 2006). The host fish for this species are still somewhat speculative, but it is thought that it parasitizes a diadromous fish host. Moreover, host studies conducted for Roanoke slabshell only showed successful transformation on blueback herring (most successful), gizzard shad, and white perch although a suite of taxa (ictalurids, cyprinids, centrarchids, catastomids, and anguillids) were considered (Price et al. 2009).

Roanoke slabshell has been documented in limited numbers in the tailrace of the Parr development (Alderman and Alderman 2012), representing the most upstream extant occurrence of the species. It has also been documented farther downstream in the upper Congaree River (Alderman 2009, Price et al. 2009).

Yellow Lampmussel

The yellow lampmussel is a freshwater mussel species that is found primarily in medium to large rivers and streams. Preferred habitat includes a variety of substrates such as silt or sand, gravel bars, and in the bedrock cracks of both large and small rivers and streams (Price 2006b). The range of this species extends from the Ogeechee River in Georgia to Nova Scotia, with distribution in South Carolina spanning the Savannah, Broad, Wateree, Congaree, and Pee Dee River basins (Bogan and Alderman 2008, Price et al. 2009, Kleinschmidt 2013b).

Gravid yellow lampmussels observed in the Congaree River in 2007, were reported to release their glochidia between June and July (Price et al. 2009). These animals are long-term brooders that attract piscivorous hosts with mantle lure display. Broad River host trials indicate that Moronids like striped bass and white bass are likely natural hosts for yellow lampmussel, though Centrarchids may also be viable hosts (Price et al. 2009).

Limited numbers of yellow lampmussel have been documented in the Parr tailrace (Alderman and Alderman 2012), representing the most upstream extant occurrence of the species in the Broad River Basin. It has also been documented farther downstream in the upper Congaree River (Alderman 2009, Price et al. 2009).

4.6.4 Potential Adverse Impacts And Issues

During preliminary relicensing discussion, consulting resource agencies and other stakeholder requested information regarding occurrence and distribution of rare, threatened and endangered species in the Project Vicinity to aid in identifying potential negative effects of continued Project operations. To that end, additional information will be collected during relicensing, as outlined in the *Rare, Threatened and Endangered Species Desktop Assessment Study Plan*, *Rocky Shoals Spider Lily Study Plan*, *Broad River Spiny Crayfish Study Plan*, *Monticello Reservoir Freshwater Mussel Reconnaissance Survey Study Plan*, *American Eel (Anguilla rostrata) Abundance Study Plan,* and the *Instream Flow Study Plan* (Appendix H).

4.6.5 Proposed Mitigation And Enhancement Measures

No PM&E measures related to rare, threatened and endangered species are being proposed at this time.

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4.7 RECREATION AND LAND USE [§ 5.6 (D)(3)(VIII)]

The Project is located within Newberry and Fairfield Counties and situated in the Piedmont Region of South Carolina. The Piedmont Region is the largest geographic region in the State and is home to Kings Mountain National Military Park, Sumter National Forest, and major tourist attractions such as Lake Keowee, Lake Hartwell, Lake Wylie, the Catawba River, and the Saluda River (StudySC.org, 2014). Land use classifications within the Project Boundary are presented in the following table:

TABLE 4-21: LAND USE CLASSIFICATIONS WITHIN THE PROJECT BOUNDARY

CLASSIFICATION	SHORELINE MILES	ACRES
Parr Reservoir		
Project Works Lands	2.26	90
Public Recreation Lands	5.30	942
Undeveloped Area Lands	81.79	2,188
Parr Lands Total	**89.35**	**3,220**
Monticello Reservoir		
Project Works Lands	2.47	112
Nuclear Exclusion Zone Lands	5.43	184
Dock Approval Lands	21.46	238
Public Recreation Lands [a]	18.73	942
Dock Exclusion Lands	8.14	145
Monticello Lands Total	**56.23**	**1,621**
TOTAL PROJECT AREA LANDS [b]	**145.58**	**4,841**

[a] Includes the shoreline surrounding the Recreation Lake and all islands.
[b] Includes Project Area lands between the Project boundary line and the high water mark (425-foot contour on Monticello Reservoir, 266-foot contour on Parr Reservoir), as well as SCE&G-owned islands. These calculations do not include Project Area waters.

4.7.1 EXISTING RECREATIONAL FACILITIES

SCE&G permits public use of the Project land and waters for recreation. Monticello and Parr reservoirs and the Recreational Lake are popular recreational sites in western Fairfield County. Table 4-22 lists recreation sites at Monticello and Parr reservoirs. These sites are also shown in Figure 4-16. Encompassing approximately 300 acres and 10.2 miles of shoreline, the Recreational Lake offers opportunities for fishing, swimming and picnicking 7 days a week. Approximately 8,400 acres of land and water within the Project are part of the statewide Wildlife Management Area (WMA) Program, managed by SCDNR (SCE&G, 2002).

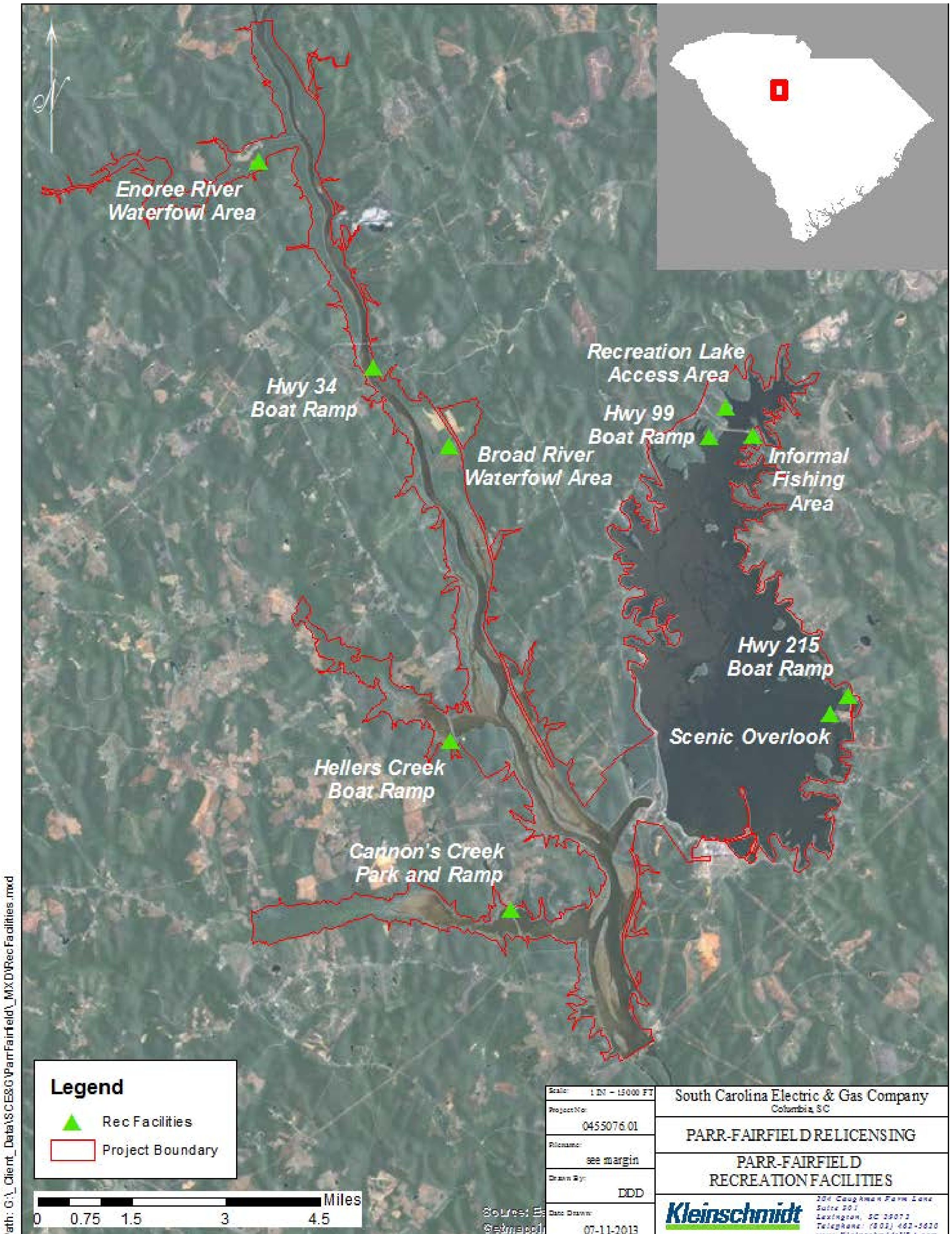
SCE&G maintains six public parks on Monticello and Parr reservoirs. Four of these parks provide boat launches, courtesy docks, and picnic facilities. The Hwy 34 area only provides a boat ramp and the informal fishing area is available for bank fishing only. In conjunction with the Fairfield County Recreation Commission, SCE&G maintains a multiple-use recreational area at Monticello Reservoir that includes a scenic overlook, baseball field, tennis courts, basketball court, picnic facilities, and fishing facilities that provide barrier free access (SCE&G, 2002). Additionally two waterfowl management areas, which are under management jurisdiction of SCDNR under its WMA Program, are located on the Broad River (Broad River Waterfowl Sub-impoundment) and the Enoree River (Enoree River Waterfowl Sub-impoundment).

According to a 2009 FERC Form 80 Licensed Hydropower Development Recreation Report, as determined by staff observations and estimations, approximately 12,000 people visited the area during the daytime annually and 1,500 visited at night.

TABLE 4-22: RECREATION SITES AT THE PROJECT

MONTICELLO RESERVOIR RECREATION SITES & INFORMAL AREAS	PARR RESERVOIR RECREATION SITES & INFORMAL AREAS
1. Scenic Overlook	1. Cannon's Creek Boat Ramp
2. Hwy 215 Boat Ramp	2. Heller's Creek Boat Ramp
3. Hwy 99 Boat Ramp	3. Broad River Waterfowl Area
4. Recreation Lake Access Area	4. Hwy 34 Boat Ramp
5. Informal fishing area, east side of Hwy 99	5. Enoree River Waterfowl Area
	6. Enoree River Bridge Informal Access Area

FIGURE 4-16: RECREATION FACILITIES AT PARR PROJECT



4.7.2 RECREATIONAL USE OF LANDS AND WATERS

Management plans that cover recreation resources within the Project Vicinity include South Carolina's 2008 State Comprehensive Outdoor Recreation Plan (SCPRT 2008); Fairfield County Comprehensive Plan, 2021 (2007); Draft of Newberry County 2013-2022 Comprehensive Plan (2011); and the City of Newberry, South Carolina Comprehensive Plan 2010-2020 (2010).

South Carolina 2008 State Comprehensive Outdoor Recreation Plan

The South Carolina State Comprehensive Outdoor Recreation Plan (SCORP) provides information on the supply and demand for outdoor recreation facilities in South Carolina, creates policies for meeting that demand them, and to qualifies South Carolina for funding from the federal Land and Water Conservation Fund (LWCF) for acquiring or developing lands for public outdoor recreation (SCPRT 2008). The SCORP offers no recommendations specific to the Project, but the recreation goals outlined in the SCORP may be applied by governments at the state, county, or municipal levels, including Newberry and Fairfield Counties and the city of Newberry. The following goals of the SCORP may be relevant to the Project:

- promote the state's tourist attractions;
- provide for the preservation and perpetuation of the Palmetto State's rich historical heritage;
- lease or convey lands to local governments for parks and recreation facilities; and,
- study the state's park and outdoor recreational resources and facilities, the current and projected needs for these resources, and the extent to which these needs are being met (SCPRT, 2008).

Fairfield County Comprehensive Plan, 2021

The Comprehensive Plan for Fairfield County (2007) is an update of the 1997 Fairfield County Comprehensive Plan, which was developed in accordance with the requirements of the Comprehensive Planning Enabling Act of 1994. The plan identifies challenges and issues facing the county and provides responses. With respect to the Project, the plan discusses the recreation opportunities provided at Lake Monticello. Based on the current inventory of parks and facilities, the county has a recreational "deficit" of 129 acres; however, the deficit estimate is misleading because the county has school facilities, trails, National forest, and private and commercial resources. In addition, recreational opportunities are available in neighboring Richland County.

Specifically, however, the plan indicates a general need for more football and soccer fields located strategically around the county.

Draft of Newberry County 2013-2022 Comprehensive Plan

The Draft of Newberry County 2013-2022 Comprehensive Plan (2011) was developed in accordance with the requirements of the Comprehensive Planning Enabling Act of 1994. According to the plan, Newberry County "has abundant recreational opportunities," including 5,282 acres (1.35 percent of all land) classified as parks and recreation; most parks and recreation facilities are in the city of Newberry and the towns. The plan outlines the existing recreation sites provided by SCE&G and associated with Project 516, and proposed future recreation sites within the Project 516 Project Area, which include Sunset Road, Big Creek, Crayne's Landing, and Simpson's Ferry (Newberry County, 2011).

City of Newberry, South Carolina Comprehensive Plan 2010-2020

The City of Newberry Comprehensive Plan 2010-2020 is a revision of the 1999 Plan and is a general guide for the "future social, economic, and physical development of the City of Newberry." While the plan does not address recreational activities or needs at the Project specifically, it provides the city's goals and policies concerning culture and art, natural resources, public facilities, recreation and open space, transportation, land use, and long range planning (City of Newberry, 2010).

4.7.3 Existing Shoreline Buffer Zones within the Project Boundary

All SCE&G property between the adjacent back property and the waters of Monticello Reservoir is the area defined as the shoreline buffer zone. The following structures and activities are prohibited within the buffer zone (SCE&G, 2002):

- permanent structures;
- land-based structures, storage buildings, shelters, patios, gazebos, fences, swimming pools, satellite dish, signs, storage of boats, canoes and other water craft or automobiles;
- septic tanks or drain fields or both;
- planting of grass except as a permitted erosion control measure;
- storage or stockpiling of construction material;

- vegetation removal of any type except within permitted 10 foot wide, meandering access paths to the shoreline; and
- limbing or trimming buffer zone vegetation to create views or visual corridors.

SCE&G addresses instances of buffer zone non-compliance through their Land Use and Shoreline Management Plan.

4.7.4 Current and Future Recreation Needs Listed in Existing State or Regional Plans

No specific recreation needs pertinent to the Project are identified in existing state or regional plans.

4.7.5 Current Shoreline Management Plan Or Policy

Article 20 of the Project License issued to SCE&G in 1974 orders that SCE&G allow public access, to a reasonable extent to Project waters and adjacent Project lands (with the exception of lands necessary for the protection of life, health, and property) for navigation and outdoor recreational purposes. This Article also allows SCE&G to grant permits for public access to the reservoirs subject to FERC approval (F.P.C., 1974).

In 1991, SCE&G recognized that appropriate policies and procedures should be in place to govern shoreline activities at the Project. Utilizing experience gained at their Saluda Hydroelectric Project (FERC No. 516), SCE&G filed a proposed Shoreline Management Plan (SMP) with the Commission to regulate the use of Project shorelines. After extensive stakeholder consultation, an amended SMP was filed with the Commission. It was approved on June 4, 2001. The SMP was included as part of the Project's Exhibit R (FERC, 2001).

The SMP approved in 2001 primarily covers activities associated with Monticello Reservoir. It deals with the following matters: water quality management; forest management; waterfowl management; nuclear exclusion zone restrictions for the operation of SCE&G's V.C. Summer Nuclear Station; fishing, boating, and hunting; public access and recreation; private boat docks and access; vegetation removal; water withdrawal; erosion control; and prohibited activities. Currently, no private shoreline development activities, such as docks or erosion control measures, are permitted on Parr Reservoir or the Recreation Lake. Adjacent property owners must have a minimum of 200 feet on the Project Boundary Line to be considered eligible for a dock on Monticello Reservoir.

In 2006, SCE&G amended the SMP's policy regarding common docks on Monticello Reservoir. The original policy allowed for two to five adjacent property owners to share a single common dock if the shoreline frontage requirement of 200 feet was met. The policy was amended to allow no more than two individual, adjacent single family residential lots to share a common dock. The shoreline frontage requirement of 200 feet was retained.

Additional details regarding dock sizing requirements, erosion control, and other permitted activities are included in the SMP on file with FERC and available at the following website address: https://www.sceg.com/docs/librariesprovider5/default-document-library/lake-monticello-dock-permits-application.pdf

4.7.6 The National Wild And Scenic River System

The Project is not located on a designated wild and scenic river segment.

4.7.7 Project Land Being Considered for Inclusion in the National Trails System or as a Wilderness Area

No Project lands are being considered for inclusion in the National Trails System or as a Wilderness Area.

4.7.8 Regionally Or Nationally Important Recreation Areas

Regionally and nationally recognized recreation opportunities within the Project Vicinity include Dreher Island State Park, Chester State Park, Kings Mountain National Military Park, Sumter National Forest, Greenwood State Park, and Lake Wateree State Park. These areas provide opportunities for hunting, boating, fishing, hiking, picnicking, swimming, and camping in the Project Vicinity (StudySC.org, 2014).

Descriptions of large parks in the vicinity of the Project are as follows:

- Sumter National Forest – an 371,000-acre national forest providing walking, riding, and camping opportunities;
- Lake Greenwood State Park – contains an 11,400-acre manmade lake along the southwestern border of Newberry County with several miles of shoreline and public access;

- Lake Wateree State Park – a 72-acre state park containing outdoor and water-oriented facilities, a campground, picnic areas, and a boat ramp;
- Lynch's Woods Park – a 260-acre woodland area in the city of Newberry which has 7.5 miles of hiking and biking trails, 3.5 miles of equestrian trails, a primitive camp site, and picnic tables; and
- Lake Monticello Park – a 25-acre park containing tennis courts, ball field, basketball court, picnic facilities, fishing pier, and walking trail.

Fairfield and Newberry Counties encompass several municipal recreation areas. Fairfield County has16 public parks and recreation facilities encompassing approximately 90 acres, and Newberry County has 45 public parks and recreation facilities encompassing more than 530 acres. These facilities (Table 4-23) provide the following amenities: playgrounds, picnic areas, softball fields, horseback riding, hand-carried and trailered boat launches, basketball courts, swimming pools, birding and wildlife watching opportunities, and multi-use trails that support hiking.

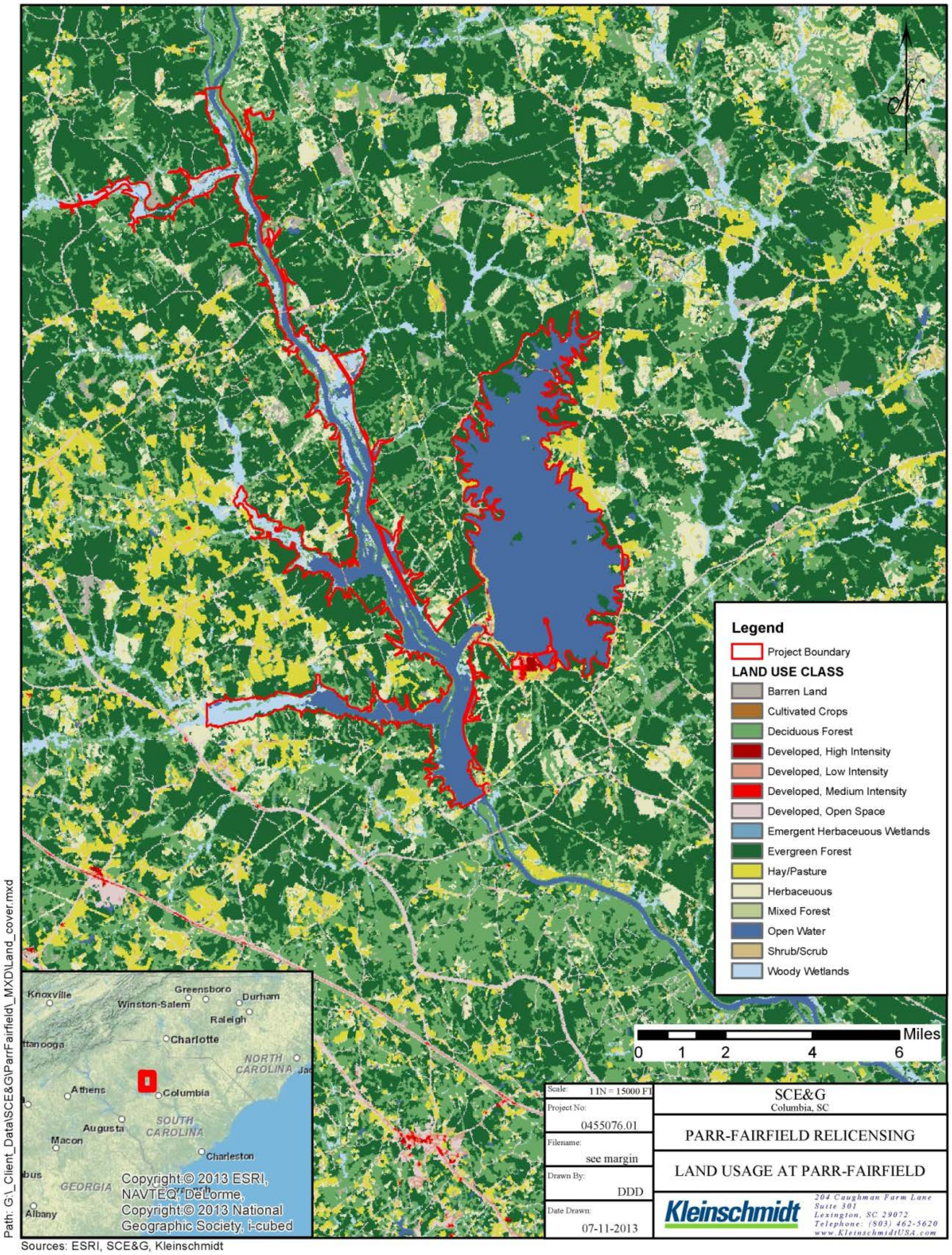
TABLE 4-23: RECREATION FACILITIES IN FAIRFIELD AND NEWBERRY COUNTIES

FAIRFIELD COUNTY	NEWBERRY COUNTY
Lake Monticello	Brick House Recreation Area
Feasterville Mini Park	Broad River Canoe Access
Mitford Mini Park	Cannon's Creek Public Access Area
Sheldon Mini Park	Dreher Island State Park
Eunice Shelton Trail	Hellers Creek Access Area
Adger Park	Little Mountain Reunion Park
Blair Park/Willie Lee Recreation Center	Lynch's Woods Park
Garden St. Park	Peak-to-Prosperity Rail Trail
Middle Six Mini Park	Wells Japanese Garden
Chappelltown Mini Park	Little Mountain Explorer Bicycling Route
Centerville Mini Park	
Horeb Glenn Park	
Alton Trail	
Fortunes Spring Park	

4.7.9 NON-RECREATIONAL LAND USE AND MANAGEMENT WITHIN THE PROJECT BOUNDARY

Project operations, maintenance, and recreation are the primary activities on Project lands. The land use types within the Project Boundary consist mostly of open water, woody wetlands, and evergreen forest. Figure 4-17 is a map of land use types in the Project Boundary.

FIGURE 4-17: LAND USE MAP OF THE PROJECT



Sources: ESRI, SCE&G, Kleinschmidt

4.7.10 RECREATIONAL AND NON-RECREATIONAL LAND USE AND MANAGEMENT ADJACENT TO THE PROJECT BOUNDARY

The lands adjacent to the Project Boundary are dominated by forestland, deciduous forest, and hay/pasture land use types. The lands in the Project Vicinity are dominated by forestland and grasslands. Overall, only a small percentage of the Project Vicinity is developed (Table 4-24 and Table 4-25).

TABLE 4-24: LAND USES IN FAIRFIELD COUNTY

LAND USE	SQUARE MILES	PERCENT
Developed	5.03	0.71
Agriculture	0.01	0.04
Forestland	514.13	72.41
Wetlands	16.86	2.37
Grasslands	108.19	15.24
Shrub/Scrub	5.68	0.80
Barren Land	11.90	1.68
Open Space	22.02	3.10
Open Water	26.20	3.69
Total	710.02	100%

TABLE 4-25: LAND USES IN NEWBERRY COUNTY

LAND USE	SQUARE MILES	PERCENT
Developed	9.08	1.40
Agriculture	0.18	0.03
Forestland	407.19	62.90
Wetlands	20.70	3.20
Grasslands	142.44	22.00
Shrub/Scrub	5.10	0.79
Barren Land	6.45	1.00
Open Space	35.16	5.43
Open Water	21.06	3.25
Total	647.34	100%

The closest city to the Project is the City of Newberry. The City has no forested land or cropland in its center; however, its eastern areas have extensive areas of forested land, and cropland and pasture. The City of Newberry is surrounded by forested and agricultural land to the west and south (City of Newberry, 2010). Parks and open space is the predominant land use type at 30.6 percent; single-family residential land use is the second predominant land use type at 29.3 percent, followed by public and institutional land use at 14.4 percent (City of Newberry, 2010).

4.7.11 POTENTIAL ADVERSE EFFECTS AND ISSUES

Continued Project operation will not adversely affect the Project's land use and recreation opportunities. The Applicant is proposing a *Recreation Use and Needs Study* (Appendix H) to assess the existing and future recreational use, opportunities, and needs for the Project. The assessment is designed to provide information concerning the current and future availability and adequacy of recreation sites owned and managed by SCE&G and specific informal recreation areas at Monticello and Parr reservoirs, and about mitigation and enhancement measures necessary at the Project. SCE&G is also proposing a *Downstream Recreational Flow Assessment Study* (Appendix H) designed to identify and assess preferred recreational flows and a *Downstream Navigational Flow Assessment Study* (Appendix H) designed to evaluate the flow levels within the Broad River needed for one-way navigation.

In addition, the Applicant is proposing to develop consensus-based Shoreline Management Plans for Monticello and Parr reservoirs that identify appropriate shoreline activities within the Project Boundary and offers guidelines to help ensure that such activities avoid or minimize environmental effects.

4.7.12 PROPOSED MITIGATION AND ENHANCEMENT MEASURES

Although no measures to mitigate or enhance recreation and land use are planned at this time, the Applicant may consider some measures to enhance existing recreation opportunities pending the outcome of the *Recreation Use and Needs Study*, *Downstream Recreational Flow Assessment Study, Downstream Navigational Flow Assessment* and the Shoreline Management Plans for Monticello and Parr reservoirs.

4.7.13 REFERENCES

City of Newberry. 2010. Comprehensive Plan 2010-2020. Planning and Development Services Department. City of Newberry, South Carolina.

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4.8 AESTHETIC RESOURCES [§ 5.6 (D)(3)(IX)]

The Project Vicinity is predominantly rural, consisting of forest and grasslands. Development is minimal in the counties. The largest urban development in the area is the City of Newberry, which is the county seat of Newberry County and the nearest city to the Project. Newberry is located along the I-26 corridor connecting the Columbia Metro area and the Greenville-Spartanburg Metro area (City of Newberry, 2010). Although it is the largest city near the Project Area, Newberry consists of mostly parks, recreation and open space; single-family residential; and public and institutional space. Lands surrounding the Project are forested and rural (City of Newberry, 2010).

4.8.1 VISUAL CHARACTER OF THE PROJECT VICINITY

The Project is located along the Broad River within a rural area of Fairfield and Newberry counties in the Piedmont physiographic region, which is characterized by rolling hills, forests, farms, and orchards. The Project is located in an ecoregion of the Piedmont region called the Southern Outer Piedmont ecoregion, which has lower elevations and irregular plains rather than plains with hills (SCDNR, 2014; EOE, 2014).

Approximately 72 percent of Fairfield County and 63 percent of Newberry County is forested. Most forested lands are within close vicinity of the Project.

Roadways run parallel to the waterline and structures that support recreational and Project-related activities. The shorelines surrounding the Project structures are armored with concrete embankments and rip-rap. Vegetation surrounding the Project Area varies, but forested shorelines are the most predominant landscape type. The eastern shoreline of the Monticello Reservoir has less forested area and more residential development than the rest of the Project Vicinity.

4.8.2 NEARBY SCENIC ATTRACTIONS

Numerous scenic attractions of local and regional importance are located in the Project Vicinity, and Fairfield and Newberry counties offer many municipal recreation areas, as described in Section 4.7.1. Fairfield County is flanked by Lake Wateree to the east and Monticello Reservoir to the west. These provide a combined total of more than 20,000 acres of pooled water in the Project Vicinity.

Fairfield County's rich history is evident in its numerous historical homes built before the Revolutionary War (Fairfield County, 2014). Like Fairfield County, Newberry County, which is situated between the Broad and Saluda rivers, also has a rich history and was the site of several American Revolutionary War battles. The City of Newberry features the Newberry Opera House, which was built in 1881 and serves as a performing arts facility with state-of-the art technology (NewberryCounty.org, 2014).

4.8.3 Visual Character of Project Lands and Waters

Monticello Reservoir covers 6,800 acres and has 54 miles of shoreline. SCE&G owns shoreline property extending from a minimum of 50 feet wide, measured horizontally from the 425-foot mean sea level contour, to as much as 200 feet wide. Approximately 7.2 miles of the Monticello Reservoir shoreline are within the Nuclear Exclusion Zone (NEZ) of the V. C. Summer Nuclear Station and, therefore, are not open to the public. The shoreline within the NEZ is marked with signs and buoys and is not available for public use (SCE&G, 2002).

Parr Reservoir covers about 4,400 acres and has 94 miles of shoreline. The reservoir was originally formed in 1914 as part of a conventional hydro project at Parr Shoals. The height of its dam was raised 9 feet in the 1970s during construction of the pumped storage development, nearly doubling the reservoir's surface area. The Recreational Lake, which was constructed by SCE&G solely for recreational use, is located adjacent to Monticello Reservoir and has a surface area of 300 acres. Recreational Lake is maintained at a stable water level and is not affected by the operation of the pumped storage facility (SCE&G, 2002).

4.8.4 Potential Adverse Effects and Issues

Although continued Project operation will not adversely affect the aesthetics of the Project Area, the Applicant is proposing (1) a *Recreation Use and Needs Study* to assess the existing and future recreational use, opportunities, and needs for the Project; and (2) a consensus-based Shoreline Management Plan for both Monticello and Parr reservoirs that will identify appropriate shoreline activities within the Project Boundary.

4.8.5 Proposed Mitigation And Enhancement Measures

No mitigation or enhancement measures for aesthetics are proposed at this time.

4.8.6 REFERENCES

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South Carolina Department of Natural Resources (SCDNR). 2014. Piedmont Ecoregion Aquatic Habitats. [Online] URL: https://www.dnr.sc.gov/cwcs/pdf/habitat/PiedmontAquatic.pdf Accessed on April 2, 2014.

4.9 CULTURAL RESOURCES [§ 5.6 (D)(3)(X)]

4.9.1 PREHISTORY AND HISTORY OF THE REGION

At the beginning of the Paleoindian period (about 11000 BC to 8000 BC), most of South Carolina was cool and dry, and boreal tundra and spruce-pine forests covered most of the state. By the end of the period, the climate ameliorated; rainfall was more frequent; and the state was covered with deciduous forests that contained beech, elm, hickory, oak, and birch. During this time, the large fauna, including mammoth, mastodon, giant sloth, and bison became extinct. The relative importance of the role of humans and the climate in the extinction of these large animals remains unclear, although both probably contributed.

Most of our knowledge about the Paleoindian period in the Southeast is based on surface collections and inference rather than controlled subsurface excavations. The limited information available suggests that the earliest Native Americans followed a mixed subsistence strategy based on hunting (or scavenging) the megafauna and smaller game, combined with foraging for wild plant foods. Groups are thought to have consisted of small, highly transient bands made up of several nuclear or extended families or both. Settlements appear to have been concentrated along major rivers near the Fall Line and in the Coastal Plain, although many additional sites along the coast almost certainly were inundated by the rise of sea level that has occurred since that time.

Environmental change at the end of the Pleistocene led to changes in human settlement patterns, subsistence strategies, and technology. As the climate warmed and the megafauna became extinct, population size increased, and territory size and settlement range decreased. Much of the Southeast during the early part of this period consisted of mixed oak-hickory forest. Later, during the Hypsithermal interval between 6000 BC and 2000 BC, southern pine communities became more prevalent in the interriverine uplands, and extensive riverine swamps were formed.

The Archaic period typically is divided into three subperiods, Early Archaic (8000 to 6000 BC), Middle Archaic (6000 to 3000 BC), and Late Archaic (3000 to 1000 BC), based on changes in projectile point morphology, settlement patterns, and subsistence practices. Each of these subperiods appears to have been lengthy, and the populations were successful in adapting technology to prevailing climatic and environmental conditions of the time.

The Woodland period brought a number of important developments, including a gradual increase in population and sedentariness, the widespread adoption of ceramic vessel technology, the introduction of the bow-and-arrow technology, the intensification of horticultural activities, the establishment of long-distance trading networks, and the use of conical burial mounds for interring the dead. Like the preceding Archaic Period, the Woodland is traditionally divided into three subperiods: Early Woodland (1000 BC to 500 BC), Middle Woodland (500 BC to 500 AD), and Late Woodland (500 AD to 1000 AD).

The Mississippian Period, dating from 1000 to1540 AD, saw dramatic changes across most the southeastern United States. Mississippian societies were complex sociopolitical entities that were based at mound centers, usually located in the floodplains along major river systems. The flat-topped platform mounds served as both the literal and symbolic manifestation of a complex sociopolitical and religious system that linked chiefdoms across a broad network stretching from the Southeastern Atlantic Coast, to the Spiro Mounds in Oklahoma in the west, to as far north as Aztalan in Wisconsin. Mound centers were surrounded by outlying villages that usually were built along major rivers to take advantage of the rich floodplain soils. Smaller hamlets and farmsteads dotted the landscape around villages and provided food, tribute, and services to the chief in return for protection and inclusion in the sociopolitical system. While Mississippian subsistence was focused largely on intensive maize agriculture, hunting and gathering of aquatic and terrestrial resources supplemented Mississippian diets.

Permanent European settlement in South Carolina began in 1670, when English adventurers from the island of Barbados settled on the west bank of the Ashley River near what is now Charleston; they relocated to the present site of Charleston in 1680. In the 1740s and 1750s, Europeans drawn to the area by the township program, which granted tax credits and free land, settled into the South Carolina Piedmont. The pioneers in the backcountry remained mostly separated from the low-country settlements of the state (Revels 2003).

Both Fairfield (Ederington 1902) and Newberry counties were settled in the mid-eighteenth century, mostly by German and Swiss immigrants along the Broad and Saluda rivers. Beginning in 1759, several stockade forts were built in the area as protection from the Cherokee Indians. Disease and corruption were widespread in the forts. The Treaty of Charleston, signed in 1761, ended the Cherokee War, and a large immigration to the South Carolina backcountry followed.

Throughout the Revolutionary War, more than 250 battles were fought in South Carolina. Ten battles occurred in Newberry County, and three battles occurred in Fairfield County. After the war, cotton cultivation gave the backcountry a cash crop, and evangelical missionaries solidified the backcountry communities. As cotton grew, larger plantations replaced small farms, and infrastructure improvements included new roads and canals.

The push for railroad development began in the middle of the nineteenth century. The railroad boom created new business and helped the growth of the upstate towns. The Laurens Railroad, connecting Greenville and Columbia Railroad in Newberry County, opened in 1854.

In 1861, South Carolina seceded from the Union. No Civil War battles were fought in Newberry County, but soldiers from Newberry were present at all of the major battles. After the war, a sharecropping system developed on most farms. The population in Newberry and Fairfield Counties continued to grow as commerce such as textile mills, railroads, and cotton production developed in the area. Sustained growth persisted from after the Civil War throughout World War I (Revels 2003).

The Parr Shoals Development, which consists of a dam / spillway, powerhouse, and reservoir, was constructed between 1912 and 1914. The Fairfield Pumped Storage Development facility consists of a powerhouse, penstocks, a substation, an office/maintenance building, four earthen dams, and a reservoir. The facility (excluding office/maintenance building) was constructed between 1974 and 1978.

4.9.2 IDENTIFICATION OF HISTORIC OR ARCHAEOLOGICAL SITES IN THE PROPOSED PROJECT VICINITY

Consultation with the South Carolina SHPO and Indian tribes was initiated in 2013. The Area of Potential Effects was defined and agreed to with the SC SHPO. An *Initial Historic and Archaeological Resources Study* (Appendix I) was conducted which identified 128 previously recorded archaeological sites within a 0.5-mile radius, including 31 that are within or partially within the PBL.

A 2013 *Phase I Cultural Resource Investigation* (Appendix I) of the Project Area resulted in the examination of 32 isolated finds, 65 archaeological sites, and 2 historic resources. Table 4-26 identifies the sites that are eligible or potentially eligible for the National Register of Historic Places (NRHP) and summarizes recommendations for the sites. The remaining sites and finds are considered ineligible for the NRHP, and no additional work is necessary for those sites (Carpini and Nagle 2014).

TABLE 4-26: ELIGIBLE OR POTENTIALLY ELIGIBLE SITES

SITE NAME/NUMBER	**NRHP ELIGIBILITY**	**RECOMMENDATIONS**
Blair Mound (38FA48)	Listed	No further work at this time
Lyles Ford (38FA592/38NE16)	Eligible	Mitigation in consultation with State Historic Preservation Office (SHPO) and FERC
Parr Hydroelectric Facility (Structure 39-0081)	Eligible	Develop Programmatic Agreement (PA) and Historic Properties Management Plan (HPMP)
Prehistoric Scatter (38FA569)	Potentially eligible	No further work at this time
Prehistoric Scatter (38FA571)	Potentially eligible	No further work at this time
Prehistoric camp (38NE8)	Potentially eligible	Stabilize site
Prehistoric camp (38NE10)	Potentially eligible	Stabilize site
Prehistoric camp (38NE1085)	Potentially eligible	No further work at this time
Prehistoric camp (38NE1079)	Potentially eligible	No further work at this time
Prehistoric camp (38NE1082)	Potentially eligible	No further work at this time
Eighteenth/Nineteenth Century Canal (38FA568)	Potentially eligible	No further work at this time
Prehistoric Scatter (38NE1068)	Potentially eligible	No further work at this time
Prehistoric camp and historic house site (33NE1077)	Potentially eligible	No further work at this time
Prehistoric habitation site and historic isolate (38NE1080)	Potentially eligible	No further work at this time
Fairfield Pumped Storage (39-0082)	Will be eligible in 2028, when it reaches 50 years of age	Develop PA and HPMP

4.9.3 DISCOVERY MEASURES

S&ME, Inc (S&ME) conducted a Phase I cultural resources investigation within the Project Boundary from August 13 to December 16, 2013. The investigation included 70 areas encompassing 3,375 acres identified as having high potential to include cultural resources. In addition, S&ME will conduct some artifact analysis and report the findings to SCE&G.

4.9.4 IDENTIFICATION OF INDIAN TRIBES THAT MAY ATTACH RELIGIOUS AND CULTURAL SIGNIFICANCE TO HISTORIC PROPERTIES

The number of prehistoric archaeological sites within the region indicates that Native Americans have inhabited the area for at least 13,000 years. Native Americans clearly were present in the South Carolina region in the early eighteenth century when European explorers first entered the region, and they persisted in the area well into the period of European settlement. This confirms that Native Americans have a well-justified traditional connection to the region that includes the Project Area.

Under Section 106 of the National Historic Preservation Act, the Commission is obligated to seek out any federally recognized Indian tribe that can demonstrate a traditional cultural or religious connection to land under its jurisdiction and to involve them in the relicensing process. Although the Project Boundary encompasses no federally recognized tribal lands, some federally recognized tribes may have an interest in the Project relicensing. The following tribes are on FERC's mailing list, and FERC will contact them to determine if they will participate in the relicensing process. All of the following tribes will remain on the mailing list, will be invited to attend cultural resources meetings, and will be informed of all other meetings for the Project.

- Catawba Indian Nation
- Cherokee Nation
- Eastern Band of Cherokee Indians
- Santee Sioux Tribal Council
- Tuscarora Nation
- United Keetoowah Band

In addition, S&ME contacted representatives from the following tribes in April 2013 for initial consultation concerning Project relicensing:

- Principal Chief Cherokee Nation
- THPO Absentee-Shawnee Tribe
- THPO Catawba Indian Nation
- THPO Eastern Band of Cherokee Indians
- THPO Choctaw Nation of Oklahoma
- Governor Chickasaw Nation
- THPO Santee Sioux Tribe of Nebraska
- THPO Seminole Nation of Oklahoma
- THPO Eastern Shawnee Tribe of Oklahoma
- THPO Jena Band of Choctaw Indians
- Tribal Administrator Poarch Band of Creek Indians
- Chief Tuscarora Nation
- THPO Muscogee (Creek) Nation
- THPO Seminole Indian Tribe
- Tribal Archaeologist Mississippi Band of Choctaw
- NAGPRA and Section 106 Representative Miccosukee Tribe of Indians in Florida
- Chief United Keetoowah Band of Cherokee Indians

4.9.5 Potential Adverse Effects and Issues

This section identifies any known or potential effects of Project operations on the cultural resources of the Project Area, including those resulting from continuing operations and those that may result from cumulative effects. For the purposes of this PAD, Project effects are any changes of the natural and human environment attributable to continued operation of the Project.

Any proposed change in Project operation will be evaluated in terms of its effect (beneficial or adverse) on cultural resources associated with Project lands. SCE&G will incorporate any study results for any Project operation changes, as necessary, into the cultural resources assessment.

The continued management and operations of the Project may affect historic properties as a result of Project-induced shoreline and riverbank erosion, the construction of any Project-related recreational facilities, and continuing development along the shoreline. Considering historic properties in the planning and permitting process could have a beneficial effect on historic properties by identifying and protecting significant sites that lie along the shoreline.

4.9.6 PROPOSED MITIGATION AND ENHANCEMENT MEASURES

In consultation with SCE&G and other stakeholders, FERC will develop a programmatic agreement (PA) to comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA), which calls for FERC to consider the effect of undertakings on historic properties. The PA will define certain stipulations for the management of historic properties affected by the Project.

In addition, SCE&G may manage historic properties under two different management documents: a shoreline management plan (SMP) and a historic properties management plan (HPMP). The SMP will guide the type and degree of development that may take place within the Project Boundary. It will outline how SCE&G will consider cultural resources when issuing permits for the construction of docks, seawalls, and other water-control structures. The HPMP will be designed to be used in coordination with the SMP and will include the following principles and procedures:

a) completion, if necessary, of identification, evaluation and mitigation of historic properties within the Project Area of Potential Effects (APE);
b) a plan for monitoring and protecting historic properties within the Project APE that may be affected by shoreline erosion, other Project-related ground-disturbing activities, and vandalism;
c) mitigation of unavoidable adverse effects on historic properties;
d) treatment and disposition of any human remains that may be discovered, taking into account any state and federal laws and regulations;
e) discovery of previously unidentified historic properties during Project operations; and
f) a plan interpretation of the historic and archeological values of the Project for the public.

4.9.7 REFERENCES

Carpini, H.L and Nagle, K. 2014. Phase 1 Cultural Resources Investigations for the Parr Hydroelectric Project (FERC Project No. 1894). Prepared for South Carolina Electric and Gas. Prepared by S&ME.

Ederington, William. 1902. History of Fairfield County, South Carolina.

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4.10 SOCIOECONOMIC RESOURCES [§ 5.6 (D)(3)(XI)]

The following is a summary of selected socioeconomic variables for the areas surrounding the Project, including Fairfield and Newberry counties, South Carolina. The nearest populated town to the Project is Newberry, South Carolina.

4.10.1 POPULATION PATTERNS

In 2012, an estimated 23,363 people lived in Fairfield County, South Carolina (Table 4-27). From 2010 to 2012, the county population decreased by 2.5 percent. This population decline opposed the overall statewide population growth (2.1 percent) in South Carolina during the same period. Population densities are significantly lower in Fairfield County compared to statewide densities. Fairfield County had 34.9 people per square mile compared to the state average of 153.9 people per square mile (U.S. Census 2014)

In 2012, an estimated 37,576 people lived in Newberry County, South Carolina (Table 4-27). From 2010 to 2012, the county population increased by 0.2 percent. This population change was less than the overall statewide population growth (2.1 percent) in South Carolina during the same period. Population densities are significantly lower in Newberry County compared to statewide densities. Newberry County had 59.5 people per square mile compared to the state average of 153.9 people per square mile (U.S. Census 2014)

TABLE 4-27: POPULATION PATTERNS

	FAIRFIELD COUNTY	NEWBERRY COUNTY	SOUTH CAROLINA
Population			
Population (2013)	NA	NA	4,774,839
Population (2012)	23,363	37,576	4,723,417
Population (2010)	23,956	37,508	4,625,360
Population Change (2010 to 2013)	NA	NA	3.2%
Population Change (2010 to 2012)	-2.5%	0.2%	2.1%
Geography (2010)			
Land area in square miles (sq mi)	686.28	630.04	30,060.70
Population Density (people/sq mi)	34.9	59.5	153.9
Gender (2012)			
Female	52.2%	51.1%	51.4%
Male	47.8%	48.9%	48.6%
Age (2012)			
Persons under 5 years old	5.4%	6.3%	6.3%

	Fairfield County	Newberry County	South Carolina
Persons under 18 years old	21.6%	22.6%	22.9%
Persons 65 years old and over	16.5%	16.8%	14.7%
Race (2012)			
Caucasian	39.6%	65.8%	68.4%
Black	58.6%	31.3%	28.0%
American Indian and Alaska Native	0.3%	0.8%	0.5%
Asian	0.3%	0.5%	1.4%
Native Hawaiian and Other Pacific Islander	< 0.1%	0.3%	0.1%
Hispanic or Latino	1.9%	7.6%	5.3%
Two or More Races	1.2%	1.3%	1.6%

Source: U.S. Census 2014

4.10.2 Household/Family Distribution and Income

Between 2008 and 2012, Fairfield County had 9,475 households with 2.47 people in each household. The median household income was $35,452, which was significantly lower than the state median ($44,623). Approximately 23.2 percent of the population in Fairfield County lives below the poverty level (U.S. Census 2014).

Between 2008 and 2012, Newberry County had 14, 176 households with 2.56 people in each household. The median household income was $42,005, which was slightly lower than the state median ($44,623). Approximately 16.7 percent of the population in Newberry County lives below the poverty level (U.S. Census 2014).

4.10.3 Project Vicinity Employment Sources

The largest sources of employment in Fairfield County are educational services, health care, and social assistance. The second largest employment sector is manufacturing. Public administration is the third largest employment sector in Fairfield County, and the smallest source of employment is wholesale trade, representing 1.4 percent of the employed population (U.S. Census 2014).

The largest sources of employment in Newberry County are educational services, health care, and social assistance. The second largest employment sector is manufacturing. Retail trade is the third largest employment sector in Newberry County, and the smallest source of employment is the information sector, representing 0.9 percent of the employed population (U.S. Census 2014).

4.10.4 The Regional Economy

As in Fairfield and Newberry counties, the primary employers within the state of South Carolina are educational services, healthcare, and social assistance services. The state also relies heavily on manufacturing and retail trade to provide employment.

Total gross state product in 2001 was $115.2 billion; 15.5 percent of that came from the public sector. The main contributors to the gross state product were manufacturing ($23.1 billion), general services ($19.6 billion), trade (19.3 billion), government ($17.9 billion) and financial services ($16.6 billion). South Carolina was ranked 28th among all 50 states for gross state product in 2001 (City Data 2010).

4.10.5 Potential Adverse Effects and Issues

Continued Project operation may not affect the local economy significantly in terms of creating jobs; however, the Project provides a renewable source of low-cost energy, which benefits energy users.

The Applicant believes that sufficient socioeconomic data are available for the areas surrounding the Project; therefore, no studies or protection, mitigation or enhancement (PM&E) measures are proposed related to this resource area.

4.10.6 References

City Data. 2010. South Carolina Economy. [Online] URL: http://www.city-data.com/states/South-Carolina-Economy.html Accessed March 10, 2014.

U.S. Census. 2014. QuickFacts: South Carolina. [Online] URL: http://quickfacts.census.gov/qfd/states/45000.html Accessed March 10, 2014

4.11 TRIBAL RESOURCES [§ 5.6 (D)(3)(XII)]

On May 17, 2013, SCE&G notified FERC that SCE&G began informal consultation with the South Carolina State Historic Preservation Officer as well as the Tribal Historic Preservation Officers for the Eastern Band of Cherokee Indians and the Catawba Indian Nation for the purposes of Phase I Cultural Resource Investigations. FERC notified SCE&G that this was acceptable and SCE&G completed Phase I investigations in consultation with the above listed agency and tribes in 2013. At this time, SCE&G is unaware of any adverse effects or issues associated with tribal resources based on pre-process consultation with the Eastern Band of Cherokee Indians and the Catawba Indian Nation. Official Section 106 consultation will begin after FERC authorization in accordance with § 5.5 (e).

SCE&G has no formal management activities specific to tribal resources; however, the existing license requires SCE&G to consult with the University of South Carolina to account for archaeological resources before disturbing any ground.

4.12 RIVER BASIN DESCRIPTION [§ 5.6 (D)(3)(XIII)]

4.12.1 AREA OF RIVER BASIN AND SUB-BASIN AND LENGTH OF STREAM REACHES

Extending across the Piedmont region of North and South Carolina, the Broad River basin includes a total of 4,691 stream miles and 18,533 acres of lake waters. In South Carolina, the Broad River basin incorporates 27 watersheds and some 2.5 million acres (SCDHEC 2007).

The lower Broad River basin, where the Project is located, is a sub-basin of the Broad River basin. The lower Broad River basin forms at the confluence of the Broad and Pacolet Rivers, approximately 34 miles northwest of the Project Area, and has a total drainage area of nearly 824,000 acres (NRCS 2010). From its headwaters in the Blue Ridge Mountains of North Carolina to its confluence with the Saluda River to form the Congaree in Columbia, SC, the Broad River is about 153 miles long. The Lower Broad River basin includes about 67 miles of the southern extent of the river (USGS 2014).

4.12.2 MAJOR LAND AND WATER USE IN THE PROJECT AREA

4.12.2.1 LAND USE

The Broad River basin is dominated by forestland, which encompasses approximately 60.6 percent of the total land cover, followed by agriculture at approximately 23.8 percent of the land cover. Overall, only a small percentage of the Broad River basin is developed (9.8 percent). The cities of Spartanburg, Gaffney, and Chester; and portions of the cities of York, Union, and Columbia encompass most of the developed land in the basin (SCDHEC 2007). None of the several mining operations within the Broad River basin are located within the Project Vicinity.

Within the Project Vicinity, forestland is the dominant land cover. Portions of Sumter National Forest are found in Newberry and Fairfield Counties, where the Project is located. Agricultural land encompasses about 12,000 acres in both counties; cropland and hayland are the dominant agricultural land types in Newberry and Fairfield, respectively. Developed land in the Project Vicinity is generally limited to the cities of Winnsboro, approximately 14 miles east of the Project; and Columbia, approximately 12 miles southeast of the Project (NRCS 2014).

4.12.2.2 WATER USE

In the Piedmont region of South Carolina, surface water bodies including lakes, reservoirs, and major river systems constitute the primary source of water for public supply, industry, agriculture, and power production. Surface water withdrawals and uses differ between Fairfield and Newberry Counties. Hydroelectric facilities account for most of the surface water withdrawals in Fairfield County followed by nuclear power and water supply facilities. In Newberry County most surface water is used for water supply, followed by irrigation and golf courses (SCDHEC 2004; Table 4-28). The Broad River, Monticello and Parr reservoirs, and Recreational Lake also are used for recreational purposes, including boating, swimming, and fishing (SCE&G 2002). Recreational use of the Project Area is described in detail in Section 4.7.

TABLE 4-28: SURFACE WATER USE IN FAIRFIELD, NEWBERRY AND RICHLAND COUNTIES, SC

	FAIRFIELD COUNTY SURFACE WATER USE[a]	NEWBERRY COUNTY SURFACE WATER USE[a]	RICHLAND COUNTY SURFACE WATER USE[a]
Aquaculture	NR	NR	13.900
Golf Course	NR	10.000	341.138
Hydroelectric	3,025,896.060	NR	473,338.480
Industrial	NR	NR	10,263.504
Irrigation	NR	125.700	0.300
Mining	NR	NR	NR
Nuclear Power	246,543.778	NR	169,724.200
Water Supply	795.788	2,270.162	23,259.800
Other	NR	NR	NR
Total:	**3,273,235.626**	**2,405.862**	**676,941.322**

[a] Millions of gallons
NR=None recorded
Source: (SCDHEC 2004)

4.12.3 ALL DAMS AND DIVERSION STRUCTURES IN THE BASIN

The Lower Broad River basin has 108 dams, 9 of which are located on the Broad River. Seven of the dams are privately owned, and the remaining two are owned by public utility companies. Four of the dams are currently used for hydroelectric generation, four for recreation, and one for flood control (Table 4-29; USACE 2013).

TABLE 4-29: BROAD RIVER DAMS IN LOWER BROAD RIVER BASIN, SC.

DAM NAME	OWNER	TYPE	PURPOSE
Neal Shoals	South Carolina Electric & Gas Company	Public Utility	Hydroelectric
Lockhart	Lockhart Power Company	Private	Hydroelectric
Parr Shoals	South Carolina Electric & Gas Company	Public Utility	Hydroelectric
Ophelias	Wilcox, Edward	Private	Recreation
Ben Lippen School	Columbia International University	Private	Recreation
Shimmy S Pond	Shimmys Pond Inc	Private	Recreation
Cola International University Lower	Columbia International University	Private	Recreation
Broad River Trace	Broad River Trace LLC	Private	Flood Control
Lockhart west canal embankment	Lockhart Power Company	Private	Hydroelectric
Columbia diversion dam	City of Columbia – operated by Lockhart Power Company	Private	Hydroelectric

Source: USACE, 2013

4.12.4 Tributary Rivers and Streams

The Tyger and Enoree are the two major tributaries that join the Broad River in the lower Broad subbasin. The confluence of the Enoree River with the Broad River occurs within the Project Boundary, and the Tyger River joins the Broad River less than 4 miles north of the boundary. Minor tributaries joining the Broad River in this subbasin include Turkey Creek, approximately 32 miles north of the Project; the Sandy River, approximately 9 miles north of the Project; and the Little River, about 13 miles southeast of the Project (USGS 2014).

4.12.5 References

Natural Resources Conservation Service (NRCS). 2010. An Assessment of the Lower Broad Subbasin: hydrologic Unit Code (8 digit): 03050106.

South Carolina Department of Health and Environmental Control (SCDHEC). 2004. South Carolina Water Use Report. Technical Report No.004-05 Bureau of Water, Columbia, S.C.

South Carolina Department of Health and Environmental Control (SCDHEC). 2007. Watershed Water Quality Assessment: Broad River Basin. Technical Report No.006-07. Bureau of Water, Columbia, S.C.

South Carolina Energy & Gas Company (SCE&G). 2002. Land use and Shoreline Management Plan – Monticello and Parr Reservoirs. Effective April 1, 2002. SCE&G Lake Management.

U.S. Army Corps of Engineers (USACE). 2013. National Inventory of Dams. [Online] URL: http://geo.usace.army.mil/pgis/f?p=397:4:1473658987832501::NO. Accessed April 2, 2014.

U.S. Geological Survey (USGS), 2014. 200301, HYDROGL020 - U.S. National Atlas Water Feature Areas: aqueducts, canals, dams, intercoastal waterways, rivers, and streams: U.S. Geological Survey, Reston, VA.

5.0 PRELIMINARY ISSUES AND STUDIES LIST FOR EACH RESOURCE AREA [§ 5.6 (d)(4)]

To aid in the identification of issues that should be evaluated in this relicensing process, SCE&G has worked closely with state, federal and local resources agencies and NGOs to obtain existing information about resources at the Project and/or in the vicinity of the Project. Resource Conservation Groups (RCGs) and Technical Working Committees (TWCs) were formed as a way proactively to engage interested stakeholders prior to the start of the relicensing process and provide a forum for discussion of resource issues. SCE&G has hosted a series of meetings with the stakeholders not only to identify potential Project related issues, but also to develop draft study plans to gather more information on these issues and potential Project impacts. Notes from these RCG and TWC meetings are included in Appendix C. SCE&G used the information collected during these meetings to serve as a baseline in developing this PAD, to develop the initial list of issues, to identify potential information gaps, and ultimately to develop draft study plans. Discussion of these issues and brief descriptions of proposed studies intended to address each issue, are set out below.

This section of the PAD also discusses relevant qualifying federal and state or tribal comprehensive waterway plans.

5.1 ISSUES PERTAINING TO THE IDENTIFIED RESOURCES

This section identifies known or possible effects of Project operations. This includes potential effects from continuing operations as well as issues related to possible cumulative effects on the resources specified in section 4.0, including those identified through consultation with agencies and stakeholders.

5.1.1 GEOLOGY AND SOILS

The Parr Development is operated in a run-of-river mode. Fairfield Development is a pumped storage facility. Each will continue to be operated as such under the new license. Due to the pumped storage operations, some erosion has and will continue to occur in Parr and Monticello reservoirs. However, as the Project has been operating in this manner for approximately 40 years, many areas along the shoreline are experiencing slight to no active erosion. Nevertheless, some areas of each reservoir experience differing degrees of active shoreline erosion. SCE&G is aware of this and is addressing it through the implementation of a Shoreline Management Plan, as well as maintenance of rip-rap installation. Erosion issues will continue to be monitored through the bi-annual erosion studies at Monticello Reservoir and annual erosion studies at Parr Reservoir.

5.1.2 WATER RESOURCES

During early discussions with agencies, SCDNR indicated concern over the water quality in a specific area of the Broad River, immediately below the Parr Shoals Dam. The river immediately below Parr Shoals Dam is naturally divided by Hampton Island, creating two distinct channels, a west and an east channel. SCDNR is concerned that the west channel of the river does not receive flows sufficient to maintain state specified water quality standards, specifically dissolved oxygen standards. SCE&G has worked with SCDNR and other stakeholders to develop a study plan which will identify any issues pertaining to these concerns.

The Water Quality Report, which was completed by SCE&G and is comprised of data collected by SCDHEC, SCDNR, USGS and SCANA, indicated that water quality within the reservoirs is not adversely affected by Project operations. However, after further review of the Water Quality Report some stakeholders indicated a concern over the water quality data, specifically dissolved oxygen levels, collected at the USGS gage positioned immediately downstream of Parr Shoals Dam. SCE&G is examining the concerns of the stakeholders by reviewing additional data collected by USGS at various gages throughout the Project Vicinity.

5.1.3 FISH AND AQUATIC RESOURCES

At preliminary relicensing meetings, state and federal resource agencies and other stakeholders requested additional information regarding the impacts of daily reservoir fluctuations on littoral spawning for fish in Parr and Monticello reservoirs. Additionally, stakeholders indicated concern over the impacts of instream flows on the fisheries resources downstream of Parr Shoals Dam and the potential for entrainment and impingement at Parr Shoals Hydroelectric Facility and Fairfield Pumped Storage Facility. SCE&G is developing study plans in consultation with the interested stakeholders and intends to implement these studies in 2015 and 2016 to address these concerns.

5.1.4 WILDLIFE AND BOTANICAL RESOURCES

No adverse effects or issues related to terrestrial wildlife and botanical resources have been identified at this time and none are expected to occur due to continued Project operations. However, during initial meetings conducted prior to relicensing, SCDNR staff indicated the need for additional aerial survey data characterizing use of the Project Area by overwintering waterfowl. Through consultation with the Fisheries TWC, SCE&G developed a study plan to address this request.

5.1.5 RARE, THREATENED AND ENDANGERED RESOURCES

At this time, no specific issues or adverse impacts related to rare, threatened and endangered species have been identified. However, during preliminary relicensing discussion, consulting resource agencies and other stakeholder requested information regarding occurrence and distribute of rare, threatened and endangered species in the Project Vicinity to aid in identifying potential negative effects of continued Project operations. Stakeholders also requested a study of the Rocky Shoals Spider Lily downstream of Parr Shoals Dam and mussels in Monticello Reservoir. USFWS indicated a concern over the possible presence of the spiny crayfish within the Project Boundary. USFWS is also interested in determining any potential impacts on Georgia aster, yellow lampmussel and Roanoke slabshell. SCE&G has considered all of these requests and concerns and developed study plans, which will address these issues.

5.1.6 FLOODPLAINS, WETLANDS, RIPARIAN AND LITTORAL HABITAT RESOURCES

While no adverse impacts or issues are expected with regards to floodplains and wetlands within the Project Area, there is the potential for continued Project operations to impact littoral and riparian areas within the Project Boundary. Fluctuations in reservoir levels due to operation of the Project has caused some erosion and potential loss of aquatic habitat and stakeholders have indicated an interest in further examining the severity of the effects of these fluctuations on the shorelines of both Parr and Monticello reservoirs.

Additionally, while SCE&G currently has a Shoreline Management Plan in place for both reservoirs, updated SMPs will be created in consultation with federal, state and local agencies and NGOs to protect the littoral and riparian zones of Parr and Monticello reservoirs.

5.1.7 RECREATION AND LAND USE

Continued Project operation is not expected to affect the Project's land use and recreation opportunities adversely. However, a *Recreation Use and Needs Study* will be performed to assess the existing and future recreational use, opportunities, and needs for the Project.

In addition, as previously discussed, a consensus-based Shoreline Management Plan for Monticello and Parr reservoirs will be developed in consultation with interested stakeholders that identifies acceptable shoreline activities within the Project Boundary and offers guidelines to help ensure that such activities avoid or minimize environmental effects.

Also during early discussions with agencies and NGOs, a request was made for SCE&G to assess flows downstream of Parr Shoals Dam in the context of recreational experiences and to identify preferred flows, primarily as they relate to wade-angling, canoeing and kayaking. A request was also made for SCE&G to examine flows in the Broad River downstream of Parr Shoals Dam to determine whether navigation conditions below the Project satisfy state guidelines. SCE&G worked with interested stakeholders to develop study plans which will address these requests.

5.1.8 AESTHETIC RESOURCES

While the Project is mostly hidden from public view, roadways run parallel to the waterline and structures that support recreational and Project-related activities. No effects to aesthetic resources are expected from continued Project operations.

5.1.9 CULTURAL AND TRIBAL RESOURCES

Continued management and operation of the Project could affect historic properties near and around the Project Area due to Project-induced shoreline and riverbank erosion, the construction or upgrading of any Project-related recreational facilities, and continuing development along the shorelines. SCE&G will continue to consider historic properties with regards to Project operations and maintenance of Project lands as this will aid in identifying and protecting significant historic sites that lie along the shoreline and are affected by Project operations. As SCE&G is aware of the importance of protecting historic sites and has a proactive attitude in identifying and protecting these areas, it is unlikely that continued Project operations will cause any negative effects to historic properties located within the Project Boundary.

5.1.10 SOCIOECONOMIC RESOURCES

The Project has a somewhat limited socioeconomic influence over the immediate area and does not significantly contribute to business or industry in the area. Although the Project does not provide a large source of jobs, it does provide a source of renewable, low-cost energy, which benefits energy users. No adverse impacts associated with the socioeconomics in the surrounding areas are expected to occur through continued operation of the Project.

5.2 POTENTIAL STUDIES AND INFORMATION GATHERING REQUIREMENTS ASSOCIATED WITH THE IDENTIFIED ISSUES

The following sections identify initial information gathering and studies for each resource based upon the issues identified in Section 5.1. All draft study plans developed by SCE&G in collaboration with federal, state, and local agencies and NGOs are included in Appendix H. Stakeholder consultation and correspondence are included in Appendix C.

5.2.1 OPERATIONS

SCE&G developed the *Hydraulic and Project Operations Model Study Plan*, which outlines the process to complete Hydrologic and Hydraulic Project Operations Models. These models will be used to assess ability to provide potential changes to Project operations, and the resulting effects of potential modifications to operations of the project.

5.2.2 GEOLOGY AND SOILS

SCE&G believes adequate information exists to assess the effects of Project operations on geology and soils in the Project Vicinity. No studies associated with geology and soils are proposed at this time.

5.2.3 WATER RESOURCES

To address SCDNR's concerns of low dissolved oxygen levels in the west channel of the Broad River, immediately below Parr Shoals Dam, SCE&G has developed the *Water Quality in the Downstream West Channel Study Plan*. This study plan was designed to specifically monitor the dissolved oxygen levels in this area of the river and assess the quality of the aquatic habitat available to the variety of species who utilize this part of the river. No other study plans have been developed pertaining to water resources at this time.

5.2.4 Fish and Aquatic Resources

As mentioned, SCE&G has developed a *Reservoir Fluctuation Study Plan* to examine, among other things, the extent to which fluctuations related to Project operations affect available aquatic habitat along the shorelines of Parr and Monticello reservoirs.

SCE&G has also developed, in conjunction with federal and state agencies and NGOs, a *Desktop Fish Entrainment Study Plan*, which aims to assess the likely effects of Project-induced entrainment and impingement based on the physical characteristics of the Project.

The Fisheries TWC requested that the American eel (*Anguilla rostrata*) be studied to document the relative abundance of this species in the Broad River, directly downstream of Parr Shoals Dam. SCE&G developed the *American Eel* (*Anguilla rostrata*) *Abundance Study Plan* in response to this request.

Stakeholders also requested that an Instream Flow Incremental Methodology (IFIM) study be performed at the Project to determine the potential impact of Project operations on fishery resources and aquatic habitat. SCE&G developed the *Instream Flow Study Plan* in consultation with and with the concurrence of interested stakeholders.

5.2.5 Wildlife and Botanical Resources

Per the request of SCDNR, SCE&G has developed the *Monticello Reservoir and Parr Reservoir Waterfowl Survey Study Plan*. This study is designed to gain a better understanding of waterfowl utilization of Project waters, as well as evaluate potential Project effects on water level fluctuations on overwintering waterfowl utilizing Parr and Monticello reservoirs. Aside from this study, SCE&G believes that adequate information exists to characterize the wildlife and botanical resources within the Project Boundary. Therefore, no further studies are proposed.

5.2.6 Rare, Threatened and Endangered Resources

After examining existing data on the status of freshwater mussels in Project Area, the RT&E TWC determined that no such data were available for Monticello Reservoir; thus the *Monticello Reservoir Freshwater Mussel Reconnaissance Survey Study Plan* was developed.

At the request of the USFWS, SCE&G developed the *Broad River Spiny Crayfish (Cambarus spicatus) Study Plan*, to determine whether this species, a South Carolina species of special concern, is located within the Project Area or downstream of the Project in the Broad River.

During issues scoping, the RT&E TWC identified a South Carolina state species of concern, the Rocky Shoals Spider Lily (*Hymenocallis coronaria*) as occurring in the Broad River, downstream of the Parr Shoals Dam. TWC members request a survey to document the presence of this species in reaches downstream of the Project Area, and so SCE&G developed the *Rocky Shoals Spider Lily (Hymenocallis coronaria) Study Plan*.

SCE&G is also planning to conduct a literature-based study to compile existing information on federally and state listed RT&E species in the immediate Project Area, and developed the *Rare, Threatened and Endangered Species Study Plan* with input from the RT&E TWC.

5.2.7 Floodplains, Wetlands, Littoral and Riparian Resources

Stakeholders have indicated an interest in examining the effects of fluctuations on the shorelines of both Parr and Monticello reservoirs. In response to this concern, the Fisheries TWC developed the *Reservoir Fluctuation Study Plan*.

To continue to protect and manage the littoral and riparian zones of Parr and Monticello reservoirs, SCE&G will develop new SMPs in consultation with federal, state and local agencies and NGOs.

5.2.8 Recreation and Land Use

In order to assess existing recreational use, opportunities and needs at the Project accurately and thoroughly, SCE&G has developed a *Recreation Use and Needs Study Plan* in collaboration with interested stakeholders. The study is designed to provide information pertinent to the current and future availability and adequacy of SCE&G owned and managed recreation sites and specific informal recreation areas at Monticello Reservoir and Parr Reservoir.

Additionally, per the request of stakeholders involved in the Recreation TWC, SCE&G has developed the *Downstream Recreational Flow Assessment Study Plan* to assess whether flows downstream of Parr Shoals Dam provide adequate recreational opportunities. Similarly, at the request of the Recreation TWC, SCE&G has developed the *Downstream Navigational Flow*

Assessment Study Plan, with the objective of assessing flows within the Broad River necessary to facilitate one-way navigation, at identified points of constriction.

SCE&G will also be developing two SMPs, one for Parr Reservoir and one for Monticello Reservoir, to replace the current Land Use and Shoreline Management Plan for Monticello and Parr reservoirs, which was implemented in 2002.

5.2.9 AESTHETIC RESOURCES

SCE&G believes adequate information exists to assess the aesthetic effects of Project operations. No studies of aesthetic resources at the Project are proposed at this time.

5.2.10 CULTURAL AND TRIBAL RESOURCES

SCE&G hired S&ME to conduct a Phase I cultural resources investigation within the Project Boundary from August 13 to December 16, 2013. The investigation included 70 areas encompassing 3,375 acres identified as having high potential to include cultural resources. The *Phase I Cultural Resources Investigation* report (Appendix I) provides a description of the artifact findings. No other studies are proposed at this time to assess cultural and tribal resources at the Project. Additional consultation with SHPO, FERC and the Catawba Indian Nation is expected to occur during the relicensing process.

5.2.11 SOCIOECONOMIC RESOURCES

SCE&G believes that adequate information exists to assess the socioeconomic effects of the Project and Project operations. No studies relevant to socioeconomics are proposed for the relicensing effort at this time.

5.3 RELEVANT QUALIFYING FEDERAL AND STATE OR TRIBAL COMPREHENSIVE WATERWAY PLANS

Section 10(a) of the Federal Power Act (FPA), 16 U.S.C. § 803(a)(2)(A), requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. On April 27, 1988, FERC issued Order No. 481—A revising Order No. 481, issued October 26, 1987, establishing that FERC will accord FPA Section 10(a)(2)(A) comprehensive plan status to any Federal or state plan that:

- is a comprehensive study of one or more of the beneficial uses of a waterway or waterways;
- specifies the standards, the data, and the methodology used; and
- is filed with the Secretary of the Commission.

FERC currently lists comprehensive plans for the State of South Carolina and U.S. resources. Of these listed plans 20 are potentially relevant to the Project, as listed below in Table 5-1. These plans may be useful in the relicensing proceeding for characterizing desired conditions.

TABLE 5-1: LIST OF QUALIFYING FEDERAL AND STATE COMPREHENSIVE WATERWAY PLANS POTENTIALLY RELEVANT TO THE PROJECT

RESOURCE	COMPREHENSIVE PLAN
Botanical Resources	Forest Service. 2001. Sumter National Forest revised land and resource management plan. Department of Agriculture, Columbia, South Carolina. January 2004.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 1998. Amendment 1 to the Interstate Fishery Management Plan for Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). (Report No. 31). July 1998.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 1998. Interstate fishery management plan for Atlantic striped bass. (Report No. 34). January 1998.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 1999. Amendment 1 to the Interstate Fishery Management Plan for shad and river herring. (Report No. 35). April 1999.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 2000. Technical Addendum 1 to Amendment 1 of the Interstate Fishery Management Plan for shad and river herring. February 9, 2000.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 2009. Amendment 2 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. May 2009.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 2010. Amendment 3 to the Interstate Fishery Management Plan for shad and river herring, Arlington, Virginia. February 2010.
Fisheries Resources	Atlantic States Marine Fisheries Commission. 2000. Interstate Fishery Management Plan for American eel (*Anguilla rostrata*). (Report No. 36). April 2000.
Fisheries Resources	National Marine Fisheries Service. 1998. Final Recovery Plan for the shortnose sturgeon (*Acipenser brevirostrum*). Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. December 1998.
Fisheries Resources	South Carolina Water Resources Commission. 1985. Instream flow study – Phase I: identification and priority listing of streams in South Carolina for which minimum flow levels need to be established. Report No. 149. Columbia, South Carolina. June 1985.

RESOURCE	COMPREHENSIVE PLAN
Fisheries Resources	U.S. Fish and Wildlife Service, National Marine Fisheries Service, and South Carolina Department of Natural Resources. 2001. Santee-Cooper Basin diadromous fish passage restoration plan. Charleston, South Carolina. August 28, 2001.
Fisheries Resources	U.S. Fish and Wildlife Service. n.d. Fisheries USA: the recreational fisheries policy of the U.S. Fish and Wildlife Service. Washington, D.C.
Fisheries Resources	South Carolina Wildlife and Marine Resources Department. 1989. South Carolina instream flow studies: a status report. Columbia, South Carolina. June 1989.
Fisheries Resources	South Carolina Water Resources Commission. 1988. Instream flow study – Phase II: determination of minimum flow standards to protect instream uses in priority stream segments. Report No. 163. Columbia, South Carolina. May 1988.
Water Resources	South Carolina Department of Health and Environmental Control. 1989. Non-point source management program for the State of South Carolina. Columbia, South Carolina. April 1989.
Water Resources	South Carolina Department of Health and Environmental Control. 1989. Assessment of non-point source pollution for the State of South Carolina. Columbia, South Carolina. April 1989.
Water Resources	South Carolina Department of Natural Resources. 2004. South Carolina Water Plan-Second Edition. Columbia, South Carolina. January, 2004.
Water Resources	South Carolina Department of Health and Environmental Control. 1985. Water classifications and standards, and classified waters. Columbia, South Carolina. June 1985.
Water Resources	South Carolina Water Resources Commission. National Park Service. 1988. South Carolina Rivers Assessment. Columbia, South Carolina. September 1988.
Recreation	South Carolina Department of Parks, Recreation, & Tourism. 2008. South Carolina State Comprehensive Outdoor Recreation Plan (SCORP). Columbia, South Carolina. April 2008.
Recreation	National Park Service. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. 1993.
Recreation	South Carolina Department of Parks, Recreation, & Tourism. 2002. The South Carolina State Trails Plan. Columbia, South Carolina. 2002.
Wildlife Resources	South Carolina Department of Natural Resources. 2005. South Carolina comprehensive wildlife conservation strategy: 2005-2010. Columbia, South Carolina. September 2005.
Wildlife Resources	U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

5.3.1 REFERENCES

Federal Energy Regulatory Commission. 2013. List of Comprehensive Plans. December, 2013. [Online] URL: http://www.ferc.gov/industries/hydropower/gen-info/licensing/complan.pdf. Accessed April 25, 2014.

6.0 SUMMARY OF CONTACTS [§ 5.6 (d)(5)]

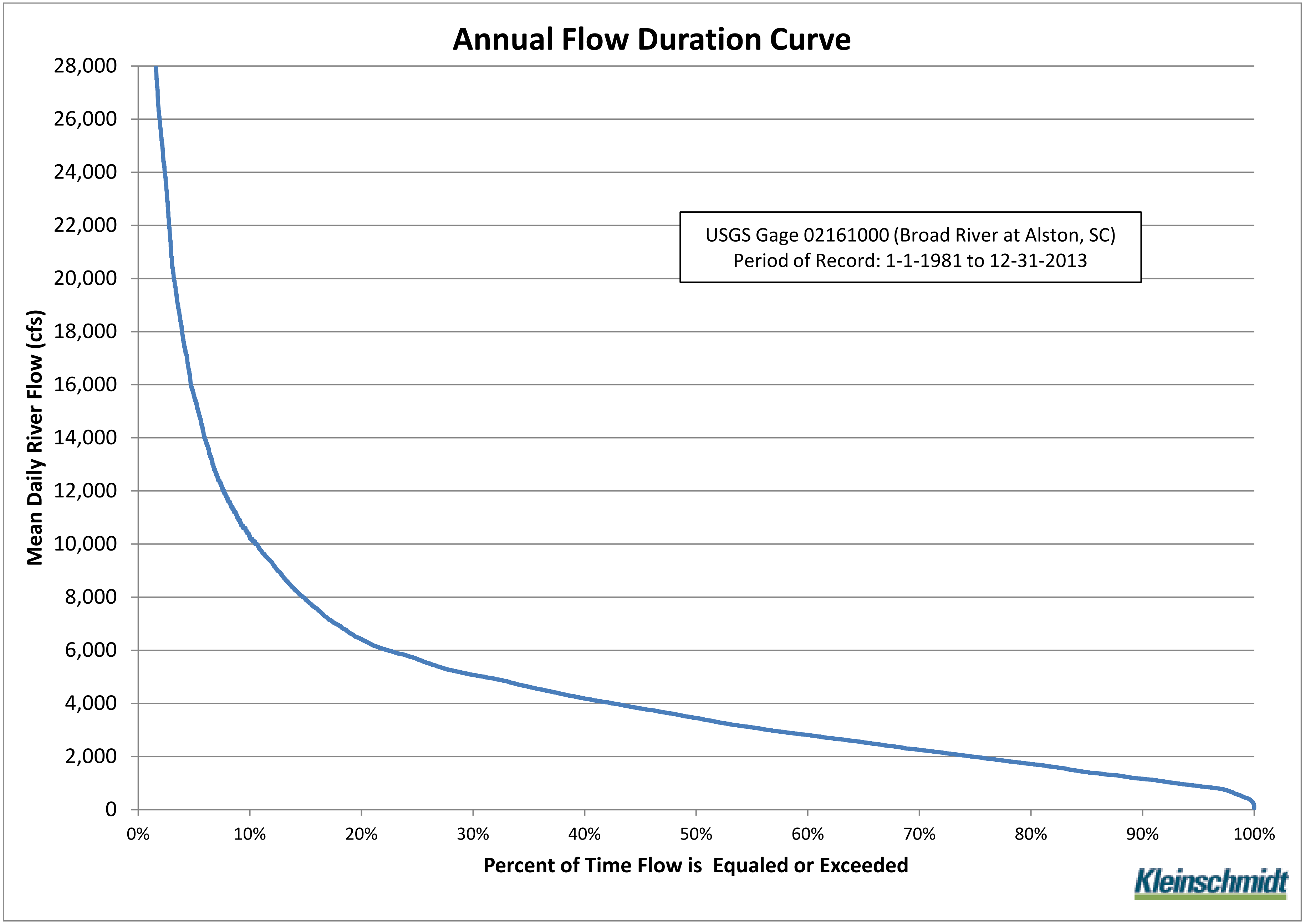
The Applicant has distributed this PAD and accompanying NOI simultaneously to FERC, federal and state resource agencies, local governments, Native American tribes, NGOs, and others potentially interested in the licensing proceeding. Appendix B details the distribution list for the PAD and NOI. This PAD appropriately references all information sources cited and Appendix C contains a record of contacts made with agencies and other organizations to date to obtain Project resource data and information.

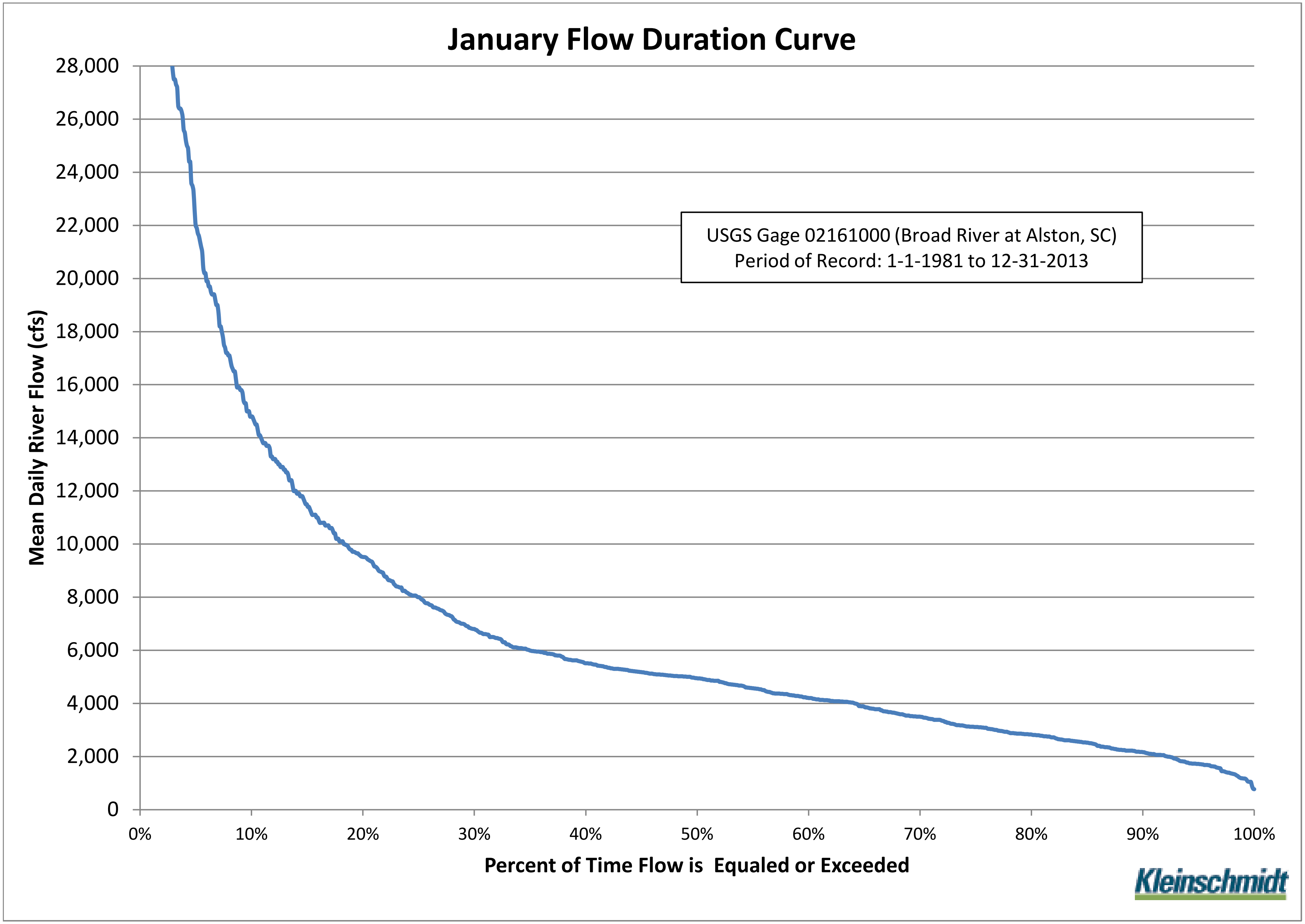
7.0 PURPA BENEFITS [§ 5.6 (e)]

The Applicant is not seeking PURPA benefits for the Project.

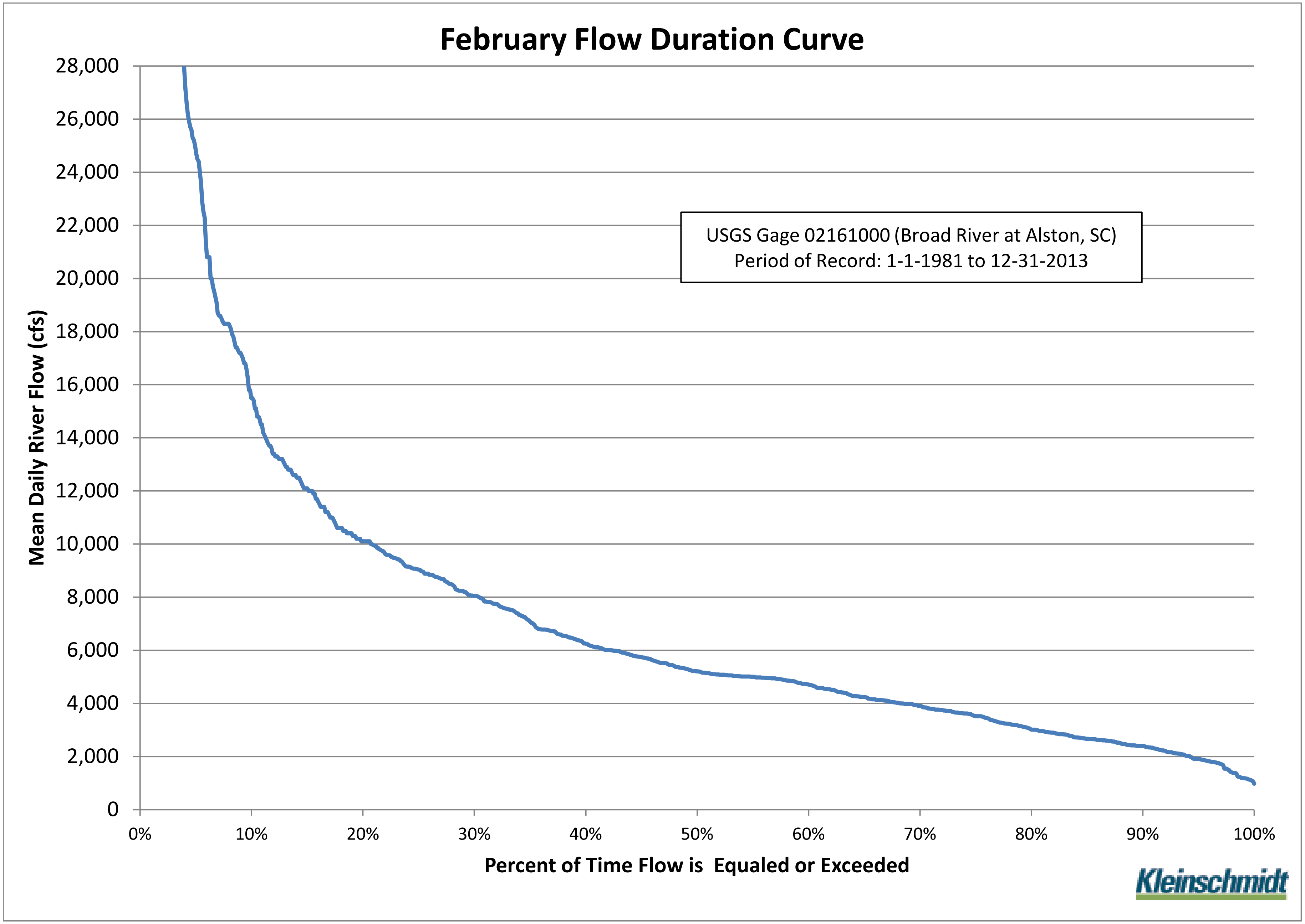
APPENDIX A

FLOW DURATION CURVES

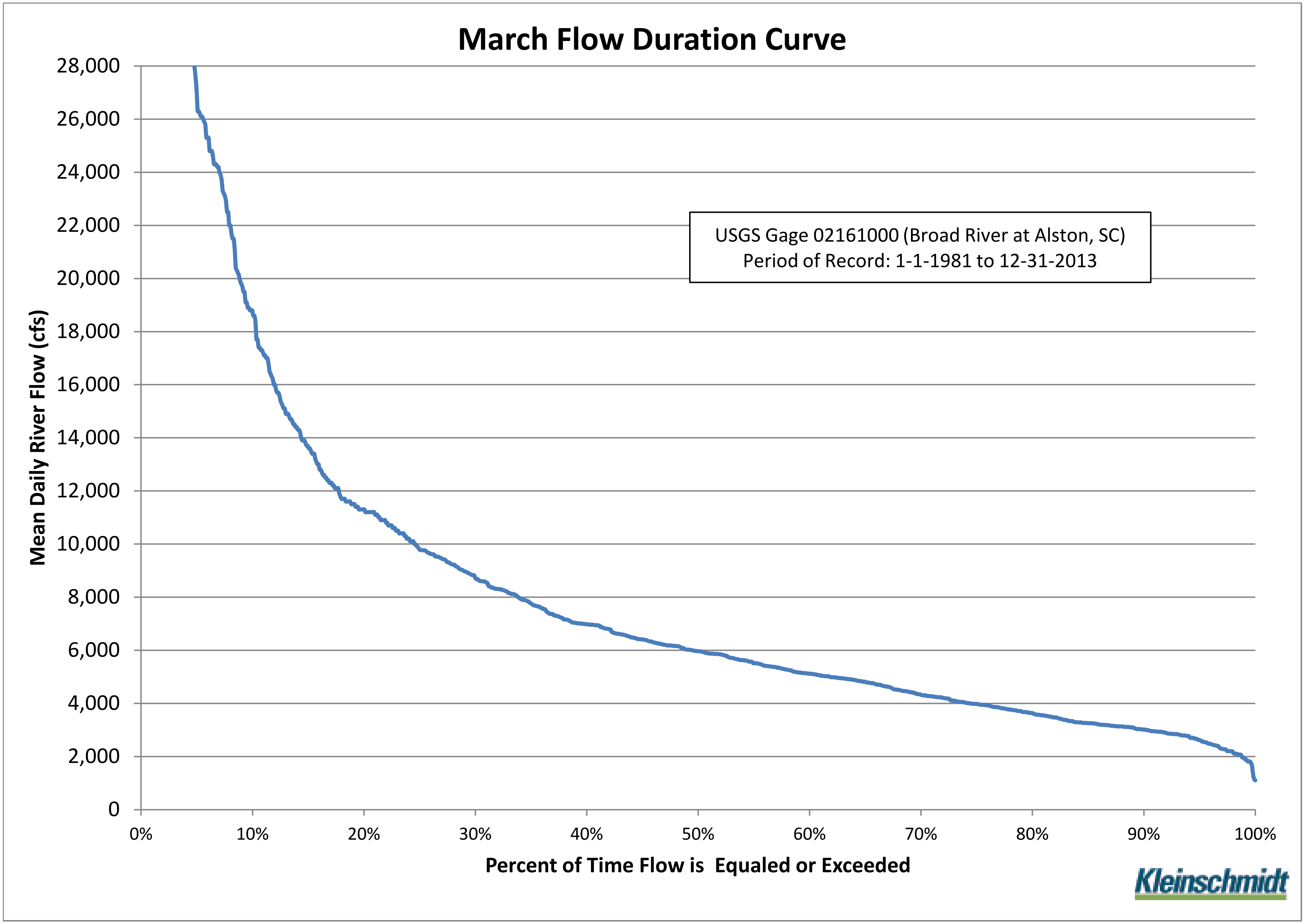

Annual Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow is Equaled or Exceeded
Kleinschmidt



January Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow is Equaled or Exceeded
Kleinschmidt



February Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Time Flow is Equaled or Exceeded
Kleinschmidt



March Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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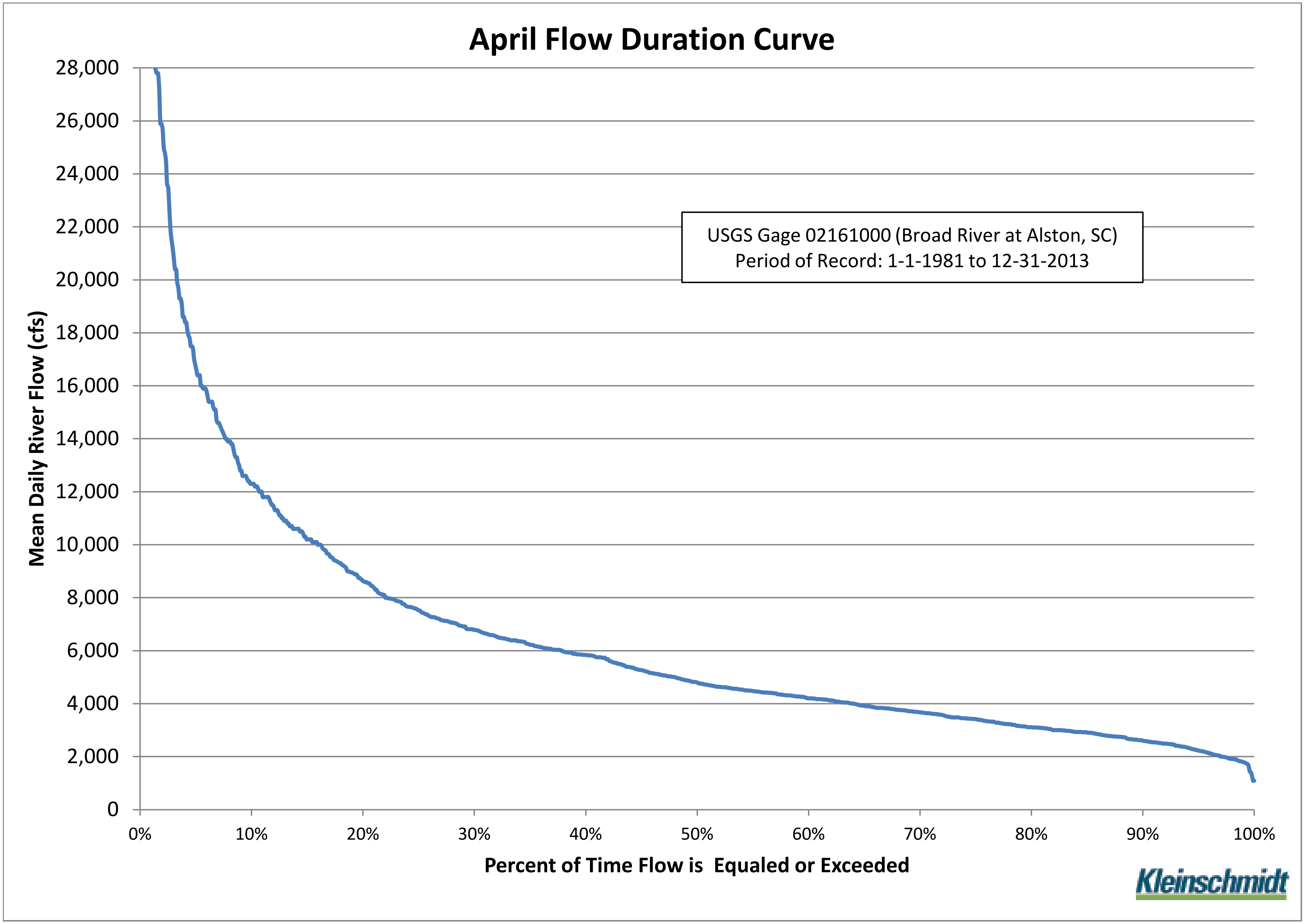
April Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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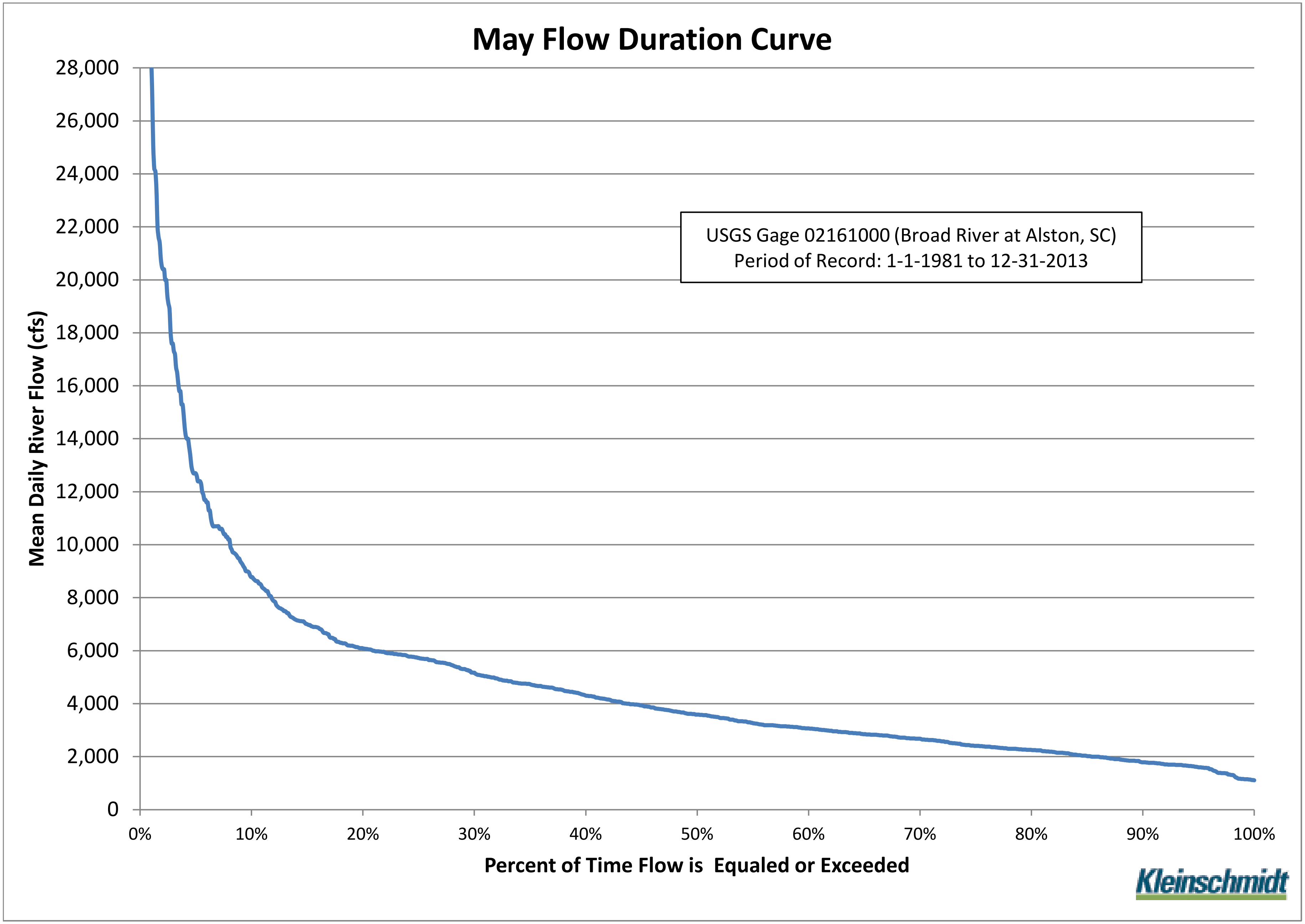

May Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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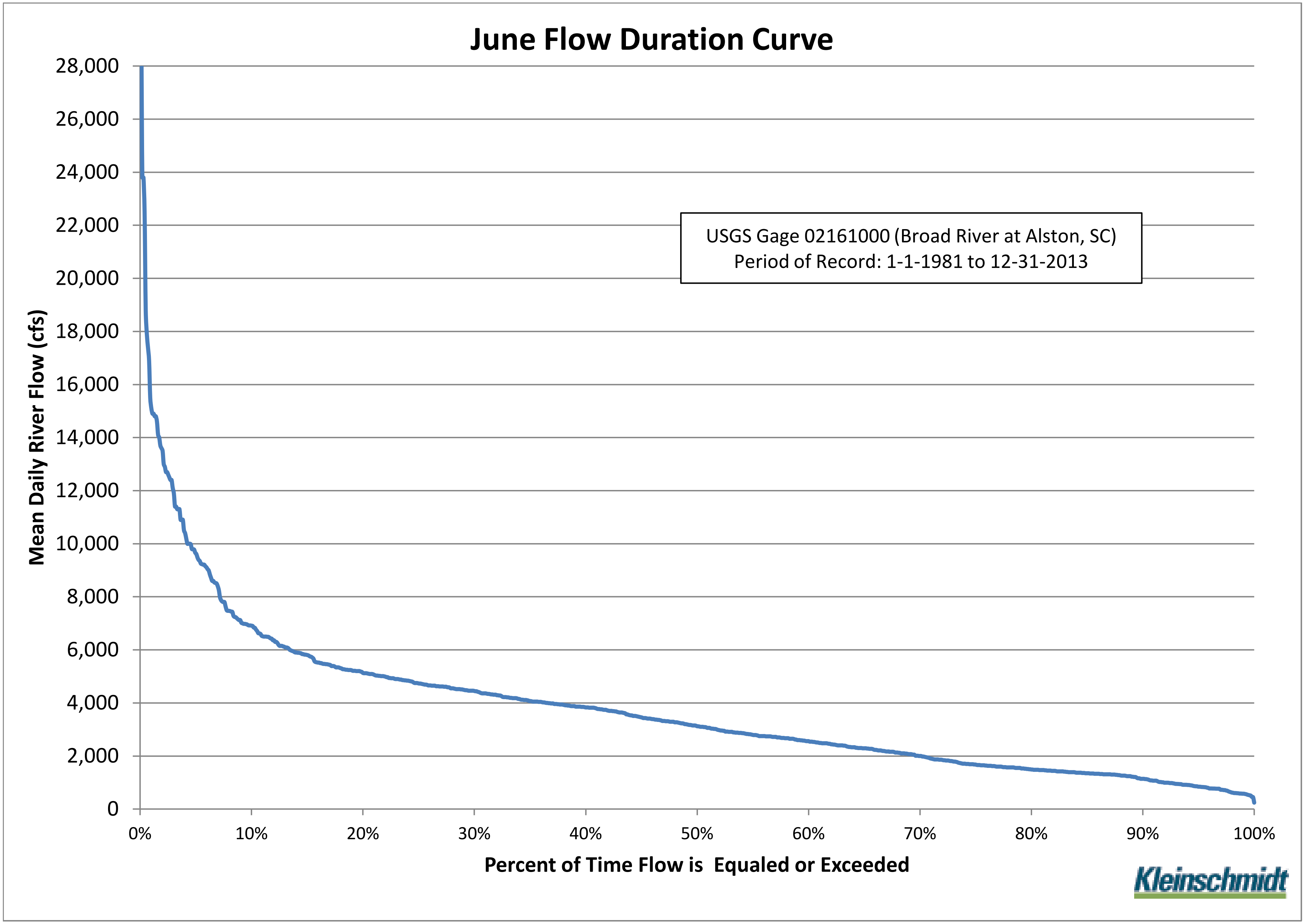
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Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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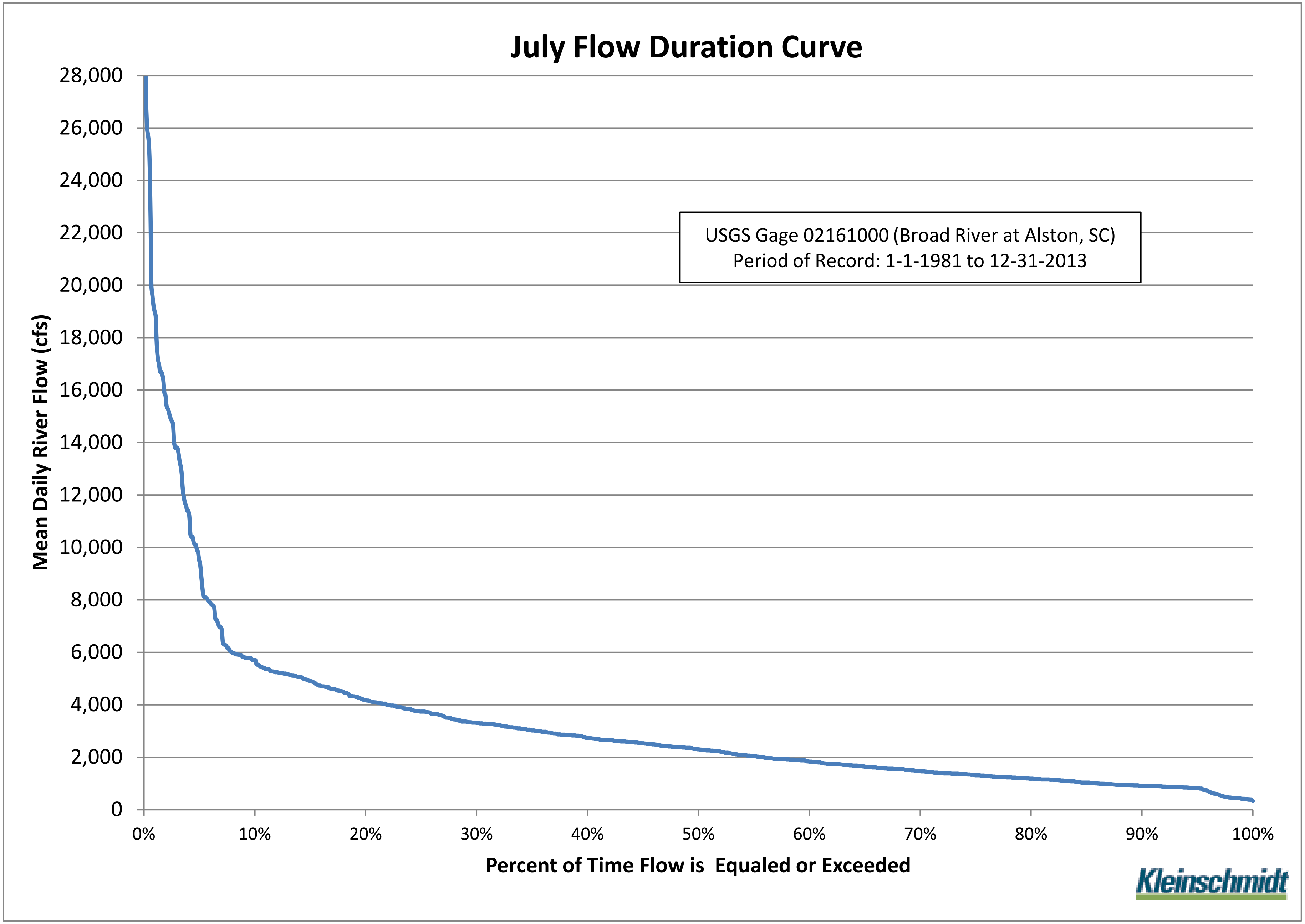
July Flow Duration Curve
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Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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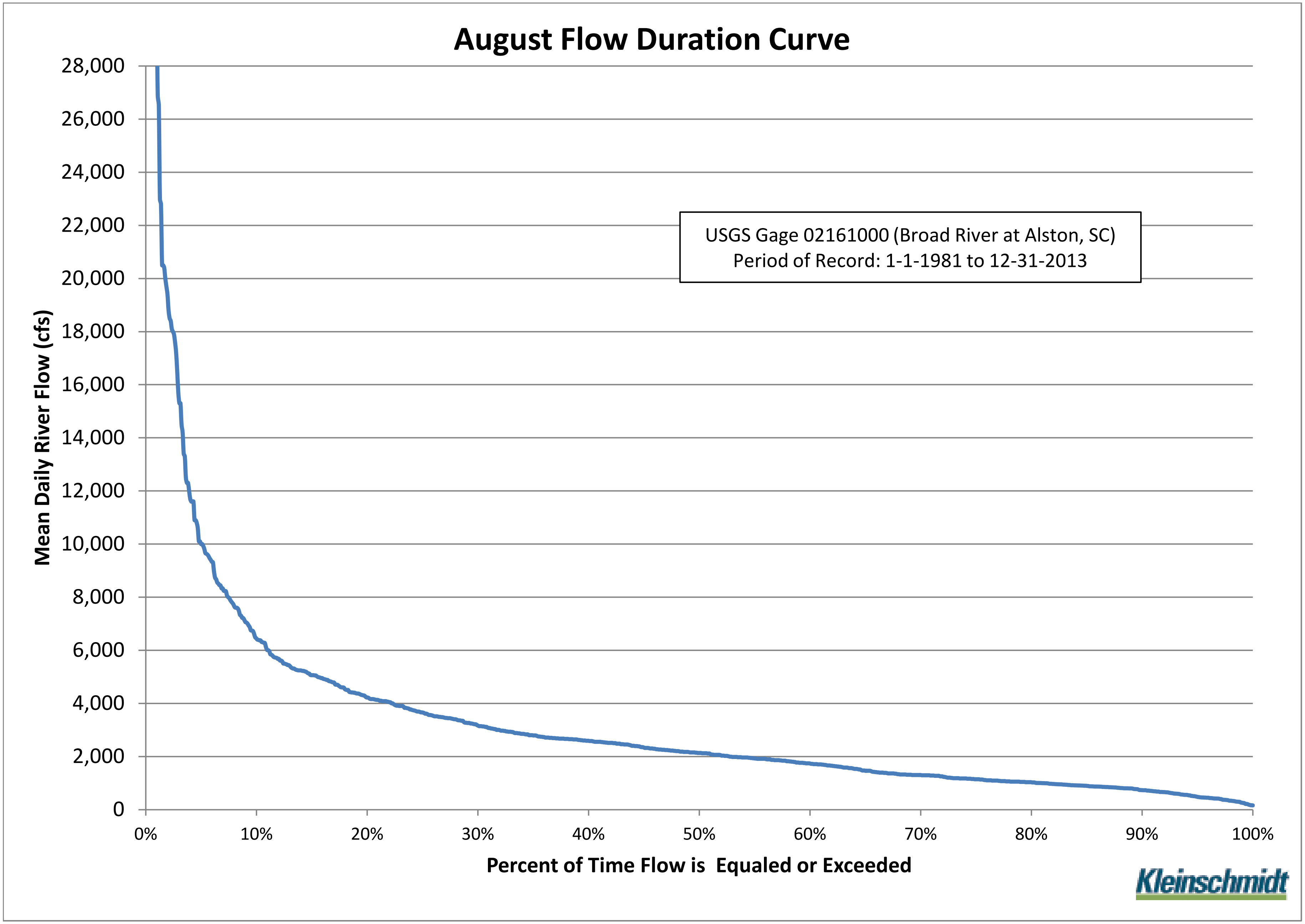
August Flow Duration Curve
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Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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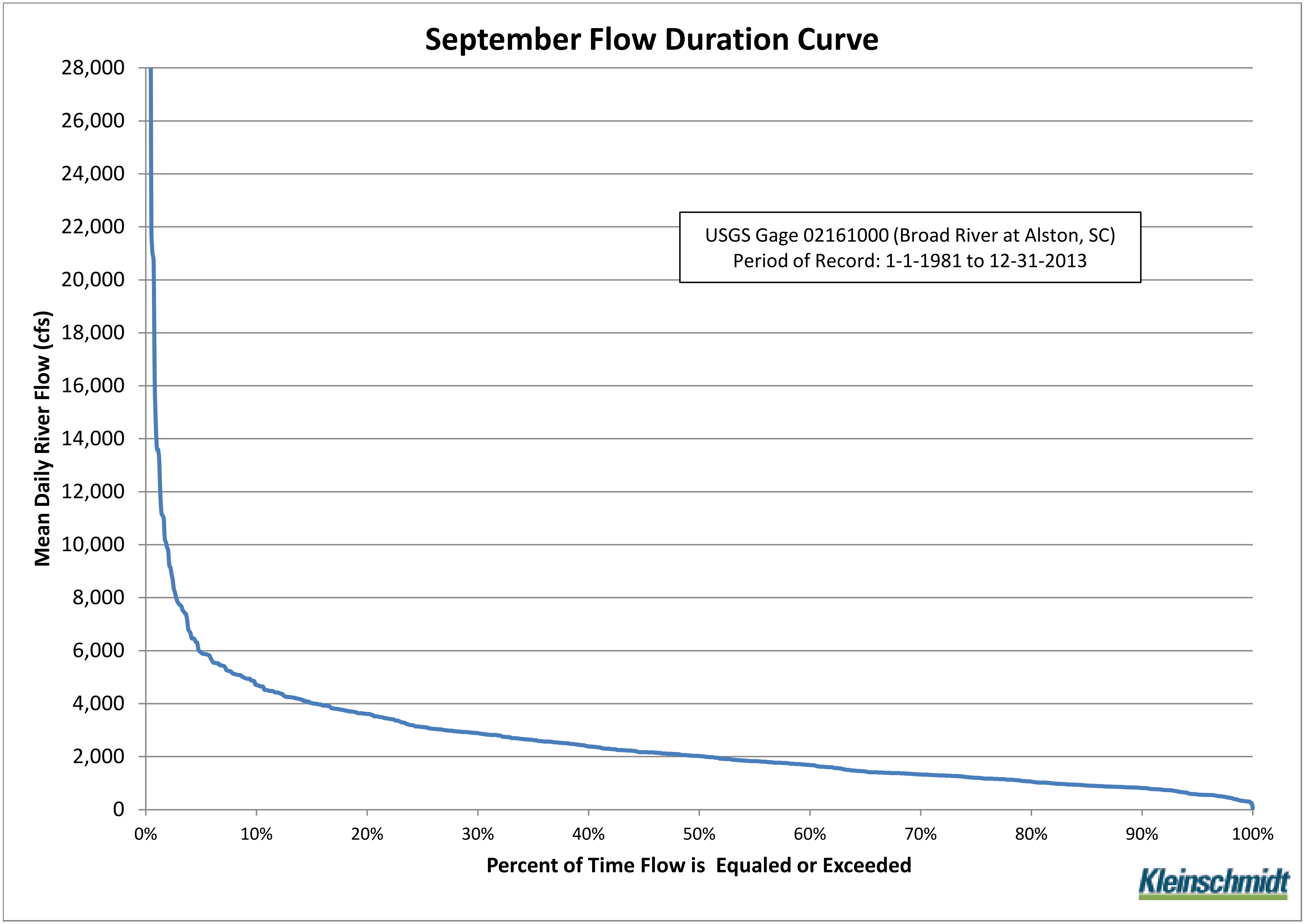

September Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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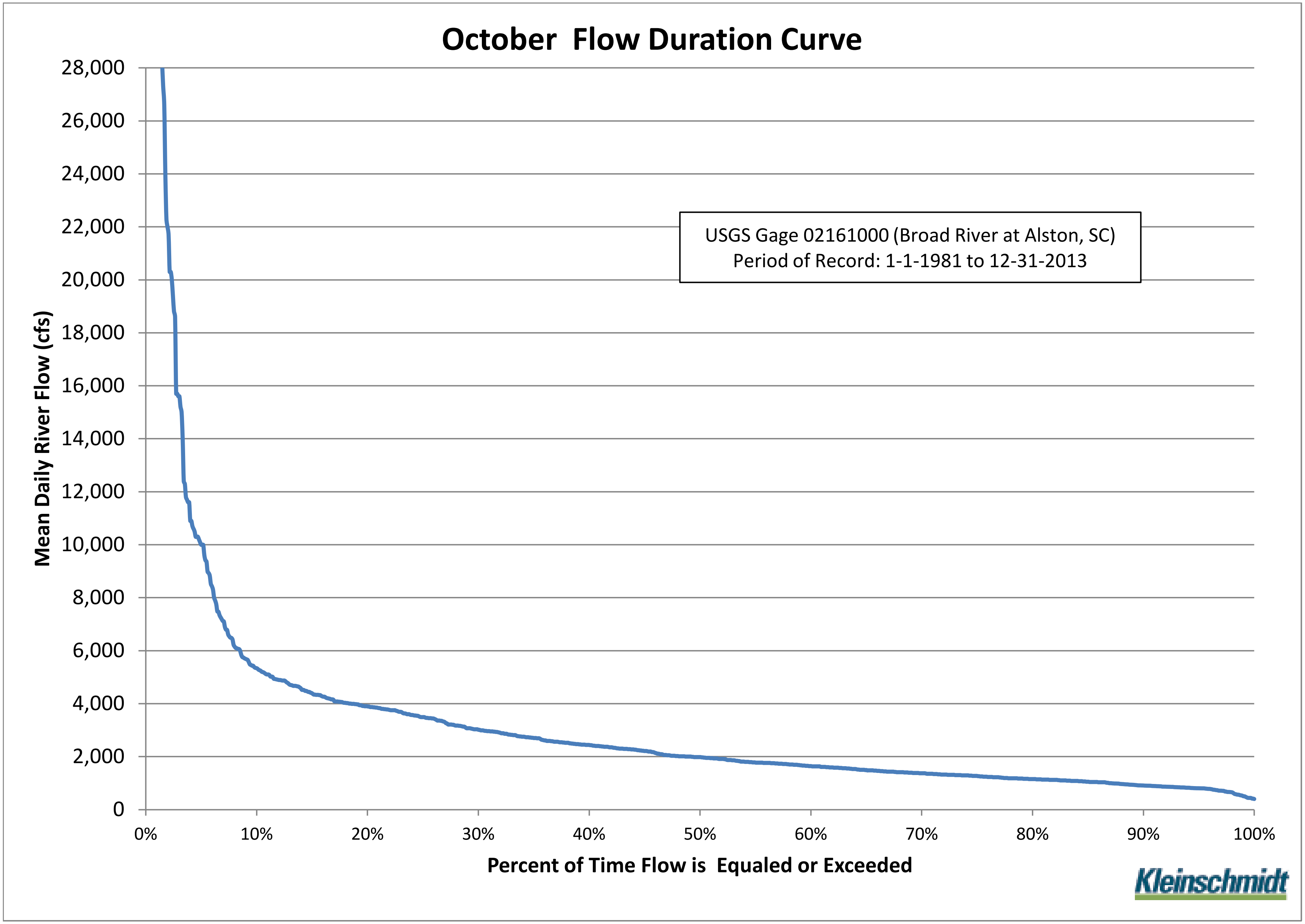
October Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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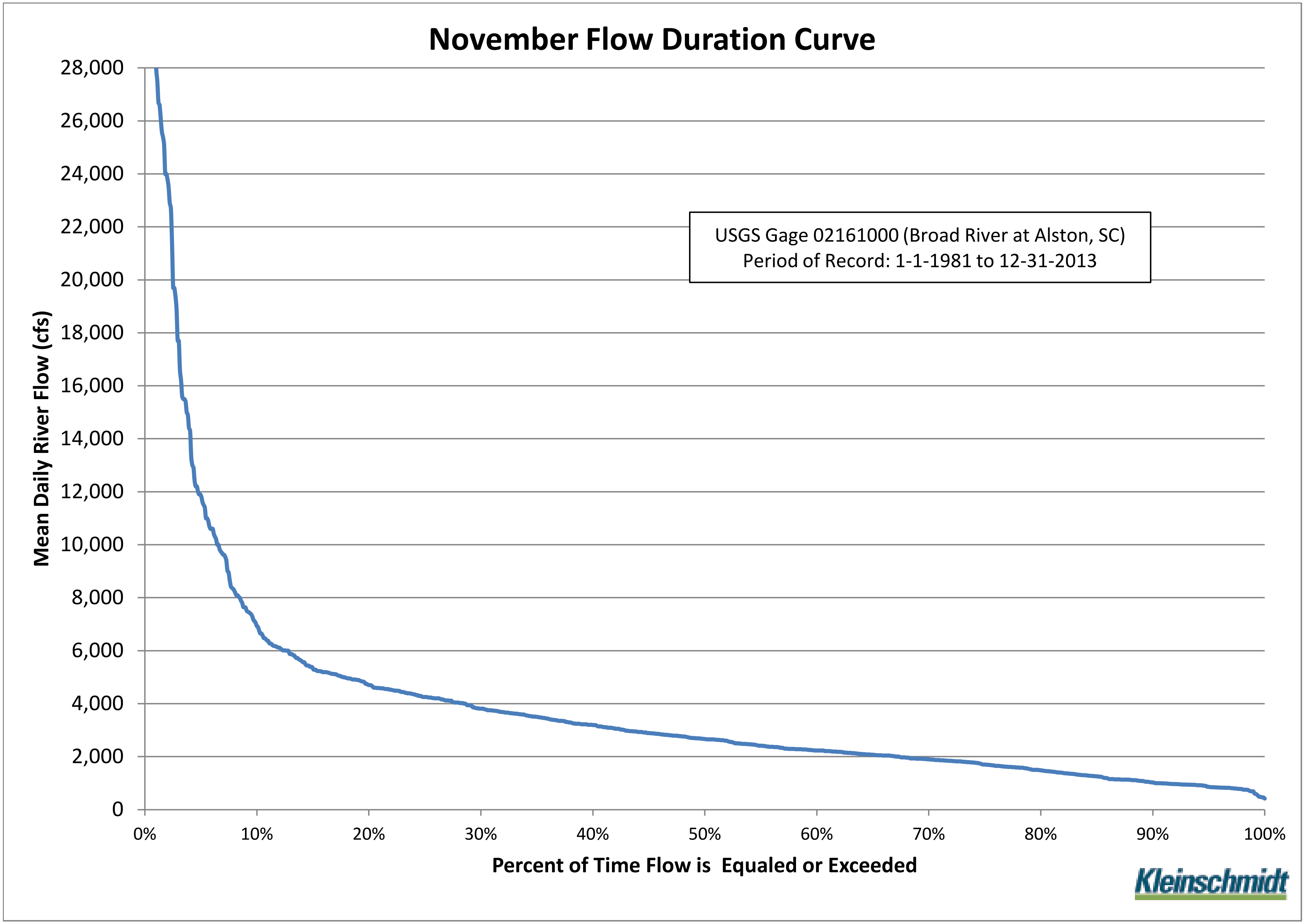
November Flow Duration Curve
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Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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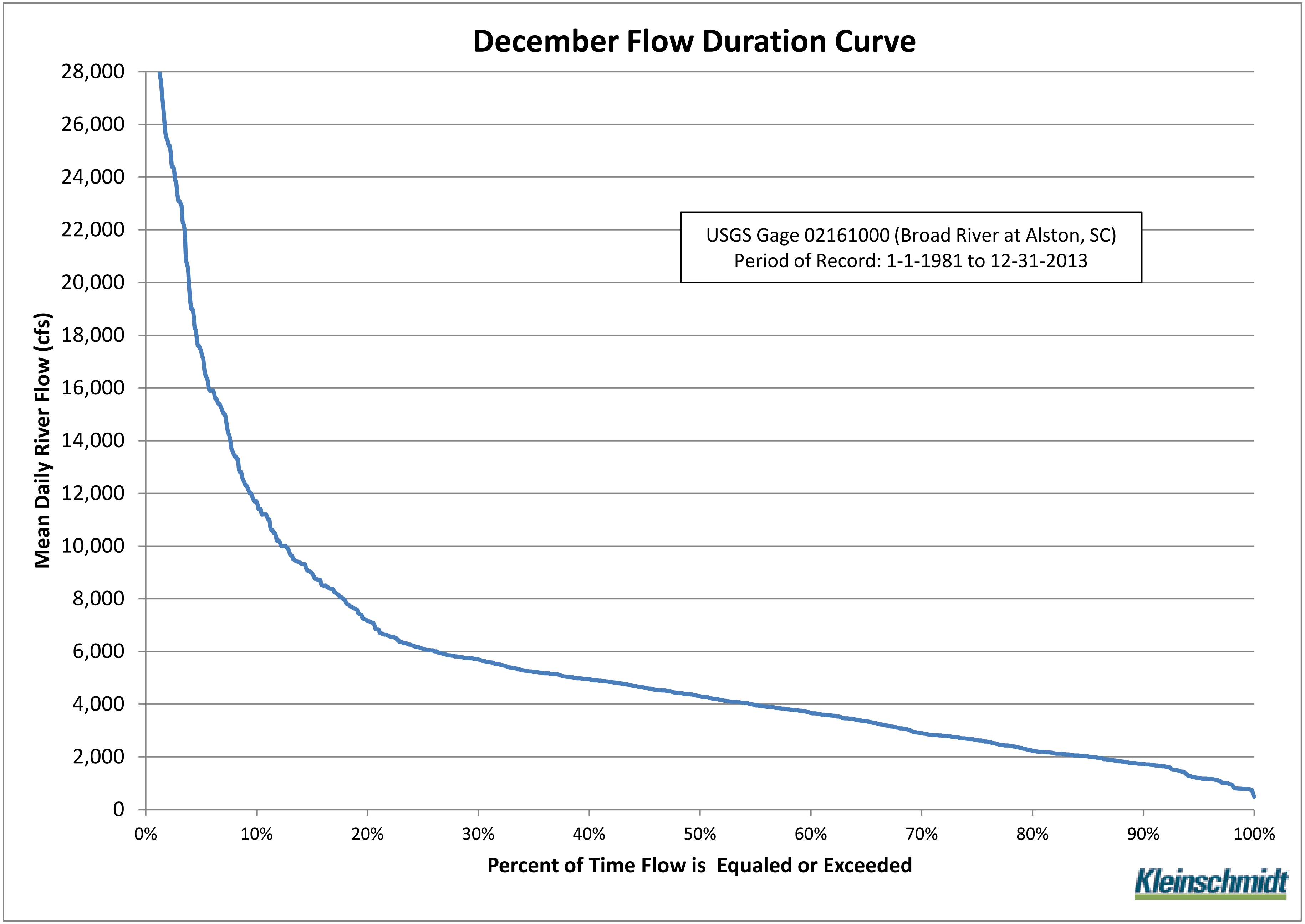
December Flow Duration Curve
USGS Gage 02161000 (Broad River at Alston, SC)
Period of Record: 1-1-1981 to 12-31-2013
Mean Daily River Flow (cfs)
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Percent of Time Flow is Equaled or Exceeded
Kleinschmidt

APPENDIX B

DISTRIBUTION LIST

Parr Distribution List
January 2015

Beth LeMaster
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Union, SC 29379

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Bill Stangler
Congaree Riverkeeper
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Columbia, SC 29250

Bob Perry
SCDNR
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Columbia, SC 29202

Byron Hamstead
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Chuck Hightower
SCDHEC
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David Eargle
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Columbia, SC 29201

Dick Christie
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Lancaster, SC 29720

Elizabeth Johnson
SCDAH
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Columbia, SC 29223

Erich Miarka
Gills Creek Watershed
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Dr. Frank Henning
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Hopkins, SC 29061

Fritz Rohde
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F/SER47
Beaufort, NC 28516

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Charleston, SC 29412

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Fantry Law/Town of Winnsboro
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Blythewood, SC 29016

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Parr Distribution List
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January 2015

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Public Service Commission of South Carolina
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Mayor Roger Gaddy, M.D.
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Winnsboro, SC 29180

Mayor Gregrey Ginyard
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Eastern States Office
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U.S. House of Representatives
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Washington, DC 20515

Kevin Marsh
SCANA
220 Operation Way
MC D302
Cayce, SC 29033-3701

Steven Byrne
SCE&G
220 Operation Way
MC D303
Cayce, SC 29033-3701

Parr Distribution List
January 2015

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Cayce, SC 29033-3701

William Argentieri
SCE&G
220 Operation Way
MC A221
Cayce, SC 29033-3701

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Winnsboro, SC 29180

Dr. Wenonah G. Haire
Catawba Indian Nation
Tribal Historic Preservation Office
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Rock Hill, SC 29730

Sandra Reinhardt
Catawba Indian Nation
Tribal Historic Preservation Office
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Rock Hill, SC 29730

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United Keetoowah Band of Cherokee Indians
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Robert Morgan
U.S. Forest Service
Sumter National Forest
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Huger, SC 29450

Emily Dale or Representative
SCDAH
8301 Parklane Road
Columbia, SC 29223

FERC Courtesy Copies:

Office of Energy Projects
Federal Energy Regulatory Commission
888 First Street, N.E.
OEP Room 61-02
Washington, DC 20426

Office of General Council
Federal Energy Regulatory Commission
888 First Street, N.E.
OGC-EP Room 101-56
Washington, DC 20426

APPENDIX C

STAKEHOLDER CONSULTATION AND CORRESPONDENCE

MEETING NOTES

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Parr Hydro Development and Fairfield Pumped Storage Development Relicensing
Agency/NGO Kick-off Meeting

September 19, 2012

Final KDM 10-3-12

ATTENDEES:

Steve Summer (SCANA)
Milton Quattlebaum (SCANA)
Charlene Coleman (American Whitewater)
Hal Beard (SCDNR)
Dick Christie (SCDNR)
Phil Gaines (SCPRT)
Chuck Hightower (SCDHEC)
David Hancock (SCE&G)
Mike Summer (SCE&G)
Terri Hogan (Congaree National Park NPS)
Gerrit Jobsis (American Rivers)
Rebecca Haynes (American Rivers)
Bill Stangler (Congaree Riverkeeper)
Rebekah Dobrasko (SHPO)
Mark Caldwell (USFWS)
Bill Marshall (SCDNR)
Randy Mahan (SCANA)
Tommy Boozer (SCE&G)
Amanda Hill (USFWS)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The meeting opens with introductions, followed by a presentation detailing information about the Parr and Fairfield projects by Bill Argentieri. Bill displays many pictures and maps of the projects so that the stakeholders can get an idea of where the projects are located and how the facilities are set up. He then describes each project in detail. As Alan suggested, this presentation was summarized into a project data sheet and is included at the end of these notes.

After Bill has completed the project overview, the group gets a chance to ask questions. Dick begins by asking if Lake Monticello is within the project boundary and whether there is a Shoreline Management Plan in place. Tommy tells him yes, Monticello is within the PBL and that a shoreline management plan was put into place in 2002. The sub-impoundment is also included in the PBL and SMP. It is stated that SCE&G has not sold property within the PBL down to the 425 feet high water mark on Monticello. Dick also asks where Parr Reservoir officially begins, which is at the southern end of Henderson Island on the Broad River.

Gerrit asks how the Fairfield units could be operated, if the two units on each penstock needed to be operated at the same time. Ray said that each unit could be operated independently. There is no need to operate the two units on the same penstock at the same time.

Gerrit asks the group if the PBL for Parr Shoals extends below the dam. The PBL does not go beyond the dam, although SCE&G may own property downstream of the project. Bill mentions that there are docks on Lake Monticello but none on the Parr Reservoir. However, both Parr and Monticello have public access.

Bill mentions to Rebekah that there are cultural resources that will need to be addressed, and that Stage 1 and Stage 2 analyses will be performed with a local archaeological firm.

Gerrit asks if 256' is the minimum height in which they can operate the Fairfield project, considering the pumped storage set up, or if there is more operational flexibility. Ray explains that there is no more flexibility because silt entrainment issues arise when the pool gets too low. Ray also states that these projects are operated based on a generation schedule and that everything depends on the time of year and the load mix. The question is raised concerning whether or not there is a sediment management plan in place at the Parr project, or if there is any type of sediment management currently ongoing, including the use of sand gates. Ray answers that there are no sand gates and no penstocks at Parr. He explains how the project is set up, where water passes right through the powerhouse with only a trash gate in place. He mentions how there is a new drag rake that helps with sediment, by scooping out the sediment and trash and depositing it into a bin to be hauled off and disposed of elsewhere. Ray does say that he has not heard of there being a big sediment issue at Parr.

Dick brings up the issue of maintaining instream flow minimums, which SCE&G employees admit has been difficult, especially with the instantaneous readings versus daily average readings.

Hal and Amanda asked what the allowed amount of phosphorus in the water is to still be able to pass water quality standards. With the building of the new nuclear stations, that level may have been changed, or restated to consider higher evaporation rates. Chuck couldn't find much information about that during the meeting, but said he would follow up and let the group know.

Alan wrapped up this question and answer session by jumping into the next item on the agenda, an overview of the licensing process. He explained that our goal is the use an enhanced traditional licensing process, which has to be requested when the NOI and PAD are filed. If FERC rejects the request, we will have to use the integrated licensing process, which is very strict on timelines and deadlines. Alan mentions that the enhanced TLP would be a more laid back process for SCE&G and the agencies and NGOs, and that letters from the agencies and NGOs to FERC agreeing to use this process would help in getting it approved. Gerrit asks for details on the enhanced TLP so that the stakeholders can feel comfortable concurring with the use of this process. Alan also tells the group that FERC has decided that the PAD now has to include study plans, and so we want to go ahead and set up our resource conservation groups to get things started and organized. Alan explains a little about the RCGs and preliminary sign-up sheets are circulated around the room. Bill adds that he is planning on having the RCG meetings and technical working committee (TWC) meetings at the Lake Murray Training Center, since it is a fairly central location for everyone involved.

Alan also goes over a few things that are planned for the next 6 months, including the issue identification workshops with the public which are planned for late January, or early February. There is also a float trip planned for late March or early April 2013, which will involve a 2-3 day paddling excursion over 30 miles of the Broad River, to view some of the project area. Steve Summer brought up the idea of also doing a motorized tour of Parr Reservoir and Lake Monticello.

Again, the floor is opened up to everyone for questions and comments. Amanda asks if the agencies and NGOs can be provided with more information on the projects so that they know what types of questions to ask in the future. She specifically asks for a presentation on current operations. It is decided that there will be a meeting that includes presentations on specific information that the agencies and NGOs want, and that the agencies and NGOs must submit their questions and requests for information by Friday, October 19, 2012. A meeting will be set up in November to address these items.

Ray Ammarell has drawn up a short document detailing the standard project numbers, and it has been included at the end of these minutes. Alan asks if anyone has any reports or information that we have not already collected to send it in so it can be included in the PAD.

A few closing questions were asked. Dick asked about the sediment again, and Ray explains that while the sediment at Parr moves around, it doesn't seem like there has been as much accumulation in the last 40 years as there was earlier on in the life of the project (the Parr Shoals Dam was built in 1914). He explains his theory that the sediment accumulation has reached its equilibrium and whatever sediment is entering the dam is flowing right through. This hasn't affected operations except at Fairfield PS while pumping to Monticello Reservoir during low flows.

Amanda asked about a bathymetry study and Steve says he will get the study that was done for Parr.

Hal asked if there is any connection between the waterfowl impoundment and Parr reservoir. It is determined that there are flap gates that allow for water to come in to the impoundment but not back out to Parr.

These final questions wrapped up the meeting. The next gathering will be sometime in November where SCE&G employees will present information requested by the agencies and NGOs.

Parr Hydroelectric Project

Parr Hydro Development

&

Fairfield Pumped Storage Facility Development

FERC Project No. 1894
Project Data Sheet
September 19, 2012

Parr Hydroelectric Plant
General

- Parr Dam concrete gravity spillway, 37’ high, 2000’ long
- Earthen embankment on west end
- The concrete overflow section (wing wall) on west end approx. 35’ high
- (10) bottom hinged bascule crest gates, each 200’ long and 9’ high
    - Added 1974-1977
- Powerhouse: Steel-framed brick building, containing six vertical turbines with generators
- Non-overflow section on the east end
- Hydraulic crest gates can spill excess inflow

Parr Hydro Plant

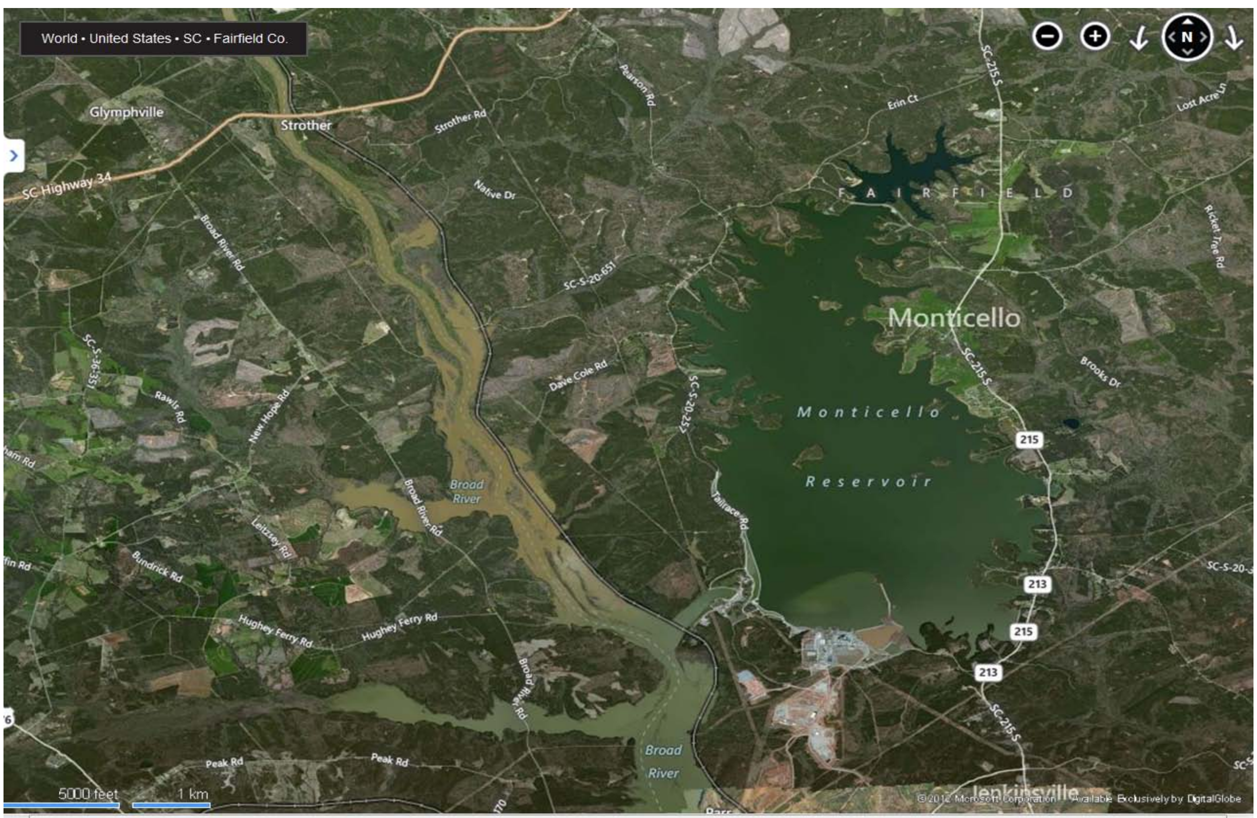
Kleinschmidt

Fairfield Pumped Storage Facility

General

- Four earthen dams (A, B, C, and D)
- Earthen Dam Construction:
    - Random fill shells (u/s and d/s)
    - Central impervious core
    - Upstream impervious blanket
- Riprap slope protection on upstream slopes
- Downstream slopes are grassed
- Dam B: main dam across Frees Creek
- Intake structure for plant integrated into abutment of Dam B
- Four steel penstocks lead from the intake structure to the powerhouse

Fairfield Pumped Storage Facility



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Parr Hydroelectric Project Operations

Parr Development

- Primarily used for base load
- Licensed capacity 14.9 MW; hydraulic capacity ~6,000 cfs (6 units)
- Parr Hydro operates in modified run-of-river mode
- March – May: 1,000 cfs minimum flow, or average daily natural inflow to Parr Reservoir (less evaporative loss from Parr and Monticello Reservoirs).
- Remainder of year: 800 cfs daily average flow and 150 cfs minimum flow, or average daily natural inflow (less evaporative loss from Parr and Monticello Reservoirs)
- This means that when inflow minus evaporation falls below 800 cfs (1,000 cfs March-May), we do not get to keep any water – what comes in must go out.

Parr Hydro Inflow

- Inflow to Parr Reservoir is the sum of flows at 3 USGS gage sites:
  - Broad River near Carlisle (02156500, 5 miles below Neal Shoals)
  - Tyger River near Delta (02160105)
  - Enoree River at Whitmore (02160700
- New USGS gage installed at Hwy. 34 bridge on Parr Reservoir
  - Broad River at Blair, SC (02160750)

Parr Hydro Evaporation

- Evaporation is estimated based on SC State Climatologist Office data, and surface areas of Parr and Monticello Reservoirs.
- Increased evaporation from VCSNS was provided by plant staff.

Fairfield Development

- Primarily used for peaking, reserve generation when Saluda not available, and off-peak power usage (pumping to store water for generation)
- Fairfield Pumped Storage licensed capacity 511.2 MW; hydraulic capacity 50,400 cfs generating & 41,800 cfs pumping (8 units).
- Operate project so that "releases from lower reservoir during flood flows shall be no greater than flows which would have occurred in the absence of the project."
- Based on USGS flood study from 1970s, Fairfield should stop generating and Parr's crest gates should be completely lowered when Broad River flow reaches 40,000 cfs.
  - Measured by adding discharge from 3 USGS gages upstream of Parr Reservoir.

Parr Hydroelectric Project Hydrologic Data

Parr Reservoir (Full)

- 4,400 acres
- 13 miles long
- Storage capacity directly affected by FFPS Ops
- Total storage at full pool – 32,000 acre-feet
- Active storage – 29,000 acre-feet in 10’ operating range
- Reservoir Range – 256’- 266’ (top of crest gates)
- Drainage area – 4,750 sq. miles
- 31 river miles downstream of Neal Shoals
- 24 river miles upstream of Columbia diversion dam

Monticello Reservoir (Full)

- 6,800 acres
- Total volume of water available approx. 9.5 billion gallons of water (29,000 acre-feet)
- Affects Fairfield Pumped Storage Facility only
- Total storage at full pool – 400,000 acre-feet
- Active storage – 29,000 acre-feet in 4.5’ operating range
- Reservoir range – 420.5’- 425’
- Drainage area – 9,400 sq. miles

Safety

- Sirens at plant activate when Parr Crest Gates lower to release water into the Broad River.
- Both Developments have Emergency Action Plans to notify the public if a dam failure is imminent or has occurred.
- Both developments have Public Safety Plans to identify where watering signs are located.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Parr Hydro Development and Fairfield Pumped Storage Development Relicensing Informational Meeting

December 4, 2012

final KDM 12-27-12

ATTENDEES:

Steve Summer (SCANA)
Milton Quattlebaum (SCANA)
Frank Henning (Congaree National Park NPS)
Hal Beard (SCDNR)
Dick Christie (SCDNR)
Phil Gaines (SCPRT)
Robert Stroud (SCDNR)
David Hancock (SCE&G)
Beth LeMaster (US Forest Service)
Malcolm Leaphart (Congaree Riverkeeper)
Ron Ahle (SCDNR)
Rebecca Haynes (American Rivers)
Tom McCoy (USFWS)
Bill Stangler (Congaree Riverkeeper)
Rusty Wenerick (SCDHEC)
Prescott Brownell (NOAA)
Bill Marshall (SCDNR)
Jon Sherer (City of Columbia)
Randy Mahan (SCANA)
Tommy Boozer (SCE&G)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Tom Hanzlik (SCE&G)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Alison Jakupca (Kleinschmidt)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting by welcoming everyone and asking them to sign the attendance sheet. He then turns the meeting over to Bill, who begins with an overview presentation of the Parr Project. Bill shows several detailed images of the Project, which includes Parr Hydro and Fairfield Pumped Storage, and the project boundary line. Ron asks if any area downstream of the dam is included in the PBL and Bill's answer was no, the project ends at the Parr dam. Above the dam, the PBL ends at Henderson Island and around Cannon's Creek at Highway 176 and Heller's Creek, about three-quarters of a mile below Highway 34.

Bill then turns the meeting over to Ray, who directs the presentation towards hydraulic conditions at the Project. Historically, Parr dam was a run of river dam, with no flashboards or gates until 1976 when gates were added for the construction of Fairfield Pumped Storage. Now the dam provides limited regulation of flows, less than 40,000 cfs. There is limited storage available in the Parr Reservoir, approximately 29,000 acre-feet. A USGS gage is located about one mile downstream of the dam at Alston, and states that the discharges at the gage are regulated by low to medium flows due to the power plants above the station. Parr Hydro passes instream flow in the Broad River up to 6,000 cfs. The level of daily fluctuation at Parr reservoir is usually around 8 feet, with a maximum of 10 feet, and depends on what time of year it is.

In 1976, ten bascule gates were added to the Parr dam. Each gate is 200 feet long and 9 feet tall, and they are operated in pairs. The 29,000 acre-feet of active storage in the Parr Reservoir, with a ten foot drawdown, is exchanged with the Monticello Reservoir via the Fairfield Pumped Storage Facility. With all six units operating, Parr Hydro can pass up to 6,000 cfs. Parr usually operates continuously to pass the normal Broad River flow, and doesn't increase generation just because Fairfield is operating. Instead that water is stored for later use. Fairfield Pumped Storage operates in a peaking mode, meaning it is operated as a quick option to provide energy during peak usage times of the day.

Article 39 of the current Project license defines flood flows as those exceeding 40,000 cfs, or those that flood South Carolina Highway 28 in Peak, SC. During floods, the Project needs to manage the Parr Reservoir backwater and keep levels from impacting upstream railroad tracks. During high flows, or when natural flows exceed 40,000 cfs, Parr Hydro passes what it can through the powerhouse and spills the remainder. Article 14 focuses on low flows at the Project. There must be an instantaneous minimum flow of 150 cfs and a daily average minimum of 800 cfs or inflow whichever is less. During the months of March, April and May there must be a minimum instantaneous flow of 1000 cfs.

There are three USGS gages in the area to monitor these flows. When the evaporation level, as calculated by the SC State Climatologist, is subtracted from the sum of the three gages, and the flow is less than 800 cfs (or 1000 cfs during March through May), Parr is operated to pass the required flow. During low flows, when there is no excess inflow to supplement the losses from the two reservoirs, the impact on the FFPS operation is less megawatt hours available. Hal makes the point that the reason the minimum flow is raised to 1000 cfs during the months of March, April and May is because that is the time of the striped bass spawning. Ron asks the question, when the Broad River is around 800-900 cfs, how does that low flow affect the pumped storage? Ray explains that the Project is a peaking operation, so it only uses the water from Lake Monticello to spin the turbines as it flows down to the Parr Reservoir.

Malcolm questioned the structural integrity of the crest gates, as they were built in 1976. Ray explains that the gates were in good condition and the dam has rock anchors that tie it down, providing a strong hold. He also states that independent safety inspectors are hired every five years to inspect the dam, along with regular FERC inspections and internal inspections. He assures the group that the dam is in very good condition.

Ray then turns the meeting over to Tommy, who spends some time talking about recreation on the lakes, and the shoreline management plan. He tells the group that there are 384 acres set aside for recreation around the Project. Lake Monticello has a surface area of 6,700 acres, 54 shoreline miles and 21.6 miles of shoreline available for docks. There are 300 surface acres at the recreation lake, with 10.2 shoreline miles. No docks are allowed on the recreation lake. The Parr Reservoir has a surface area of 4,400 acres and 94 shoreline miles. Lake Monticello has boat ramps at Highway 215 and Highway 99. The lake also has about 50 acres of islands. Parr Reservoir has a boat ramp on Cannon's Creek and Heller's Creek. There is also a primitive boat ramp at Highway 34.Terrible Creek has 638 acres set aside as a waterfowl hunting area and Enoree River has another 191 acres for waterfowl hunting. There is no hunting allowed at Heller's Creek. The recreation lake doesn't allow power boats.

Tommy then goes over the Shoreline Management Plan that was in developed in 2002 for Lake Monticello. Tommy says that after the plan was implemented, the number of docks on the lake grew from 16 to about 65. He again mentions that no docks are allowed on Parr Reservoir and the recreation lake. The South Carolina Department of Natural Resources leases approximately 8,000 acres for management within the PBL. The Shoreline Management Plan seems to be satisfying people's needs in the area. Ron mentions that he has noticed times when the boat ramps at Lake Monticello were full and people were waiting to use the area. He doesn't believe the boat ramps available are adequate for everyone who is using them. He asks if studies have been done to see if these facilities are enough. Tommy says no studies have been done, and he hasn't received any complaints, but that this issue will definitely be one looked into during this relicensing process. Everyone in attendance received a copy of the 2002 Shoreline Management Plan for Lake Monticello.

Bill introduces Tom Hanzlik to the group, who is in attendance to further explain the workings of Parr Hydro and Fairfield Pumped Storage. Tom starts off with some general information about Parr Hydro. The total generation is 14.9 MW with six units and a maximum of 6,000 cfs through the plant. It is a modified run-of-river facility and with the Parr Reservoir acting as the lower reservoir for Fairfield. Fairfield generation includes 8 units capable of 75 MWs each, with an operating range of 4.5 feet. Eight Hundred and eighty megawatts are generated per foot of water. One foot out of Lake Monticello equals 2 feet into Parr. When Fairfield is pumping, it uses a load of 83 megawatts per unit, or 1280 megawatts per foot. The reverse is true when pumping, so two feet of water out of Parr equals one foot into Lake Monticello.

The plant's limitations involved the presence of too much water, or not enough. During flood conditions, as Ray explained earlier, the Alston gage must not reach above 40,000 cfs or Fairfield must be shut down and the crest gates lowered at the Parr dam. The reverse happens during drought conditions. FFPS power generation is limited to the amount of water available at Lake Monticello.

The question was raised as to how the operation of Fairfield will change once the new nuclear plants come online. Tom answers that nothing will change with Fairfield in terms of it not being needed. Since it is used for peaking, it will still be a big asset to the company during times of high energy demand. Fairfield will always be the quick and efficient way to produce power for filling in the gaps during peak periods, as opposed to starting up a different plant, run by coal, natural gas, or nuclear. The benefits of Fairfield include flexibility, either as a pump or generator, as it is quick to respond in both modes; maintaining reliability of the transmission grid, when another plant trips off-line; and its rapid loss of load.

Ray also mentions that two coal plants are due to be decommissioned by 2018. This includes 5 units, or about 500-600 MW. The new nuclear plants will replace this loss, but FFPS will still be needed to fill in the gaps. Malcolm mentions that the nuclear plants will increase evaporation at Lake Monticello, but it won't be much in terms of the entire project. It is also mentioned that FFPS is a limited resource and only good for about 8 hours of generation. After it is used up, it must be "recharged" for use again, by pumping the water back to Monticello.

After Tom finishes his presentation, Bill addresses the remaining questions that were submitted by the agencies and NGOs. Bill explains that several topics brought forward, such as instream flow and sediment/sand dynamics, will be discussed in further detail once the technical working committees are formed, specifically the Fish and Wildlife TWC. SCDNR asked for information about the aquatic habitat conditions in the mile-long bypass reach of the Broad River, immediately below the dam. Bill asked if Ron would elaborate on this issue. Ron explained that an island just below the dam splits the bypass in two, and while flows reach down both sides of the island, one side has significantly lower flows, causing warmer water temperatures and lower dissolved oxygen levels. Ron is interested in studying how this has affected the number of fish species. Prescott mentions an instream flow and habitat characterization study would be helpful. Bill answers this will definitely be something looked into once the TWCs are formed. Fish entrainment, including impingement, bar rack spacing, and velocities at the intake, will be discussed within the fish and wildlife TWC. The issue of projected long term water demands on the Broad River is information that will be included in the PAD.

Bill Stangler asked if there are areas downstream from the Project to improve recreation opportunities on the Broad River and asked for an inventory of SCE&G/SCANA properties downstream of the Project. Bill answered that the Company would consider specific proposals or ideas related to downstream recreation but did not intend on bringing lands downstream of Parr Dam into the Project boundary. An inventory of SCE&G/SCANA properties downstream of the project will not be provided, since these areas are not included in the PBL. A description of water temperatures and anticipated affects of the expanding nuclear facilities, including modeling of the thermal plume, was also requested. It is mentioned that monitoring has been done and will be continued before and after the nuclear plants come online. As much information as is available during the writing of the PAD will be included in the PAD. Only baseline data will be available at the time the PAD is filed, since this will be before the nuclear plants actually go online.

Beth asks why the PBL was set all the way up to Henderson Island. Ray answers this was due to where the USGS backwater profiles reached due to the addition of crest gates on the Parr Dam. The question is asked and affirmed that a relicensing settlement agreement will be pursued.

Before the meeting closes, several upcoming events are discussed. Two public outreach workshops will be held in January. In Fairfield County, the first public outreach workshop is scheduled for Tuesday, January 15, 2013 at 7pm at the Winnsboro Woman's Club. The second public outreach workshop will be held in Newberry County and is scheduled for Thursday, January 17, 2013 at 7pm at the Newberry County Courthouse. Everyone is invited to attend and encouraged to invite others who may be interested in the Parr/Fairfield Relicensing Project.

There are also two more events being scheduled for those interested, including a 2-3 day canoe trip on the Broad River to view the Project area and a 2 day boat tour to view Lake Monticello, and the recreational and Parr reservoirs. These events will be scheduled sometime during the weeks of March 18th through April 8th. Meeting attendees are encouraged to indicate desire and availability for these outings as soon as possible. Everyone who is interested is asked to register with Kelly by February 22, 2013. Reminder e-mails and Doodle polls will be sent out to the group to help with scheduling.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Joint RCG Meeting

February 12, 2013

Final KDM 03-29-13

ATTENDEES:

Steve Summer (SCANA)
Milton Quattlebaum (SCANA)
Frank Henning (Congaree National Park NPS)
Hal Beard (SCDNR)
Dick Christie (SCDNR)
Charlene Coleman (American Whitewater)
Robert Stroud (SCDNR)
David Hancock (SCE&G)
Mark Caldwell (USFWS)
Malcolm Leaphart (Congaree Riverkeeper)
Ron Ahle (SCDNR)
Rebekah Dobrasko (SHPO)
Tom McCoy (USFWS)
Pace Wilber (NOAA)
Joseph Wojcicki (By-PAS)
Karla Reece (NOAA) via Conf. Call
Bill Stangler (Congaree Riverkeeper)
Rusty Wenerick (SCDHEC)
Prescott Brownell (NOAA)
Bill Marshall (SCDNR)
Jon Sherer (City of Columbia)
Randy Mahan (SCANA)
Tommy Boozer (SCE&G)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Mike Summer (SCE&G)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Shane Boring (Kleinschmidt)
Gerrit Jobsis (American Rivers)
Fritz Rohde (NOAA) via Conf. Call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting with introductions and a quick overview of the agenda. The group then begins reviewing and editing the Operating Procedures Document, which was distributed to everyone prior to the meeting. Pace asks if the agencies need to sign the document once it is finalized and Alan answers no.

Pace begins the edits by suggesting that since many people from the general public will be reading this document, a paragraph needs to be included on how this agreement fits into the overall licensing process. Also he suggests that a section is added to the Operating Procedures that includes mandates from all agencies involved, as well as an explanation of the mandates for the public. Alan asks the agency representatives at the meeting to provide these mandates for inclusion in the document. During this discussion, the idea of posting links to the agency and stakeholder websites on the Parr Relicensing website is brought up. Alan and Bill agree that this is fine and that Kleinschmidt will post the links when the Parr website is complete.

A discussion on the involvement of social media occurs when this section in the document is reached. The group decides that social media is okay for some uses but not others, and should reflect only the opinion of the group being represented and not as a way to speak for others. The acceptable uses of social media are clearly defined in the Operating Procedures. Also, a mission statement for the Parr Fairfield Relicensing Group is developed for inclusion in the document.

Mark asks for clarification on the term “individuals” that are to be included in the Parr Fairfield Relicensing Group. This is explained that individuals include the public at large. It is also asked what the difference is between Resource Conservation Groups and Technical Working Committees. Dick explains that they are basically one in the same, with an RCG being a larger parent group to various TWCs, providing an opportunity for people to become involved that may not have the time or technical experience to be involved in a TWC. Pace also asks for clarification on who has the responsibility of keeping FERC updated on the relicensing process. Bill answers that SCE&G is responsible for this and Alan explains how FERC requires updates to be filed by the applicant every quarter.

When the subject of confidentiality agreements is reached within the document, Pace states that their organization will need to have their lawyer look at any agreement prior to signing, and notes that time needs to be a consideration with this. Pace refers Randy to Mike Mastry as a contact for these situations.

A few other notes during discussion of the Operating Procedures include; standardization is needed of the terms “stakeholders” and “participants” within the document; “compromise” and “consensus” need to be clarified; and the term “team” should be replaced by PFRG, RCG and TWC where appropriate.

Randy reminds the group that there is no authorship to the Operating Procedures document, and that is belongs to the whole group, not just SCE&G. The document is agreed upon by everyone in attendance, and after the mandates are received and incorporated, it will be finalized and distributed to the group, as well as be posted to the project website.

Alan reiterates to the group that support of the agencies and stakeholders is crucial in FERC allowing SCE&G to use the enhanced traditional licensing process. Although this won’t be necessary until the NOI is filed, it is important for everyone to keep in mind that this concurrence is essential.

Bill also informs the group that future meetings may be located closer to the project, within Newberry and/or Fairfield Counties. Several people question the reasoning for this, especially with TWC meetings, since public attendance is very rare, if at all. Bill says future meeting sites are still being determined and he will keep everyone updated on this issue.

Alan then gives the group an overview of the Public Meetings that were held in January in Newberry County and Fairfield County. Gerrit asks if dates are set for the filing milestone documents throughout the process. While there are planned dates for submitting these documents, actual dates may vary slightly. However, deadlines for the filing of each document do occur and are specified by FERC.

With this, the meeting is adjourned. Action items stemming from this meeting are included below.

ACTION ITEMS:

- All agencies need to submit a mandate for inclusion in the final Operating Procedures Document.
- Links to agency and stakeholder websites will be listed on the Parr Fairfield Relicensing website.
- Kelly will begin including the time and meeting locations on the distributed agendas.
- Kelly will provide Gerrit with an attendance list from the Public Meetings.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Water Quality, Fish and Wildlife RCG Meeting

February 12, 2013

Final KDM 03-29-13

ATTENDEES:

Steve Summer (SCANA)
Milton Quattlebaum (SCANA)
Frank Henning (Congaree National Park NPS)
Hal Beard (SCDNR)
Dick Christie (SCDNR)
Bill Stangler (Congaree Riverkeeper)
Robert Stroud (SCDNR)
Mark Caldwell (USFWS)
Malcolm Leaphart (Congaree Riverkeeper)
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Shane Boring (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Fritz Rohde (NOAA) via Conf. Call
Karla Reece (NOAA) via Conf. Call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Shane opens the meeting by reviewing the agenda. The purpose of this meeting is to identify study needs and review, edit and finalize a mission statement for the Water Quality, Fish and Wildlife Resource Conservation Group.

The group begins with a draft mission statement and edits it until consensus is reached. The mission statement for the Water Quality, Fish and Wildlife RCG is as follows:

> "The mission of the Water Quality, Fish and Wildlife Resource Conservation Group is to develop recommendations relative to public trust resources (i.e. water quality, water quantity, fish and wildlife, etc) for inclusion in a Protection, Mitigation and Enhancement Agreement (PM&E Agreement). The purpose of the PM&E Agreement is to provide resource management recommendations for inclusion within the Parr Fairfield Hydroelectric Project license application."

After finalizing the WQFW RCG mission statement, Bill focuses the meeting toward identifying information and study needs for the group. He begins with listing all of the study needs the agencies and NGOs submitted during the project kick-off. These include:

- Entrainment and Impingement Study at FFPS and the Parr Dam

- Sediment Study
- Information about the mile long west side of the island located below the Parr Dam
- Temperature and other effects of the expanding VCS Nuclear Plant
- Instream flow requirements below Parr Dam
- Limited habitat assessment/characterization upstream of the Parr Project Boundary Line

Bill then asked the group to share any further study requests or information needs they had for the Project. Ron begins by discussing a potential spawning area for the Robust Redhorse, located just below the dam. He explains that in 5 years of sampling, that area has consistently shown the highest population, and would like to see a study developed to determine if the species is spawning in this area, when, under what conditions, etc. Ron also lists the need for fish community resource data for Lake Monticello, Parr Reservoir and the Broad River, and a study of the shoreline habitat on Lake Monticello. He believes the habitat has been degrading over time and would like to see if and how this has had an impact on fish communities. Other studies suggested include an American eel population dynamic study below Parr Dam, a waterfowl survey, spider lily survey, macroinvertebrate study, and a mussel and snail survey. Steve Summer mentions that a macro study and a mussel survey are being completed for the expansion of the nuclear plant, so this data will be available for the Parr Project as well. Mark Caldwell suggests a general rare, threatened and endangered species survey should be conducted as well, and notes that any surveys conducted for a listed species must be performed by someone permitted by the US Fish and Wildlife Service. Hal asks the group if an aquatic vegetation survey has been completed for Lake Monticello. An aquatic vegetation survey has not been done and it is added to the list. The idea of creating a water budget for the Project Vicinity is brought up, including historic pre-dam data and evaluating project effects of the downstream water budget. It is decided that this subject will be best dealt with in the Operations RCG. Robert mentions conducting a possible Creel survey. A general water quality study that includes historical to present data covering DO, pH, nutrients, metals and conductivity needs to be performed. Group discussion turned to any available bathymetry of Parr Reservoir. Bill indicated that GEL engineering collected some bathymetric profiles in Parr reservoir as part of a sediment study and indicated this information could be shared with the WQ TWC who was tasked with addressing sediment impacts on aquatic resources. The group concurred this information would be beneficial in moving forward to address this issue. Gerrit asks for an inventory to be developed listing all of the small dams located along tributaries that feed into the Project, but are located outside of the Project Boundary Line. This inventory could be used for evaluating the feasibility of removing some of the dams as a mitigation option. Discussion follows regarding this as outside of the PBL and not within FERC relicensing jurisdiction. Gerrit says that American Rivers already has a preliminary list that the group can build upon. Alan reiterated that this was not in the scope of relicensing but in the interest of maintaining open communication and information exchange between the interested parties and asks Gerrit if he would like the opportunity to give a presentation on the existing data. Gerrit agrees to this. Hal mentions that removing a dam is not always the best option in some cases, especially in regards to sediment release. This is something to keep in mind if dam removal does become an option.

Pace requests a copy of a GIS map of the Project Boundary Line. Gerrit also requests a map of SCE&G land holdings downstream of the Parr Dam. Bill A mentioned that these lands are outside of the Parr Project boundary and not within the FERC relicensing jurisdiction.

The group then focuses on developing Technical Working Committees and deciding which studies need to be addressed in which TWCs, versus the RCG as a whole. The group also evaluates which study requests can be addressed by existing data and which issues should be dealt with in a different RCG. It is decided that the aquatic vegetation survey should be included as part of the Lake and Land Management and Recreation RCG. Information regarding water temperatures and anticipated effects of the new nuclear facilities can be found in the FEIS for that project and the thermal plume study conducted for the new nuclear project's NPDES.

Four TWCs are identified as follows; the Instream Flows TWC; the Water Quality TWC; the Fisheries TWC; and the RT&E TWC. A complete list including all study requests identified and which TWC they have been assigned to is attached at the end of the notes. The TWCs are composed of the following WQFW RCG stakeholders:

- Instream Flows TWC – Gerrit Jobsis, Dick Christie, Bill Marshall, Ron Ahle, Bill Stangler, Prescott Brownell, Tom McCoy, Scott Harder, Steve Summer, Milton Quattlebaum, Bill Argentieri, Alan Stuart, Kelly Miller
- Water Quality TWC – Gerrit Jobsis, Bill Marshall, Ron Ahle, Bill Stangler, Jaclyn Daly, Rusty Wenerick, Tom McCoy, David Eargle, Scott Castleberry, Steve Summer, Milton Quattlebaum, Bill Argentieri, Alan Stuart, Kelly Miller
- Fisheries TWC – Milton Quattlebaum, Steve Summer, Gerrit Jobsis, Ron Ahle, Dick Christie, Tom McCoy, Fritz Rohde, Hal Beard and/or Robert Stroud, Chad Altman, Bill Argentieri, Alan Stuart, Kelly Miller
- RT&E TWC – Gerrit Jobsis, Bill Marshall, Bill Stangler, Tom McCoy, Karla Reece, David Eargle, Scott Castleberry, Steve Summer, Milton Quattlebaum, Bill Argentieri, Alan Stuart, Kelly Miller

During discussion of the various studies, an evaluation of diadromous fish passage alternatives was mentioned as a possible study to be included as part of the Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement. Sometime in the near future it is proposed that SCDNR present to the group an overview of current studies completed and ongoing as part of the Santee River Basin Accord.

The WQ TWC members decide that a WQ TWC meeting should be held before the float trips that are scheduled for March. Gerrit asks if it will be possible to set up recurring meeting dates for some of the groups, bunched together over a few days in a week. Bill says this idea will be considered.

With this, the meeting adjourned. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- SCE&G will develop a conceptual plan for an Entrainment and Impingement study for the Fisheries TWC to review.
- SCE&G will develop a conceptual plan for a Waterfowl Survey for the RCG to review.
- Bill A will provide GIS data of Parr PBL

- Gerrit will schedule a time to present information about small dams located within the Project Vicinity.
- SCDNR will present an overview of the current studies being conducted under the Santee Basin Accord
- Kelly will set up a Doodle Poll and schedule a WQ TWC meeting for late February/early March.

Water Quality, Fish and Wildlife RCG Study Requests

Instream Flows TWC

- Information of in-stream flow requirements below Parr Dam
- Information about aquatic habitat conditions in mile-long section on west side of island of the Broad River immediately below the dam.
- Habitat assessment upstream of Parr Dam to the end of the Project Boundary
- Limited habitat assessment upstream of Parr Project Boundary

RT&E TWC

- Mussel and snail survey
- Crayfish survey
- RT&E survey
- Spider lily survey

Fisheries TWC

- American shad spawning below Parr Dam
- Diadromous fish passage alternatives evaluation
- Information about fish entrainment and impingement at Fairfield PSS and Parr Dam - SCE&G develop conceptual for RCG review
- Robust Redhorse spawning area just below Parr Dam
- Fish community resource data on Parr, Monticello reservoirs and Broad River
- Shoreline habitat on Monticello Reservoir
- American eel abundance (population dynamics)

Water Quality TWC

- Any study or report about the dynamics of the sediment/sand movements and load throughout a year with the operations of the Project
- Historical water quality data
- Project effects on water quality
- Description of water temperatures and anticipated effects of existing and expanding nuclear facilities – FEIS and thermal plume study for new nuclear
- Macroinvertebrate survey

WQFW RCG

- Inventory of small dams for feasibility of removal potential offsite mitigation – evaluate details for RCG review
- Waterfowl survey - SCE&G develop study plan for RCG review and approval

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Lake and Land Management and Recreation RCG Meeting

February 19, 2013

final KDM 03-29-13

ATTENDEES:

Milton Quattlebaum (SCANA)
Mike Summer (SCE&G)
Dick Christie (SCDNR)
Bill Stangler (Congaree Riverkeeper)
Robert Stroud (SCDNR)
Charlene Coleman (American Whitewater)
Malcolm Leaphart (Congaree Riverkeeper)
Mark Davis (SCPRT)
Tom McCoy (USFWS)
Billy Hendrix
David Hancock (SCE&G)
Tommy Boozer (SCE&G)
Gerrit Jobsis (American Rivers)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Alison Jakupca (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Prescott Brownell (NOAA) via Conf. Call
Joseph Wojcicki (By-PAS)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

After introductions, Alan opens the meeting by giving a brief overview of the RCG meetings held on February 12th.

The group then focuses on developing a mission statement for the Lake and Land Management and Recreation RCG. Dick Christie has drafted his own version and the group uses this as a starting point. Gerrit says he would like the mission statement to include mention of the area downstream of the Parr Dam, in terms of possible recreational opportunities. Bill Stangler agrees that this should be included. This sparks a discussion on whether project effects on recreation downstream of the dam should be included in the mission statement. The question arises of whether downstream recreation potentials should be included in the mission statement at all, since FERC cannot approve anything outside of the Project Boundary Line. Eventually a consensus is reached and the final mission statement for the LLM/Rec RCG is as follows:

> "The mission of the Lake and Land Management and Recreation Resource Conservation Group is twofold:
>
> 1. Evaluate the effects of the Project operation on recreation resources and explore the potential for enhanced recreational opportunities. Develop a consensus based Recreation Plan to address public recreation within the Parr Project boundary for the term of the new license.
> 2. Develop a consensus based Shoreline Management Plan to identify appropriate shoreline activities within the Parr Project boundary and

guidelines to ensure these activities are conducted in a manner to avoid or minimize environmental impacts."

After the mission statement is developed, the group begins to identify potential information needs. This group was divided into two Technical Working Committees (TWCs), a Recreation TWC and a Lake & Land Management TWC. All members of the RCG will participate in both TWCs. An aquatic vegetation survey of Parr Reservoir and Lake Monticello was mentioned in the WQFW RCG meeting and determined to be better dealt with in the LLM/Rec RCG. Gerrit then asks SCE&G for an overview of what recreation opportunities are currently in existence. Tommy then gives the group a presentation detailing these facilities. All of the facilities listed below can be found in the Shoreline Management Plan (SMP) with a map showing their location.

- Scenic overlook on Lake Monticello
- Hwy 215 public boat ramp on Lake Monticello
- Hwy 99 public boat ramp on Lake Monticello (includes primitive camping)
- 384 acre Recreation Lake with Park site and public boat ramp
- 8 islands on Lake Monticello
- Cannons Creek public boat ramp (includes primitive camping)
- Hellers Creek public boat ramp
- Terrible Creek Waterfowl Management Area
- Hwy 34 public boat ramp
- Enoree River Waterfowl Management Area
- One Future recreation site on Lake Monticello
- One future recreation site on Broad River

Bill Hendrix suggests opening a new access point on the Broad River that would allow for easier access to the Tyger and Enoree Rivers. After the presentation, the group lists Recreation study or information needs for the Project. These are listed below.

- Potential new recreation sites upstream of the Project Boundary Line and on Parr Shoals Reservoir
- A Recreation Use Needs Study (RUNS), which includes a comprehensive inventory of recreation facilities, including amenities, for the Project,
- A study examining the effects of reservoir fluctuations on recreation
- Potential for more portage facilities close to Parr Dam
- A study examining Project effects on downstream flow with respect to recreation
- Areas downstream of the project that could improve recreational opportunities on the Broad River – as noted previously, this is outside of the Parr PBL

Two studies will definitely be completed by the Recreation Technical Working Committee (TWC), including a RUNS and a study examining downstream flows.

Tommy then gives an overview of the SMP. David mentions that dock restrictions for Lake Monticello and Parr Reservoir are very strict. Gerrit asks about the land that is not developed, like the waterfowl management areas. He would like to know how they are managed, and what the restrictions are to the public. Gerrit asks if a designated area for camping can be set up on Parr Reservoir for recreators. Alan says this is something that will be considered and the need for facilities will be evaluated in the Recreation Use Needs Study performed during relicensing. Dick adds that land that isn't designated for something else should be designated for public use. This will clarify to land owners and public recreators which land areas are available for public use. Another specific need for the Lake and Land Management TWC is updating the map included in the SMP. The group plans to go through the current SMP text and make sure everything is covered and all RCG members are satisfied with the document. The group listed the following information needs for the L&LM TWC.

- Waterfowl Management Area
- Aquatic vegetation survey of Parr and Monticello reservoirs
- SMP
- Shoreline classifications for both Parr and Monticello

Alan reminds everyone about the boat tours that are scheduled for March. The group decides that Lake Monticello will be toured on March 26th and the Parr Reservoir will be toured on March 27th. The next LLM/Rec RCG meeting will be scheduled for April, after the kayak trip and boat tours. With this the meeting is adjourned. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Kelly will send the group a copy of the Recreation Plan and SMP from the current license for the Project.

- Waterfowl Management Area – (L&LM)
- Aquatic vegetation survey of Parr and Monticello reservoirs – (L&LM)
- SMP - (L&LM)
- Shoreline classifications for both Parr and Monticello - (L&LM)
- Description and location of public access facilities and recreational uses on project waters and adjacent lands. (Recreational Use Needs Study) Recreation
- Are there areas downstream of the project that could improve recreational opportunities on the Broad River? This should include an inventory of SCE&G/SCANA properties and their potential as canoe/kayak access points and/or campsites. Recreation
- Inventory of Recreation Sites (ADA Compliant, etc.) - Recreation
- Potential new recreation sites - Recreation
- Portage facilities at Parr Dam - Recreation
- Effects of reservoir fluctuations on recreation on Parr Reservoir - Recreation
- Recreational downstream flow - Recreation

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Operations RCG Meeting

February 19, 2013

Final KDM 03-29-13

ATTENDEES:

Milton Quattlebaum (SCANA)
Dick Christie (SCDNR)
Robert Stroud (SCDNR)
Malcolm Leaphart (Congaree Riverkeeper)
Gerrit Jobsis (American Rivers)
Tom McCoy (USFWS)
Joseph Wojcicki (By-PAS)
Bill Stangler (Congaree Riverkeeper)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Kelly Miller (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Bret Hoffman (Kleinschmidt)
Prescott Brownell (NOAA) via Conf. Call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The meeting opened with the group working to develop a mission statement for the Operations RCG. Dick presented an initial mission statement and the group tweaked it until consensus was reached. The mission statement for the Operations RCG is as follows:

> "The Mission of the Operations Resource Conservation Group (ORCG) is to develop consensus based recommendations for inclusion in the FERC license application that will balance the need for flexible, efficient hydropower operation with the interests of stakeholders as identified in the Lake and Land Management, Recreation and Water Quality, Fish and Wildlife RCGs."

The group then shifts focus to discussing the possibility of developing a water budget/model for the Broad River in the Project Vicinity, using as much information as is available. The State may be creating a water budget for all of South Carolina within the next two years. This is something to stay aware of, as it will provide information for the Project water budget. The consideration of Project effects on the downstream water budget is an important piece of the overall model. Bret mentions that the information used to create the model needs to include any upstream changes, such as withdraws or changes in upstream project operations, as these could shift the curve of the model. The group also wants to find information regarding the projected long term water demands on the Broad River.

Now that the Operations RCG is formed, Bill A will provide a reference sheet with the Fairfield Pumped Storage and Parr Shoals Hydroelectric Plant standard Project numbers information. Dick asks if there are any future plans for changing plant operations. Bill and Ray answer that no changes have been identified at this point.

The group continues to discuss issues and information requests as related to operations. A request is made for instream flow compliance records. Discussion of whether or not a sediment management plan should be included in the operations RCG or in the WQFW RCG. The group decides to keep development of any plan as an operations issue and will decide how to address it in the future if sediment is determined to be problem. Addressing potential sedimentation impacts on the ecosystem will be evaluated in the WQFW TWC and that information will be shared with the Operations RCG. Other issues the group is concerned with are the effects dam operations have on the Congaree River and how project operations affect instream flows. Ray says he will pull together some information sheets for the next meeting to use as a starting point for developing some study plans on these issues. Gerrit mentions that an operational model will be a great tool for aiding the other RCGs and TWCs with some of their issues/decisions. A complete list of Operations Information Needs is included at the end of this document.

Dick asks about trash management at the Parr Dam. Ray explains that the trash rakes are cleaned off periodically, and the collected material is carted off to a separate location to decompose.

Alan asks if anyone wants or needs a presentation on anything to get a better understanding of operations at the Project. Gerrit says he has questions on how the projects operate, considering the nuclear plant, the high flows allowed, and daily operations of the plant during various conditions. Ray says he will get with John Knight and Tom Hanzlik to get this information for the group. Prescott mentions he would like a presentation that shows upstream and downstream habitats and flow conditions in each area. Alan suggests this would be a good presentation for the WQFW RCG. Prescott says he will send some example presentations that include the type of information he wants. Bill S. says he will provide the group with an updated paper that details interactions between the Broad, Saluda, and Congaree Rivers.

With this the meeting adjourns. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Bill A will provide a standard Project numbers reference sheet at the next meeting
- Ray will develop a presentation with Project operations information for the next meeting.
- Kelly and Ray will get together to determine the next appropriate meeting time, according to the information Ray is able to find. A doodle poll will then be sent out to the group.
- Bill S. will provide the updated paper on the Broad, Saluda, and Congaree interactions.
- Prescott will provide example presentations showing upstream and downstream habitats and flow conditions in each area.
- Bill A will provide instream flow license compliance records by the next meeting.

Operations Information Needs

- What effects do dam operations have on the Congaree River? It is noted that operations appear to affect the minimum (lower) and maximum (higher) outflows relative to corresponding inflows and that flow pulses increase with flow. Are these measureable at Congaree? The Jobsis (Erich Miarka) study is referenced. (Operations)
- Description of current operations and proposed future operations at the project and related effects on instream flows. (Operations)
- Water budget/allocation model– (Operations)
- Project effects on downstream water budget – (Operations)
- What are the projected long term water demands on the Broad River? This will require coordination with the City of Columbia and analysis of their plans for projected population growth and water supply demands. It will also have to consider future demand from facilities like VC Summer and other water users. (Operation)
- daily operations, low flows, drought, & flood
- operational constraints
- Information sheet: A comprehensive explanation of the hydro operations at the Parr Shoals Project. Including: daily operations, low flows, drought, flood and status on existing units (working condition) (Operation)
- Information sheet: A comprehensive explanation of the operations at the Fairfield Pump Storage station. Including: daily operations, low flows, drought, & flood. (Operation)
- Future operational plans
- Instream flow compliance records
- Sediment management plan
- Low Flow Protocol - LFP

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Water Quality TWC Meeting

February 28, 2013

Final KDM 04-05-13

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Rusty Wenerick (SCDHEC)
Shane Boring (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Randy Mahan (SCANA)
Jaclyn Daly (NOAA) via conference call
Tom McCoy (USFWS) via conference call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting with introductions, and then explains that a few people (Milton, Steve, Randy and Bill Stangler) will be joining the meeting later. Because of this, the agenda is shifted around so that the macroinvertebrate study is discussed in the afternoon.

The group begins discussing historical water quality data by going over some examples of the types of studies SCE&G has performed at Lake Monticello and Parr Reservoir, including identifying the parameters covered. Alan mentions that lots of data exists, but it needs to be consolidated into one report, where all the data is available in one location. Jaclyn requests that the report include the water quality standards that exist for some parameters. Rusty also suggests that the report include a map of the Project Vicinity that points to specific areas where water quality readings were taken, along with any data points that exceed standards.

Alan asks the group to decide what parameters should be included in this report that will indicate and evaluate any project effects. Ron mentions that he would like to see a comparison between the water that is being taken out of Parr Reservoir and the water that is being returned to Parr Reservoir. He would like to see a "before and after" type of analysis, to see if the nuclear plant has any effect on the water quality of Lake Monticello, Parr Reservoir, and to a lesser degree, the Broad River.

Rusty mentions there are a few sites within the Project Area that DHEC has listed as having violations for copper levels and pH over the last few years. He says that these areas are no longer being monitored, but the sites remain on the 303d list of impaired waters until data is collected that proves it is clear of these violations. Rusty shows the group a map (Figure 1) that displays the sites monitored by DHEC and reminds the group that all data can be found in Storet. Ron mentions that he also has data he has personally collected during his time in the field and would be willing to share this with the group for inclusion in the report.

Jaclyn asks if algal blooms are monitored within the reservoirs, since an increase in these can be toxic to fish. Alan says this can be determined if chlorophyll A is monitored, which may be so in Lake Monticello, but is unlikely at Parr Reservoir, since it isn't a true reservoir.

Alan asks Rusty what information he needs for the 401 water quality certification. Rusty says that DHEC will examine any places where there have been violations, look at the specific parameter in violation, and determine if the Project contributed to the exceedance in limits. He notes that it might not be possible to determine if the Project is affecting these limits. The watershed is likely causing increases in things like phosphorus at the impoundment however DHEC might look to see how plant operations can be used to mitigate that water quality problem. Bill Marshall mentions that DHEC will also be interested in how the Project effects water quality downstream. Rusty agrees, and notes that copper is known to have exceeded limits in the past at sites downstream of the Project. Ron says that copper could be coming from plant operations, but Alan says it could also just be from the natural environment.

Jaclyn suggests the group also consider looking at new emergent contaminants. The group says that this information would be available through NAWQA, the National Water Quality Assessment Program, a USGS program that examined the Santee watershed, which includes area in North Carolina down to the South Carolina coast. Celeste Journey is the contact person for this information. Rusty suggests the group look at existing data before going any further in searching for these emerging contaminates. Shane mentions that after all data is collected, the group needs to review it and narrow down the specific parameters that have a true nexus to the Project. Ron reminds the group of his earlier suggestion of examining water as it moves to and from the Parr Reservoir, adding that this could be an ideal way of identifying any Project effects.

To address the issue of stratification, Shane says there may already be a vertical profile in existence that shows this for Lake Monticello and Parr Reservoir. It is noted that Lake Monticello is at an elevation of 425 feet at full pool, but can go down to 418 feet in an emergency situation and with FERC approval. The maximum depth of Lake Monticello, located at Frees Creek, is 160 feet, with an average of 75 feet.

Rusty notes that the WQ TWC will be interested in seeing the water budget the Operations RCG is developing.

Bill M asks about NPDES discharges in the areas. Bill A says the Parr Fairfield Project does not have an NPDES discharge, although the nuclear plant does. Rusty says he will look at GIS information to determine if there are any more NPDES permitted areas within the Project Boundary Line.

Information Needs (Water Quality Parameters)
The group reaches consensus on what parameters need to be included in the baseline water quality report. These parameters are temperature; dissolved oxygen (DO); pH; conductivity; total dissolved solids (TDS); total suspended solids (TSS); turbidity; phosphorus; chlorophyll A; metals; nutrients; organic compounds, specifically chlorinated pesticides; fecal coliform and/or E. coli; and radionuclides. The group also agrees to look at any available information on new emerging contaminants through USGS NAWQA sampling and any available vertical profile data that might address stratification. Water Quality sampling of Parr Reservoir before and after pumping

operations. Sources for collecting the data listed above include SCE&G, USGS, DHEC, DNR, Storet, and the Operations RCG water budget (after it is developed).

The group then begins discussion of the Sediment Loading Assessment performed by GEL engineering. Alan mentions that an issue for many people involved in the Parr Relicensing is sedimentation. This sediment study that was performed in 2008 was sent to the group to spark discussion. Alan asks what the group wants to do with this issue. Bill M asks how seriously sediment affects FFPS operation. Bill A says there is sediment at the project but the only issue with it is that when sand is pumped through the system, it can cause deterioration of the blades. However, this is a maintenance issue and the sand doesn't affect generation. Bill A also tells the group that sediment would only be a problem at Parr if it reached the top of the Parr Dam. Any sediment below the one foot line at the top of the dam is insignificant. The only sediment that leaves the project is what goes through the turbines. The sand gates have not been operable for many years and there is no intention of changing that. There are no sand gates at Fairfield.

The trash rake was added to help keep the forebay area clean, so there really is no need to make the sand gates operable again. The trash rake at Parr is a drag rake. It extends approximately 50-75 feet in front of the dam, drags along the bottom of the reservoir, up along the rack and deposits into a trough. The sediment, logs and debris it collects in the trough are loaded up and carried away to a landfill. Bill A tells the group that they have seen better performance out of the units since all of the debris in the forebay area has been cleaned out and is kept clean. Another benefit of this trash rake system is that the movement of the rake stirs up sediment, which allows it to move through the turbines and out into the river. Because of this system, it seems the amount of sediment that is being transferred through the Project is equal to what is entering the reservoir. This means the sediment level within the Project is at equilibrium, as Ray Ammarell had previously said. Tom asks if a diagram of the trash rake can be provided. Bill A says he will have Ray include this information in his operations presentation.

Bill A tells the group that SCE&G is not advocating a need for dredging to eliminate some of the sediment within the Project. He says this would not be economical, as the sediment collected is not able to be resold due to quality. Bill A also says there is a man who dredges around the Hwy 34 bridge and has been doing so for about 2 years. Bill S asks if this has any affect on what is accumulating below the dam. Bill A answers that this amount is insignificant.

Ron says that if a sediment budget can be shown of what sediment enters and exits the Project (including quantity and quality) then DNR would have no concerns with sediment. Equilibrium would be the best possible situation for the Project, since there would be a constant movement of sediment into and out of the reservoirs. Bill M agrees, saying that at other hydro projects, sediment can be released downstream in large volumes, which is not the best thing for a river. He mentions that if FERC has no issue in regards to dam safety, the equilibrium situation would be great.

The group focuses on the GEL report and tries to determine the composition of the sediment that is entering the reservoir. Everyone believes it is most likely the fines, or silty type sediment, that is passing through the Project. This information will also be included in the water quality report that was discussed earlier in the meeting. Ron and Rusty ask if a sediment contaminant study has been completed in the Project Area. Bill A says that a sediment investigation study plan was developed for the VC Summer Units 2 and 3.

Information Needs (Sediment)
The sediment discussion highlights several information needs including determining a sediment budget; determining the quantity, composition and location of the samples taken for the GEL report; finding out if FERC has a dam safety issue with sediment build-up; finding out if inoperable sand gates will be an issue for acquiring a new license; and acquiring the VC Summer Units 2 and 3 sediment investigation report.

After lunch, Steve and Milton join the meeting. Steve tells the group that monthly water quality profiles are being done at Parr Reservoir as part of the water quality certification for the new nuclear units. Monthly water quality profiles have been conducted in Monticello Reservoir for many years in support of the existing nuclear unit. Steve addresses the issue of stratification at the Project. He explains that generally, Parr Reservoir doesn't stratify because it isn't a true reservoir. Steve explains because of the operation of the Fairfield Pumped Storage Facility and the nuclear plant, Lake Monticello is like three different reservoirs in one, with respect to stratification. The upper end of the lake stratifies like a normal reservoir. The section of the lake across from FFPS stays mixed down to 60 feet, due to the regular pumping and releasing of water. The eastern side of the lake is where the thermal plume from the nuclear plant discharge is located. Steve points out that the water circulation for the nuclear plant is very small compared to the amount of water that is moved back and forth from FFPS.

Steve says SCE&G has three water quality sampling locations in Parr near the discharge area and sediment sampling locations above Heller's Creek and at the discharge location for the new nuclear units. He says that sampling for macroinvertebrates, fish, sediment and water quality for the new nuclear units are all performed on Parr Reservoir. Steve says that a study performed recently by John Alderman identified a new area just below Parr Hydro that has the highest amount of mussels in all of the Broad River Basin. Alan asks if the group would like to see a macroinvertebrate study completed, separate from what is already being collected for VC Summer. Currently SCE&G is sampling for macros at a site above Heller's Creek, a site below the discharge, and in the Parr Hydro tailrace once a year. Ron mentions he would like to see a dredge done at the tailrace area at FFPS. Milton says he will dredge at three locations, from the railroad trestle up to the bend in the tailrace, this spring to see if there are any signs of macros. Rusty says he would like to Jim Glover and his group to look at the macros study plan that is currently used by SCE&G for VC Summer to make sure it is also suitable for the Parr Project. Milton says he will send a copy of the study plan to Rusty and Kelly for distribution.

Information Needs (Macros and Mussels)
Items of note stemming from the macroinvertebrate discussion include the identified needs to sample the Fairfield tailrace area at three locations for possible macro habitat; review the VC Summer Units 2 and 3 macroinvertebrate studies; review VC Summer Units 2 and 3 mussel study; and acquire feedback on these reports from DHEC aquatic biologists.

The group then shifts focus to discuss the nuclear plant's affect on water temperature of Lake Monticello. There were originally two temperature monitors in Monticello Reservoir between FFPS and Hwy 99; only one is currently in existence (FPPS forebay). Bill A asks the group if temperature information from Unit 1 needs to be included in the water quality report. Bill S says that if the nuclear plant has been in compliance for their NPDES permit, there should be no concerns with Unit 1. The group agreed.

Steve and Ron mention that Lake Monticello is probably warmer than Parr Reservoir in the winter and cooler than Parr in the summer, due to the pumping of Fairfield and the differences in depth of the two reservoirs. The new nuclear units 2 and 3 will discharge into Parr Reservoir. Rusty mentions that the NPDES permits for the new units considered how the Parr Project operates, and unless the operation is changed, the new discharge's affect on temperature won't need to be addressed. The group decides to look at the historical water quality data and see if anything needs to be addressed. Since everything for the new nuclear units has been permitted, all angles have been examined and determined to be acceptable.

Bill A then reviews what was covered in the meeting and finalizes the list for what data will be included in the water quality report. SCE&G and Kleinschmidt personnel will gather all the existing water quality data, form the report, and distribute it to the group for review. Everyone agrees to plan on meeting again in June.

With this, the meeting is adjourned. All action items from this meeting are listed below.

ACTION ITEMS:

- Kelly will send Jaclyn a copy of the American Rivers flows report by Erich Miarka.

- Ron will provide to the group WQ data he has collected

- Rusty will look at the DHEC GIS data and identify all NPDES permitted areas within the Project Boundary and report this information to the group.

- Milton will send a copy of the Macroinvertebrate Study Plan to Rusty and Kelly.

- Milton will send a copy of the Mussel Study Plan to Kelly

- Kelly will send out the macro report to the WQ TWC members and the mussel report to the WQ TWC and RT&E TWC.

- SCE&G and Kleinschmidt will compile all existing water quality data, form a report and distribute to the TWC for review.

- Bill A will include design details and operation of the Parr Hydro trash rake in the operations presentation.

- Kelly will set up a doodle poll for selecting a meeting date in June.

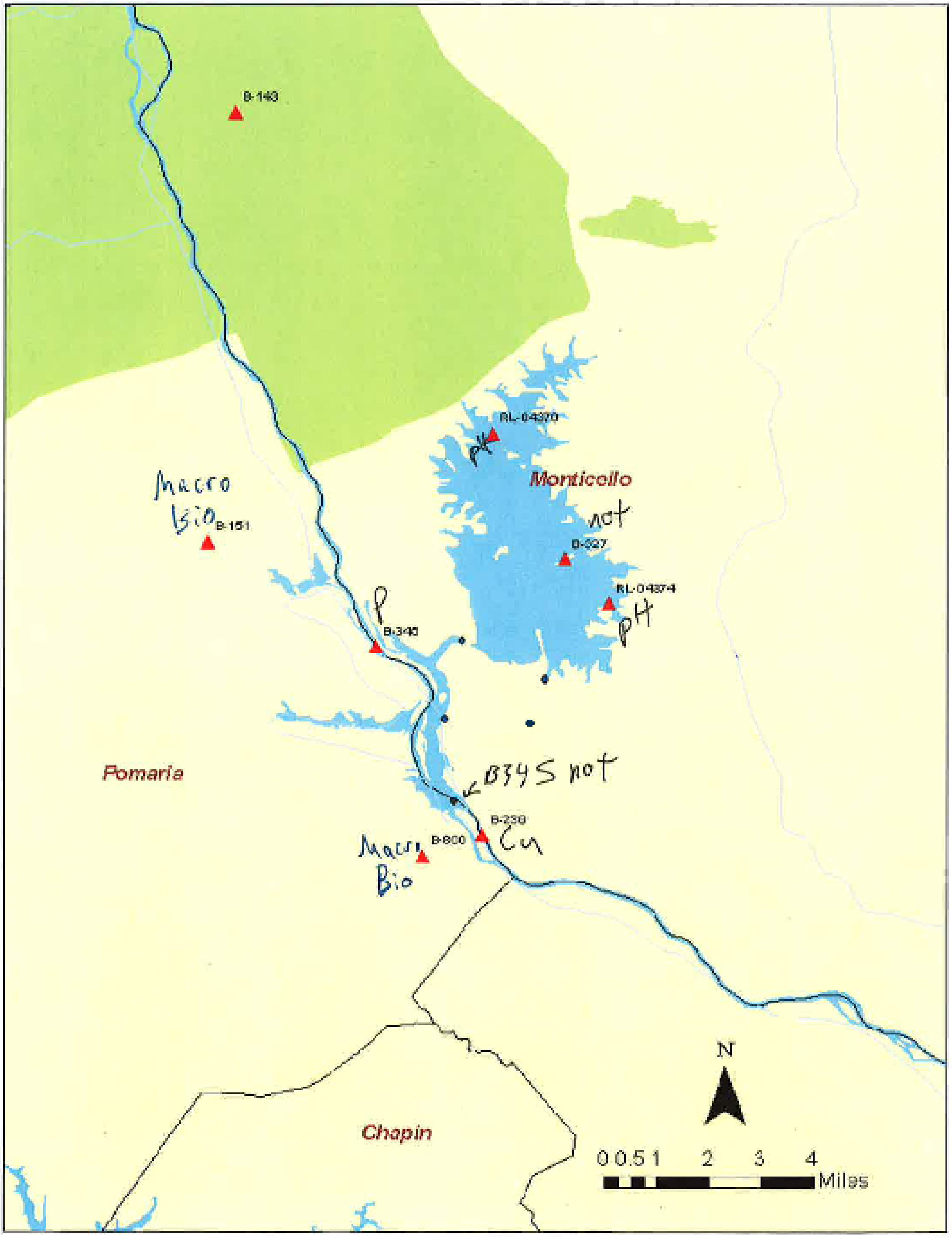


Figure 1: Map of DHEC monitoring sites at Parr and Monticello Reservoirs

Kleinschmidt

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

May 7, 2013

Final KDM 05-31-13

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Gerrit Jobsis (American Rivers)
Shane Boring (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Ray Ammarell (SCE&G)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Randy Mahan (SCANA)
Dick Christie (SCDNR)
Tom McCoy (USFWS) via conference call
Prescott Brownell (NOAA)
Kerry Castle (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting by briefly going over the agenda, then gives the group an overview of the float trip taken on March 19th and 20th. During this review, the group looks at the Project Area on a map, which sparks a discussion on the habitat just below the Parr Dam.

Ron explains how he is concerned about the separation in the habitat along the first mile of the Broad River, just below the Parr Dam. He says this is a highly utilized area of the river by fish species, and the side of the river along the west bank can grow stagnate during periods of low flow. Shane asks if a critical habitat study should be performed in this area. Ron says there are several critical habitats that need to be studied before the rest of the river is characterized. Prescott and Ron both mention they would like to have a habitat map made for as far down river as possible. Ron says that a habitat map should at least be made for the area immediately below the Parr Dam.

Gerrit tells the group he would also like to look at access along the river, since there are several areas that aren’t accessible. Prescott mentions that he is interested in studying the tributaries along the river. Ron mentions that there is a good amount of data already available on the tributaries, collected by the DNR Stream Team.

Alan refers the group to a study on the Broad River, completed by Jason Bettinger (referred to throughout these notes as the Bettinger Study), as a possible starting point for the Parr Project’s Mesohabitat Assessment and Instream Flow Study. The group notes that the Parr Project area was not included in this study, as the area in the Bettinger Study begins at Neal Shoals and extends upstream. However, the methodology used in the paper might still be utilized by the group.

After discussion on various needs for the Mesohabitat Assessment and Instream Flow Study, Gerrit focuses the group back on the agenda by beginning to list the goals and objectives for the study. Through much discussion the group agrees on four goals with corresponding objectives, as well as additional studies that need to be completed. These goals, objectives, and studies and included as an attachment at the end of these notes.

Steve and Ron then discuss the habitat issues at the west bank area. Ron says he believes that the decrease in DO and increase in temperature along the west bank area is related to the operating of the Fairfield Pumped Storage Project. Steve asks Bill if he has a copy of some aerial photos that were taken prior to Project construction since the west bank features are the result of natural topography, of which Bill answers he is not sure. Steve says he will try to find the photos, since they might show how river flow was distributed between the east and west bank area before the Project was built. Steve says that the issue will be getting water into that west channel during low flow situations. Gerrit says that Duke Energy is building a separate dam to help control flows at one of its projects. He believes the group needs to focus first on deciding what the flow needs for the area are, by seeing the area during higher flow situations. This will allow the group to evaluate how flows might be manipulated to create an even distribution over the area during low flow situations. Steve adds that LIDAR information will also be helpful, and that baseline data on temperature and DO in the west bank area will be needed to feed into the module. Ron mentions that spring through fall data needs to be collected, since he hasn't studied the area except during the summer. Kerry asks if turbidity will need to be examined along with the temperature and DO. The group considers this but decides that turbidity data is not necessary.

While looking at a photo of the dam, the group notes that there is a bit of leakage, which could be beneficial to the seemingly flow deprived west bank area. Ron agrees, but points out that during the summer, any benefits of the slight leakage at the dam may be diminished by the time they reach the central rocky location in the west channel.

The group then focuses their attention towards defining the geographic scope of the Mesohabitat Assessment and Instream Flow Study. The next hydro on the Broad River, downstream of the Parr Fairfield Project, is the Columbia Hydro Project. The upper reach of the PBL for the Columbia Hydro is noted as being at a Rocky Shoals Spider Lily population located just above the upper tip of Boatright Island. The group discusses whether or not this should mark the end of the scope for the Mesohabitat Assessment. It is decided that the scope for the Mesohabitat Assessment will stretch from Parr Dam downstream to the lower end of Bookman Island. Bill S. points out that there is a tributary on the lower end of Bookman Island, named Big Cedar Creek, and the scope should include this as well.

After deciding the scope, the group begins discussion on which definitions to use for the various mesohabitats. Two slightly varying sets of definitions are considered, including one used during the Saluda Hydro Relicensing Project, and one used in the Bettinger Study. Alan points out that using the definitions from the Bettinger study will be good for consistency, however, the group seems to prefer the definitions used during the Saluda Relicensing. Shane points out that there are several other commonly accepted definitions for the various mesohabitats and so the group decides to consider these options also. This issue is left undecided for now.

The group agrees to stay with the methodology that was used in the Bettinger Study. The group then discusses what the ideal flow would be when conducting the study. Ron says that lower flows make it easier to delineate the habitats, while Shane says the flow should be near the mean annual flow when mapping. Ron suggests a flow that is below 2,000 cfs would be best for conducting the study, and everyone agrees.

The focus then turns to identifying target and driver species for the various Habitat Use Guilds. Ron offers his personal list of fish species he has observed in the Broad River to be used as a starting point. The group decides on a list of driver species including:

- Smallmouth Bass
- American Shad
- Brassy Jumprock
- Whitefin Shiner
- Robust Redhorse
- Santee Chub
- Striped Bass
- Piedmont Darter
- Snail Bullhead
- Redbreast Sunfish
- Channel Catfish

Although the list is longer than is customary, Alan says that it can be included in the study plan with a caveat that says some of these species will later be grouped into guilds. Alan makes the point that the species which have HSI curves need to be identified, and suggests that Shane and Brandon Kulik work together on this task. Shane and Brandon will also recommend surrogates for the group to consider that can be used for the species that do not have HSI curves and work on guild classifications.

The group then focuses on establishing general transect locations for the study. Dick mentions that in the Bettinger Study a majority of the river was categorized as being glides, pools and shoals, and that these will be areas to look for when deciding on transect locations. Ron specifies that he would like at least one transect to be established right below the Parr Dam, in the area he has identified as a critical habitat. The group launches into a heavy discussion on where the transects should go and how many are needed. Eventually everyone agrees to four general areas for the study to implement the IFIM technique. These include an area immediately below Parr Dam, upstream of Haltiwanger Island, along the Coleman property, and at Haltiwanger Island. Additionally, two other sites were identified for studying wetted perimeter/staged discharge relationships, at Huffman Island and Bookman Island. These locations are included in Figure 1. With these sites agreed upon, the group decides to schedule a field trip to identify the specific locations for transects. Group members interested in participating in this trip are Ron Ahle, Shane Boring, Gerrit Jobsis, Bill Stangler, Bill Marshall, Alan Stuart, Vivianne Vejdani, Milton Quattlebaum, Tom McCoy, Prescott Brownell, Steve Summer, Ray Ammarell and/or Bill Argentieri.

To close the meeting, the group discusses scheduling, keeping in mind that the final study plan needs to be developed by early 2014 to be included in the PAD, which is due late 2014/early 2015. The actual IFIM study will be started during the summer of 2015. The group plans to meet again during the July-August timeframe to discuss the draft study plan and HSI curves. With this, the meeting adjourns. Action items stemming from this meeting are listed below, along with an attachment that includes all decisions made during the meeting.

ACTION ITEMS:

- Shane Boring will contact Brandon Kulik to work together on identifying relevant HSI curves and surrogates for the study. Shane will also ask Brandon to make guild recommendations.

- Shane Boring will research other options for mesohabitat definitions to be used in the study.

- Kelly will schedule the “Transect Identification Recon Trip” with the interested parties for June 18th and 19th.

- Kelly will schedule a follow-up meeting/conference call during the July-August timeframe for the discussion of HSI curves and study plan development.

Goals and Objectives of Mesohabitat Assessment and Instream Flow Study

Goal 1: Characterize the flow/habitat relationships for aquatic species present in the lower Broad River below Parr Dam

- Objective A: Classify and quantify/map (characterize/define) Mesohabitats occurring within study area
- Objective B: Establish target species/guilds
- Objective C: Identify study methodology (recommended IFIM)
- Objective D: Identify tributaries and study areas (reaches) on the lower Broad River of interest for the study

Goal 2: Determine effects of Parr and FFPS operations on flows of the lower Broad River below Parr Dam

- Objective A: Identify operational ranges/constraints of two facilities
- Objective B: Evaluate effects of Project operations on Parr Dam releases at various inflow ranges into Project

Goal 3: Develop recommendations for Parr Hydro Project operations to enhance flows for aquatic resources in the Congaree River (this does not include a transect study)

- Objective A: Influence on diadromous fish (includes striped bass, sturgeon)
- Objective B: Influence on other resident aquatic species (including RT&E)
- Objective C: Influence on Congaree National Park
- Objective D: Consideration of Saluda operations consistent with goals of the Santee Basin Accord

Goal 4: Develop flow recommendations for lower Broad River below Parr Dam

- Objective A: Evaluate baseline habitat
- Objective B: Evaluate high and low flows
- Objective C: Seasonal and inter-annual variations of flow recommendations
- Objective D: Evaluate low flow protocol recommendations

Additional studies:
Temperature and DO in the west channel below Parr Dam (three monitoring locations)
Recreation flows – operation of Parr
Navigation flows – operation of Parr
Water Quality – operation of Parr

Define Geographic scopes of Mesohabitat Assessment and Instream Flow Study / Discuss Mesohabitat Assessment (including methodologies)

Geographic Boundary - Parr Dam to downstream end (lower extent) of Bookman Island, just below the confluence of Big Cedar Creek

Methodologies –
Mesohabitat unit definitions for visual assessment. (NOTE: May be modified by use of Saluda descriptions)

Habitat	Type Description
Riffle	Relatively shallow (<0.5m), swift flowing section of river where water surface is broken.
Glide	Relatively shallow (<1m); with visible flow but mostly laminar in nature; minimal observable turbulence; relatively featureless bottom.
Run	Deep (>1m), swift flowing sections with turbulent flow; surface generally not broken.
Pool	Deep (>1m) slow moving sections.
Shoals	Shoal area; which may contain a variety of habitat complexes.

Use same methods Jason Bettinger used for his study in the upper Broad River, such as GPS for start and end of each classification.

Mesohabitat study should be conducted below 2,000 CFS

Define Species of Interest for Instream Flow Study

Summary of Habitat Use Guilds

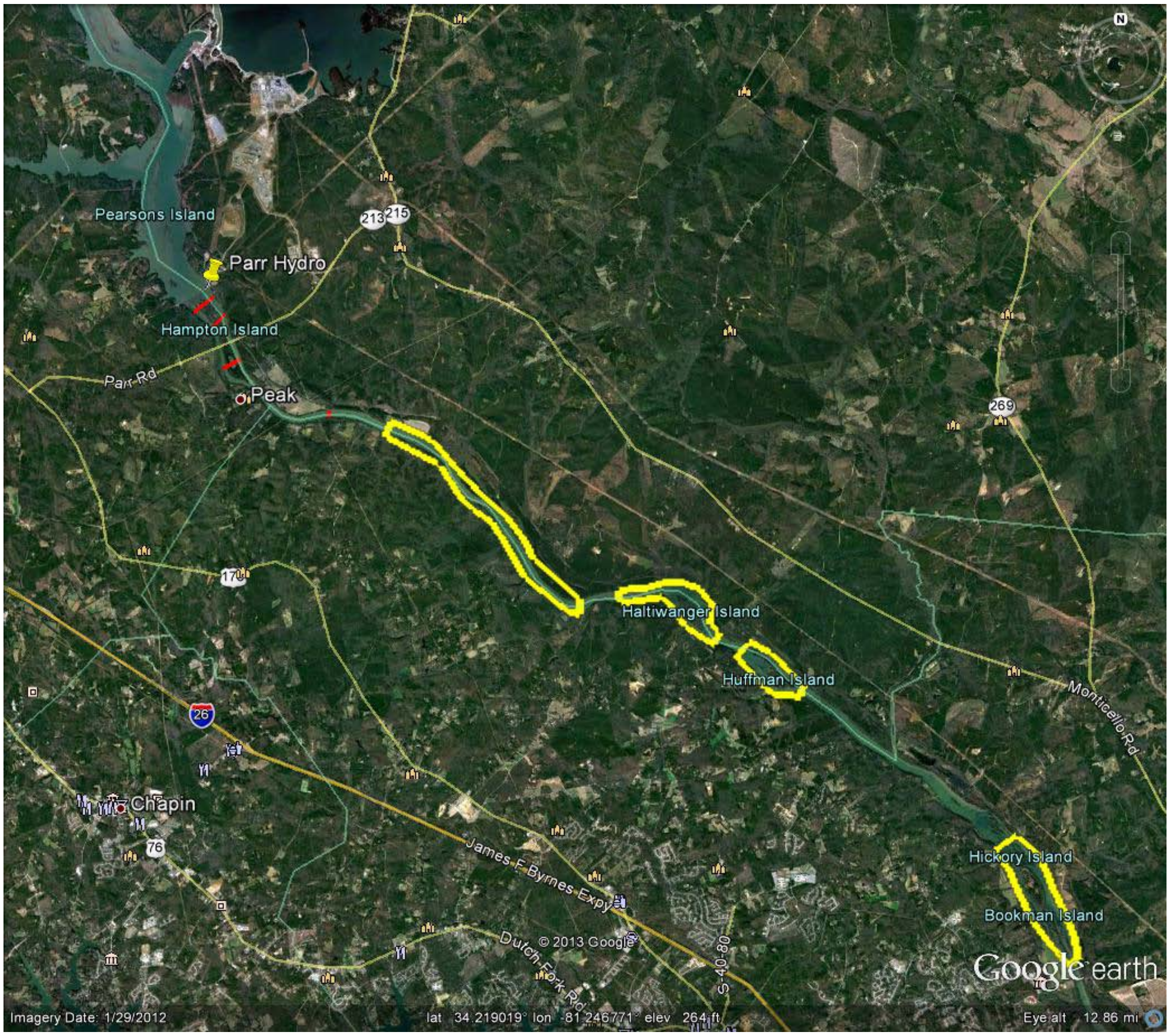
Driver Species:
American shad
Brassy jumprock
Channel catfish
Piedmont darter
Redbreast sunfish
Robust Redhorse
Santee chub
Small mouth bass
Snail bullhead
Striped bass
Whitefin shiner

Discuss Methodology (including HSI curves, number and location of transects, areas of specific interests)

Look for HSI curves that exist for driver species and make recommendations for surrogates and guilds

Methodology (number and location of transects, areas of specific interests): IFIM above Huffman Island, wetted perimeter for Huffman and Bookman islands.

Figure 1 **General Transect Locations**



MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Recreation TWC Meeting

May 14, 2013

Final KDM 06-17-13

ATTENDEES:

Bill Marshall (SCDNR)	Bill Argentieri (SCE&G)
David Haddon (SCE&G)	Milton Quattlebaum (SCANA)
David Hancock (SCE&G)	Randy Mahan (SCANA)
Alan Stuart (Kleinschmidt)	Kelly Miller (Kleinschmidt)
Alison Jakupca (Kleinschmidt)	Bill Stangler (Congaree Riverkeeper)
Jeff Carter	Billy Hendrix
Dick Christie (SCDNR)	Elly Jones (SCPRT)
Tommy Boozer (SCE&G)	Vivianne Vejdani (SCDNR)
Prescott Brownell (NOAA) via conference call	

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

After introductions, Bill A. gave the group a presentation on the property owned by SCE&G located below the Parr Dam. Bill emphasizes that this land is located outside of the Project Boundary Line. A map of the properties is located at the end of these notes. The Frost Mill parcel is approximately 62 acres of land where wood chips and other wood by-products are dumped. The Summer Shoals area has a public road (Fulmer Bottom Road) which leads down to the property however there are several other parcels of land that have no public access. Bill S. asks if SCE&G owns the islands below Haltiwanger Island, known as Chapel Shoals Island and Huffman Island. Bill A. says he is not sure, but he will find out and report back to the group through email.

Alan then focuses the group's attention toward reviewing the current Recreation Management Plan (RMP) for the Project. Bill M. asks if Tommy and David Hancock can go through each site again and explain what amenities are at each site. This information is as follows:

Lake Monticello

- Scenic Overlook – Includes ball field, tennis courts, restrooms, fishing pier, picnic tables, paved walking trail and a playground. It is to be noted that SCE&G only maintains the tip of the overlook. Fairfield County maintains the remainder, as they lease that land from SCE&G.
- Hwy 215 Boat Ramp – Includes a paved parking area, boat ramp with a floating dock, picnic table and shelter. No restrooms.
- Hwy 99 Boat Ramp – Includes a paved parking area, boat ramp and dock, restrooms, picnic tables and shelters. Primitive camping is allowed.

- Future park site – Includes a parcel of land with no public access to it. This area is set aside as a possible future recreation site.
- 7 islands – There are 7 islands on Lake Monticello, and all are used for recreation.
- Recreation Lake Impoundment – A 300 acre lake set aside completely for recreation. Includes a beach area, parking area, boat ramp, shelters, picnic tables, and restrooms. There are no docks on the recreation lake. The lake is surrounded by recreation-designated land, accessible only by boat, which can be used for camping. The beach area is open for use from April 1st until October 1st.

Parr Reservoir:

- Cannons Creek Boat Ramp – Includes shelters, restrooms and a boat ramp.
- Hellers Creek Boat Ramp – Includes picnic tables, shelters, and a boat ramp. No hunting is allowed in this area.
- Terrible Creek Waterfowl Area – Includes 638 acres available for hunting. This is a draw hunt, open one day a week, and has seven blinds, allowing up to 14 people.
- Hwy 34 Boat Ramp – This is a primitive unpaved boat ramp area, with no amenities.
- Enoree River Waterfowl Area – Includes 191 acres for first come, first serve hunting.

While Tommy is reviewing the various recreation sites at the Project, several comments and questions come up. Billy mentions that there are no trespassing signs located on the recreation-designated area surrounding the lake. Tommy clarifies that this area can be used for recreation however the signs are referring to an area leased from SCE&G by SCDNR. No trespassing is allowed on this property, as SCDNR uses it for various projects. Dick says this area may need to be identified with a name for clarification purposes. Also, regarding the Hwy 34 boat ramp, Jeff mentions that this area may need to be improved, if only for safety reasons. He points out that this would be helpful to SCDNR by providing easy access to that stretch of the river, in case of a drowning.

Tommy also mentions a parcel of land currently designated for recreation, known as the Lyne Tract, located very close to the Fairfield Pumped Storage Development. Although it is currently set aside for future recreation, this area is used for project operations, and may not even be safe for recreation, since it is located so close to pumped storage facility. David Hancock and Bill A. agree that this area, including the land located on both sides of the tailrace area, needs to be reclassified.

Billy inquires about a landing located at the top of the Enoree River, which he says is located within the PBL. He would like for this access area to be improved. The group discusses the exact location of this landing and decides it is near Maybinton Road in Newberry County. No one is sure if it is actually within the PBL, but Bill A. and Tommy say they will look into this further.

Alan then focuses the group toward discussion of the Recreation Use Needs Study (RUNS). The group brainstorms what needs to be included in the study, along with methods for data collection. Dick mentions that he would like to see duck and turkey hunting seasons to be included in the study, since there are two locations within the PBL designated solely for waterfowl hunting. Dick says that SCDNR's main issue with regards to recreation is capacity. He says they want to come away from the study with a greater understanding of current and future recreation use at the Project.

Bill M. brings up the idea of targeting specific groups through the RUNS, such as waterfowl hunters. Alan agrees and mentions contacting John Durham of the Tyger-Enoree River Alliance, who attended one of the public meetings in January. Bill S. adds that the Flyaway Foundation and Delta Waterfowl are two local groups who participate in recreation at the Project. These are all good groups to focus on interviewing for the study.

After everyone has submitted their ideas for the study, Alan has the group review the mission statement for the Recreation RCG to make sure the Recreation Plan study complies with the mission statement. Alan says the next step will be to draw up a draft study plan for the group to review. Brainstorming ideas for the draft study plan were collected by Bill A. and are attached to the end of these meeting notes.

The group then moves to the last item on the agenda, regarding downstream recreational and navigational flows. Dick says that there is a method identified in SC Water Plan for determining the flows needed to maintain navigation. These specifics are found in a 1988 report entitled Instream Flow Study, Phase II: Determination of Minimum Flow Standards to Protect Instream Uses in Priority Stream Segments. Basically it states that a minimum continuous flow for navigation should be at minimum, a depth of one foot across a channel 10 feet wide, or across 10% of a total stream width, whichever is greater. The minimum depth of one foot does not have to occur across a continuous 10% of the stream width however, each point of passage must be at least 10 feet wide.

The group discusses how they believe the shallow spot of the river is located around the second shoal below the dam, above Haltiwanger Island. Bill S. says that some of the areas between the islands should also be examined for constriction. All of these areas should be scouted during the IFIM study, to determine where the most shallow spot is located. Bill S. and David Haddon agree to speak to some people they know who are very familiar with the river and who may be aware of more restrictive areas of the river. Dick notes that the flow needs to be high enough to allow for fish and wildlife health, water quality, and recreational navigation. Although recreational flows included as part of this issue, the group agrees that the greater issue of navigational flows needs to be addressed within the Instream Flows TWC. Bill S. agrees, and states that in his opinion, although navigational and recreational flows are different, if navigational flows are addressed, by default recreational flows should also be sufficient, generally speaking.

Bill M. notes that there are some people who would like to paddle the entire Broad River, and in order to do this would need access to travel around the Parr Dam. He says that possibly a portage trail should be developed and, although he is unsure of what the demand would be, would like this or other ideas for portage around the dam to be considered.

As the meeting is wrapping up, Alan reviews the schedule for the remainder of the relicensing process. Dick expresses concern at the seeming halt in the process, between now and the submitting of the PAD. Alan says that during this time, SCE&G and Kleinschmidt will be writing study plans which will be returned to the TWCs for review. Alan also mentions that we can send out a draft copy of the PAD prior to submittal to FERC, for stakeholder review. He says we can revise the schedule to include a few extra meetings for reviewing the draft study plans and PAD, so everyone is still actively involved in the process.

Alan reminds everyone that the next Operations RCG meeting has been rescheduled for June 27^{th}. With this, the meeting is adjourned. Any action items stemming from this meeting are included below.

ACTION ITEMS:

- Bill Stangler and David Haddon will talk to some people they know who may be more familiar with the shallow spots in the downstream area of Broad River, concerning navigational flows.

- Dick Christie will gather any information SCDNR may have on the duck hunting seasons in the area of the Project.

- Bill A will investigate ideas for canoe/kayak portage around Parr Dam.

Recreation Use Needs Study

- Current use – Monticello Reservoir – February to Labor Day, Broad River Reservoir – Memorial Day to Labor Day
- Projected use
- Lake Park sites – interview
- Broad River Park Sites - interview
- Duck Season – Broad River Reservoir - Saturday after Thanksgiving to January 20??
- Goose Season – Monticello Reservoir – Fall - January
- Turkey Season – Broad River Reservoir - April
- Fishing Tournaments
- Hunting Capacity – are facilities enough to handle level of hunting
- Study period – one year
- Survey Interview Questionnaire – activity (fishing [bank/ pier / boat], pleasure boating, and hunting), park site condition assessment, crowding, what would be useful in future (amenity recommendations), camping, picnicking, wildlife viewing and photography, hiking, island use
- Demographic – zip code, county, birth year, number of people in party
- Time spent on lake
- Reason for choosing this area
- What other lakes to you recreate at?
- Destination
- Time of day – 8am – 12 noon, 12noon – 4pm, 4pm – 8pm
- Days of week – combination of week days and weekends, Memorial Day and Labor Day – random schedule
- Monticello Reservoir – interview locations Rt 215 Park Site, Rt 99 Park Site, impromptu fishing area east side of Rt 99, Recreation Lake (boat ramp and beach area), and Ball Park (Fairfield Overlook)
- Parr Reservoir (Broad River) - interview locations – Cannon's Creek Park Site, Heller's Creek Park Site, 34 Bridge Park Site, Enoree River Bridge (counter only/interview?)
- Target focus groups with questionnaire – waterfowl hunters, Flyway Foundation and Delta Waterfowl
- SCDNR provide waterfowl use data at DNR waterfowl hunting areas.

Recreational and Navigation Flows

One way downstream navigation - establish minimum continuous flow for navigation, – should be covered by IFIM study results. Description from SCDNR policy – "A minimum depth of one foot across a channel 10 feet wide or across 10 percent of total stream width, whichever is greater. Minimum depth does not need to occur across a continuous 10 percent of stream width, but each point of passage must be at least 10 feet wide."

Evaluate channels around islands. If one channel meets the criteria but the other side doesn't, DNR considers this as meeting the policy. Scout areas during IFIM study

Once navigation is addressed, the group believes recreation concerns on the Broad River have been addressed.

Evaluate portage around Parr Dam (west end)

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Rare, Threatened and Endangered Species TWC Meeting

May 16, 2013

Final KDM 06-17-13

ATTENDEES:

Bill Marshall (SCDNR)
David Eargle (SCDHEC)
Justin Lewandowski (SCDNR)
Shane Boring (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Gerrit Jobsis (American Rivers)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Randy Mahan (SCANA)
Karla Reece (NOAA) via conference call
Bill Stangler (Congaree Riverkeeper)
Sam Stokes (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting with introductions and a review of the agenda. Alan explains that Tom McCoy of the USFWS will not be able to join us for the meeting, but did send a list from the USFWS of rare, threatened and endangered species from Newberry and Fairfield Counties. Steve asks why blueback herring is on the USFWS list for Fairfield County, and Alan says that this is considered an at-risk species. Alan asks Bill M. if he sees any species that are missing from the list from a SCDNR perspective. Shane has a list of the SCDNR RT&E species, and says that the federally listed species match between the two lists. Bill M. mentions that Dick Christie gave him a list of species, mostly aquatic, and of varying levels of concern. The list includes the Newberry burrowing crayfish, a species with which the group does not seem familiar. Steve mentions that he knows Arnie Eversole, who may have more information on this particular species.

Alan asks the group what species they want to be studied. Bill M says that all of the species listed by Dick Christie need to be looked for during any studies completed for the Project. Gerrit says that American Rivers has an interest in the Project's 401 water quality certification, and thusly any species that may be associated with water quality. Alan asks the group if, with regards to a literature based survey, do all of the species listed need to be included in the survey? Bill A. begins a comprehensive list of species to be studied by combining the state conservation priority species from Dick's list with the species on the USFWS inventory, provided by Tom.

Alan asks if Steve and Milton are still doing fish surveys for the new nuclear project. Milton says they are within the Parr Reservoir.

Bill A. asks for clarification on how a "literature based study" will be performed. Shane explains that during a literature based study, a target species list is created based on consultation with the agencies, where then this list of species' preferred habitats are compared to the habitats present within a specific study area, to eventually determine which species are likely to occur within that study location.

Alan suggests that we include all of the RT&E species from the lists provided in the literature based study, and then tie the aquatic species back into the IFIM study, to prove that there is adequate and appropriate habitat for them. In regards to the bald eagle, it is easily observed that they are living in the area, and that they have plentiful and appropriate habitat. Shane adds that it will be important to show how SCE&G has implemented guidelines allowing for a healthy population of bald eagles on their land.

For clarification purposes, Alan asks again if there are other species that SCDNR would like to be studied. Bill M. says that he will talk with Dick to determine if there are any terrestrial species that need to be included. Bill M. asks if SCE&G documents any terrestrial species on their property. Steve says they do not generally do studies on terrestrial species, but there have been some surveys performed over the years on small mammals and plants. Sam Stokes says that since the Project area has been a disturbed site for many years, it wouldn't be typical to perform a terrestrial survey. He notes that terrestrial surveys are typically performed at undisturbed sites.

Steve remembers a plant species, known as Columbo that he and Milton surveyed for years ago. Bill M. says this species is on the list as a G5 and an S2, so it is added to the list of plant species to be studied. Steve notes that this plant needs to be studied in the springtime, as it dies back and is difficult to identify during other times of the year. The group agrees to just identify the species as being one known to occur within the Project Boundary. Steve says that this species is unlikely to occur near the Project shoreline, so it probably won't need to be addressed by the Shoreline Management Plan (SMP). Bill M. says that there are most species on the list provided by Dick, and they should be acknowledged as being within the PBL, if in fact they are.

A list is eventually fleshed out and is included at the end of these notes. Shane makes the point that these lists will be our starting point for inclusion in the study plan, and that it will then be up to the agencies to decide if any other species need to be included in the study.

Alan then focuses the group on the mussel and snail surveys. Steve notes that water quality monitoring is still being performed for the new nuclear project, which includes some macro and fish surveys in the Parr Reservoir and the area immediately downstream of the Parr Dam. Sediment, metals and other water quality parameters are also being studied in the area of the future new nuclear discharge, in the Parr Reservoir. John Alderman also performed a mussel survey in the fall of 2012, where he identified approximately nine different mussel species in the area from the powerhouse to about halfway down the first island downstream of the Parr Dam. Alan asks if the study looked for snails also, and Steve says he remembers two species of snails being identified as occurring within the study area, however snails were not looked for specifically.

Alan asks the group to identify what else we need to study, if anything, in terms of properly evaluating the affects of project operations. Do we need more studies done on mussels and snails, beyond what has already been completed? In addition to the Alderman study mentioned above, Jennifer Price completed a macroinvertebrate study in 2010. Bill A. suggests he and Alan talk with Tom McCoy to see what the USFWS's interest is in preparing another study on this matter. Bill M.

suggests everyone thoroughly review the two current studies to better understand what was found, and what may be lacking.

Gerrit points out that the data we have is already five years old and that by the time the license is due for renewal, it will be at least ten-year-old data. He wants to know if updated information will be needed, in case a new species is uncovered, or the presence of previously thought-to-be "rare" mussels are identified in greater numbers in a certain area. He mentions this as something for the group to think about.

The group decides that the mussel experts at SCDHEC and Tom at USFWS need to decide if another study is needed. We will reconvene to discuss this further, since no one is exactly sure yet if another study is needed or not.

The group then shifts its focus to the Rocky Shoals Spider Lily (RSSL). Bill S. says he conducted a presence/absence survey from the Parr Dam downstream to the Columbia Dam. He noted only two locations with the RSSL, one at Bookman Island, and another at a small island near Harbison State Park. He says there are only two seen locations, but other than a visual confirmation, nothing has been formally documented at this point. David Eargle mentions that he has seen a population at Haltiwanger Island however, Bill S. is not aware of this particular one. He says he will try to conduct another informal visual survey during the blooming season this year. Shane tells the group that the main point for discussion is identifying what the potential projects affects are that need to be addressed regarding the RSSL populations. He points out that the populations tend to move around some, depending on higher flows.

Gerrit tells the group that he is aware that there was a concern in August of predation to the RSSL by deer, so stakeholders examined wading depth as a measure of protection. They determined a flow that would provide a depth of water high enough to prevent deer from being able to graze on the plants, without keeping the plants submerged. Flow recommendations need to be made with consideration of this possibility.

Overall, we are aware of where the populations are located (with the need for a simple survey to be conducted by Bill S. upon his availability over the next three months), so now the group needs to identify ideal flow ranges for the plants. Deer predation is a valid issue, along with competition with other plan species. Inundation is acceptable for short periods of time however the plants do need to immerge at some point. It will be ideal for the plants to have flows mimic those of natural events.

The group decides that the proposed study should include field verification, in which basic metrics are collected, including location, basal area, and year to year basal change. Gerrit suggests the survey should be conducted two years in a row, while Shane suggests maybe a year should be skipped in between. Alan and Bill A. say that from a scheduling standpoint, the study will have to be completed during two consecutive years.

The group then discusses the possibility of a crayfish study. Everyone agrees that Alan and Bill will meet with Tom McCoy to scope out this study, as the USFWS holds the most interest with this issue. There are currently no crayfish studies underway, as part of the nuclear plant expansion.

Bill M. asks if eels are going to be studied. Alan mentions that these are being covered as part of the Instream Flows TWC. We are waiting for the fisheries study to be completed before meeting to discuss the eels further.

Karla Reece then joins the meeting via conference call to discuss the issue of sturgeon passage. She tells the group she just received confirmation from Bill Post that sturgeon are passing through Granby, however, they may not be able to pass through the Columbia Dam. If the sturgeon are not able to pass through Columbia, there will not be a need for a study at Parr. She says that she will regroup internally and reconvene with the TWC to let us know what she finds out. Bill A. asks for clarification on whether we are discussing Shortnose Sturgeon, or Atlantic Sturgeon, and Karla says both.

Regarding Section 7 consultation, the National Marine Fisheries Service (NMFS) will only require consultation if sturgeon are able to pass up to Parr Dam. Gerrit says that we know we have Shortnose Sturgeon below the Columbia Dam, and that there has been spawning in the area. He asks how do flows affect the species, and what are the species' needs regarding flows? Karla says she will look into that, to determine if flows from Parr are having any affect on the sturgeon spawning downstream. If so, this will affect the possibility of Section 7 consultation.

Bill A. asks if we need to include sturgeon in the IFIM study consideration, along with the other target species identified at the meeting. Gerrit mentions that the time frame would be different for sturgeon than for the shad and other target species for the IFIM. Alan asks Karla to provide us with as much information as she can, as soon as she can for us to move forward. He points out that we do not need anything formal at this point, since the relicensing process hasn't officially begun.

The group agrees to meet again in late June/early July to discuss Karla's findings.

Alan tells the group that we are planning to issue a draft PAD to the group for review in the fall of 2014, to allow for everyone to see if anything has been missed before the package goes to FERC for approval. With this, the meeting is adjourned. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- A small group including Alan and Bill A. will meet with Tom McCoy to get the USFWS' input on the issues/studies discussed during the meeting.
- Bill S. will survey the area downstream of the Parr Dam to identify and confirm all possible Rocky Shoals Spider Lily populations.
- Karla will find out as much information on the sturgeon issues within the Project Area as soon as she can and will report back to the group by late June/early July.
- David Eargle will have the mussel experts at DHEC review the two current macroinvertebrate studies and determine whether another study in the Project Area is needed.

- Shane will begin developing study plans for the literature-based RT&E study and the RSSL study.

RT&E Meeting Issues

RT&E Survey (literature based)
Species to be investigated in addition to USFWS list:

State conservation priority species:
Newberry burrowing crayfish - highest
Robust redhorse – highest
Piedmont darter - high
Seagreen darter - high
Highfin carpsucker - highest
Quillback - high
Santee chub - high
Striped bass – high
Bald eagle – State Threatened

Terrestrial (Vascular Plants):
Frasera caroliniensis (Columbo)
Additional plant species in the database

Develop study plan to address what species will be evaluated and how our literature search will be conducted.

Mussel & snail survey

Jennifer Price study
Alderman study (NND)

Rocky Shoal Spider Lily:

Sufficient flows recommendations on low flow (deer perdition), high flows (inundation)
Upstream of Bookman Island
Upstream of shoals above I-20

Field verification:
Shoals at upstream of islands (Haltiwanger – Frost Shoals)

Metric:
Location
Basal area
2 year survey

Crayfish:

Discuss with Tom McCoy

Sturgeon – Shortnose / Atlantic:

Kleinschmidt

Karla will re-group with other NMFS to discuss status of SNS and Atlantic sturgeon downstream of Parr-Hydro

Provide to the group with any information needs by June/ July time frame

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Lake and Land Management TWC Meeting

May 21, 2013

Final KDM 06-18-13

ATTENDEES:

Gerrit Jobsis (American Rivers)
David Haddon (SCE&G)
David Hancock (SCE&G)
Alan Stuart (Kleinschmidt)
Alison Jakupca (Kleinschmidt)
Tommy Boozer (SCE&G)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Randy Mahan (SCANA)
Kelly Miller (Kleinschmidt)
Jeff Carter
Dick Christie (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting by giving an overview of the agenda. He then turns the floor over to Tommy, who begins leading the group through the current Shoreline Management Plan (SMP) for Lake Monticello. As the group reviews the current SMP, there is discussion on updates and information needs for inclusion in the new SMP. Itemized notes taken during the meeting on suggested changes and information needs for the SMP, along with a draft outline for the document are included at the end of these notes.

Tommy explains that the Parr Reservoir was not included in the SMP, which is something the LLM TWC will need to address. He also tells the group that no dock permits have been issued in the Parr Reservoir, so any existing docks are examples of encroachment. On the issue of permits, Alan suggests that the new SMP only include shoreline management information, with permitting matters to be included in a separate handbook. This handbook with the permitting requirements set up by SCE&G does not need FERC approval, so it would be beneficial to keep the two documents separate.

Tommy moves to the Game Management section of the SMP, and explains that both reservoirs are designated Wildlife Management Areas (WMAs).

Gerrit and Randy discuss some of the language used in this section and agree how it is very vague in spots. Dick agrees saying he finds the document to be confusing and believes it doesn't serve its purpose for specifying shoreline management. He says that it includes a lot of information on lake use, but not on how to properly and appropriately manage the shoreline. David Hancock tells the group that originally the document was intended to be part of a dock management program for Lake Monticello, as an SMP was not required with the original license. Dick tells the group that FERC has produced a document that guidelines what they want to see in an SMP. He suggests this would be good to reference when the group begins working on the new SMP.

Regarding waterfowl management for the Broad River and the Enoree River, Tommy says that updated hunting regulations need to be referenced when writing the new SMP. Dick suggests this information be included in a Lake Uses section. Alan also suggests this information could be included as an appendix.

David Haddon asks if SCDNR and SCE&G police the hunting properties at the Project. Tommy says that only SCDNR polices the areas, but that SCE&G does control the area of the lake that is included in the nuclear exclusion zone. Randy says that SCE&G is going to protect their property however SCDNR has the responsibility of protecting the areas designated for certain programs. Randy also explains that since Lake Monticello is now designed as a water of the state, versus being classified as private waters, it can now be enforced by the state of South Carolina. Dick suggests a subcommittee be formed to look into the legal issues and regulations for these reservoirs. Randy agrees, saying SCE&G, SCDNR, and SCDHEC need to get together and decipher who is responsible for enforcing the various regulations for the two reservoirs.

Jeff asks if the SCDNR regulation book displays where the WMA lands are specifically. Dick says this information actually changes year to year, and that maps are printed annually to designate where the lines are drawn. Although there is public access to the maps, Jeff says that he believes a lot of people probably end up unintentionally breaking the law by hunting illegally in the regulated WMAs, simply because they are unsure of where the lines are located. David Hancock says he thinks that there may be a greater issue with people hunting WMA land who cross over onto private land. He does mention that he believes the SCE&G land department does a good job at marking the PBL, so hunters are aware of that specific property line. However, David also says he thinks they need to do a better job around the developed areas on Lake Monticello, by displaying signage that specifies there is no hunting on these lands. Dick says this is why they need to be more diligent in assigning land use classifications, so that all land within the PBL is identified for specific uses. The group brainstorms some land classifications that they are sure will be needed, and this list is included at the end of these notes.

Tommy then moves on to discussing the shoreline activities section in the current SMP. He says there is a non-disturbance policy on the shoreline of Lake Monticello, except for the allowance of access paths. He mentions that most of the access paths aren't even ten feet long just due to the size of the lots. Tommy also explains that in coves there is a distance requirement of 200 feet in order to build a dock. In other words, if a cove is not at least 200 feet from bank to bank, a dock cannot be built due to constriction concerns.

Within the current SMP, it is stated that every five years SCE&G will collect $100 per dock from the permit holder. Alan asks Tommy if this should be included in the updated permitting handbook, since this fee is not enforced currently. Tommy says that the fees are not collected on Lake Murray, so they will not be collected on Monticello. However, he thinks it should still be included in the handbook in case SCE&G does begin enforcing the fee requirement. Dick tells the group of a program that SCDNR has started on the Catawba-Wateree Project impoundments, where Duke Energy collects a one-time fee of $250 for the building or rebuilding of a dock. The money, along with some initial funds contributed by Duke Energy, goes toward funding a program for habitat enhancement around the lakes. Dick says that to date this has been a great program and may be implemented at the Duke Energy-owned Keowee-Toxaway Project. As SCE&G would work in conjunction with SCDNR, this would be included as part of the permitting program set up by SCE&G. All activities funded by the program are approved by a board. Everyone agrees that this sounds like a good idea and will keep it in mind as a possibility. The group also agrees to work on the SMP before focusing their efforts on permitting.

Gerrit asks if there is a land use classification system set up for Parr Reservoir. Tommy says that there isn't one at this time, but that that is something the group is going to work on through this process.

Alan asks if the SMP should include more information about bio-stabilization. David Hancock says that the shoreline around Lake Monticello is very hard to deal with, so bio-stabilization efforts may not help or even be possible in areas. Since the PBL would have to be cleared to do the work, these efforts may do more harm than good. Dick agrees, but says they do need to look into a way to preserve their land, since there is significant erosion happening in specific areas. He says that SCE&G should keep an eye out for future technology that may allow for easier bio-stabilization of the shoreline.

Gerrit asks if the objective of today's meeting is to develop a study plan, or a new shoreline management plan. Alan explains that the ultimate goal of the TWC is to develop a new shoreline management plan, and we want to include a draft of the SMP in the PAD for FERC. The first step of developing the SMP is to create an outline of what will be included in the final SMP, which is what we are working on in this meeting. While the draft SMP is not a "study plan" that FERC will need to approve, it is beneficial to include in the PAD, so that FERC can provide their opinion on it along with any suggestions or guidelines for the final document. The group decides that the draft SMP to be included in the PAD will consist of a preamble and a table of contents. Gerrit suggests that Kleinschmidt and SCE&G draft the outline and then bring it back to the group to approve. Everyone agrees that this would be most efficient, and Alison offers to develop the draft outline and bring back to the group for review at the next meeting.

Through the remainder of the meeting, the group tosses around various points of discussion, which will be addressed fully as the process of developing the SMP advances. These topics include:

- Reviewing and clarifying the existing Memorandum of Understanding (MOU) agreement between SCE&G and SCDNR.
- Defining any prohibited activities on the islands. Dick sites Article 18 to the group, which says recreation should be allowed except when trying to protect life, health and property.
- Clarifying what land is approved for hunting, and where the WMAs are located.

Bill makes the point that there is no need to begin working on a Woody Debris Management Plan, Buffer Zone Management Plan, and Sedimentation and Erosion Control Plans until the PAD and NOI are approved by FERC, as all of these plans may not be needed for this project.

Alison suggests that the final SMP be developed as two documents combined together, with each half of the combined document dedicated toward a specific reservoir. Ultimately, there will be two SMPs, one for Lake Monticello, and one for the Parr Reservoir. Everyone agrees that this organization makes the most sense, and will be easy for the public to follow.

Dick asks that a large map be produced that shows the PBL along with SCE&G owned lands around the Project, to be used as a tool within the TWC. This large map will allow for everyone to more easily visualize the Project Area and where all of the lines are drawn. Tommy says he will work on developing two maps, one for Monticello Reservoir and one for Parr Reservoir. It is also suggested that SCE&G talk with Fairfield and Newberry counties about adding a layer on their maps with the PBL, so the public can easily access this information.

The group agrees to meet again in the July/August timeframe, once there is a draft outline for the SMP to review and finalize for addition into the PAD. It is noted that at the first public meeting, SCE&G needs to advertise that they are developing a new SMP for the Project and that interested members of the public need to get involved in the process. With this the meeting is adjourned. Action items from this meeting are listed below.

ACTION ITEMS:

- Alison will develop a draft outline for the new SMP.

- Tommy will work on creating two large maps of the Project Area that includes the PBL and identifies SCE&G owned lands.

Shoreline Management Plan – Suggested changes:

I.3 Undeveloped Areas

Company-owned land lying within the boundary lines of the Project will be maintained through a sound forest management program, where appropriate. New plan should clarify this description.

I.4 Game Management - Include details of fishing and hunting guidelines.

Clearly identify GMA property for hunting areas

Prohibit hunting on lands below residential property

Land Classification:
Nuclear Exclusion Zone
Operations
Forest Management
Recreation
Wildlife Conservation

Discuss boat lifts in new SMP

Proposed outline of new SMP:

1.0 INTRODUCTION

2.0 PURPOSE AND SCOPE OF THE LAND USE AND SHORELINE MANAGEMENT PLAN

3.0 SHORELINE MANAGEMENT PLAN GOALS AND OBJECTIVES
3.1 Consultation
3.1.1 Recreation/ Lake and Land Management Resource Conservation Group
3.1.2 Lake and Land Management Technical Working Committee
3.1.3 Meeting Schedule

4.0 INVENTORY OF EXISTING ENVIRONMENTAL RESOURCES
4.1 Acreage of Project lands and existing classifications
4.2 Geology and Soils
4.2 Water Quality
4.3 Aquatic Resources
4.4 Terrestrial Resources
4.5 Cultural Resources
4.6 Land Use and Aesthetics
4.7 Recreation Facilities and Use

5.0 HISTORY OF THE PARR/MONTICELLO SHORELINE MANAGEMENT PLAN
5.1 Current Document
5.2 Project Boundary

6.0 LAND USE CLASSIFICATIONS (Parr Reservoir and Monticello Reservoir)
6.1 Forest Management

6.2 Public Recreation
6.3 Nuclear Exclusion Zone
6.4 Natural Areas
6.5 Project Operations
6.6 Wildlife Conservation Area
6.7 Dock Exclusion Area
6.8 Dock Approval Area
6.9 Islands

7.0 LAND USE PRESCRIPTIONS
7.1 Nuclear Exclusion Zone Prescriptions
7.2 Wildlife Conservation Area Prescriptions
7.2 Public Recreation Prescriptions
7.3 Forest Management Prescriptions
7.4 Natural Areas Prescriptions
7.5 Project Operations Properties
7.6 Shoreline Structures Prescriptions
7.7 Dock Exclusion Area Prescriptions
7.8 Dock Approval Area Prescriptions
7.9 Islands Prescriptions

8.0 ACTIVITIES AND STRUCTURES PERMITTED WITH SCE&G APPROVAL

9.0 EVALUATION PROCESS FOR NEW SHORELINE FACILITIES OR ACTIVITIES
9.1 Land Management Classification of Proposed Project Location
9.2 Allowable and Prohibited Facilities and Uses for Proposed Project Location
9.3 Shoreline Permitting Procedures
9.3.1 Limited Brushing High Water Mark or in Buffer Zones
9.3.2 Woody Debris & Stump Management
9.3.3 Water Withdrawals
9.3.5 Shoreline Stabilization
9.3.6 Docks
9.3.7 Boat Lifts

10.0 SCE&G PERMITTING FEE POLICIES

11.0 ENFORCEMENT OF SHORELINE MANAGEMENT PLAN
11.1 Violations of Shoreline Management Plan

12.0 BEST MANAGEMENT PRACTICES
12.1 SCE&G Shoreline Management (include Forest Management BMP)
12.1.1 Shoreline Permitting Program
12.1.2 Erosion Control
12.1.3 Re-Vegetation of Disturbed Areas (could combine)
12.1.4 Shoreline Enhancement Program
12.1.5 Aquatic Plant Management Activities (could combine)
12.2 Recommended Land Owner Best Management Practices (BMPs)
12.2.1 Minimizing Non-Point Source Pollution
12.2.2 Vegetation Management (could combine)

13.0 PUBLIC EDUCATION AND OUTREACH
13.1 SMP Education

LIST OF FIGURES

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Other Information Needs:

Updated maps of Project with acreages of SMP classifications

Review and revisit or clarify existing MOU agreement with DNR

Develop Permitting Guidelines

Better describe hunting on SCE&G property not within WMA property

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Operations RCG Meeting

June 27, 2013

Final KDM 07-16-13

ATTENDEES:

Vivianne Vejdani (SCDNR)	Bill Stangler (Congaree Riverkeeper)
Dick Christie (SCDNR)	Bill Argentieri (SCE&G)
Scott Harder (SCDNR)	Ray Ammarell (SCE&G)
Malcolm Leaphart (Congaree Riverkeeper)	Kelly Miller (Kleinschmidt)
Gerrit Jobsis (American Rivers)	Alan Stuart (Kleinschmidt)
Prescott Brownell (NOAA)	Bill Marshall (SCDNR)
Joseph Wojcicki (By-PAS)	Jon Quebbeman (Kleinschmidt) via Conf. Call
Erich Miarka (Gills Creek Watershed Association)	Randy Mahan (SCANA)
J. Hagood Hamilton, Jr. (SCANA)	

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting with introductions, and then turns the floor over to Gerrit. Gerrit begins with showing information collected from the USGS gages at Carlisle and Alston. The gage at Carlisle is located upstream of the Project, while the Alston gage is located downstream of the Parr Dam. The first slide Gerrit presents is of flow data collected at each gage over the previous week. He then shows a slide that includes flow data from each gage over the past thirty days, making the point that the Project does have an effect on flows. He says that American Rivers has been interested in the phenomenon of how the Project changes the flows of the Broad River, and so they asked Erich to study this effect as part of his graduate work with the University of South Carolina.

The result of this study was Erich's thesis paper entitled "Flows Effects of the Parr Hydroelectric Project," which was distributed to members of the Operations RCG in advance of the meeting. Erich then presented his findings, allowing for questions during and after the presentation. One issue that was raised was the selection of the Indicators of Hydrologic Alteration (IHA) software that Erich used to analyze the flows. As Erich indicates in his paper, the standard method of using IHA did not apply in this particular situation, however, the nature of the data and location of the gages did fit the intended use of the software. Also, IHA is designed to use daily data versus the 15 minute discharge data that Erich substituted. Erich explains to the group that this replacement in effect did not make a difference to the overall results, as long as one keeps in mind that this substitution was done. Erich also admits that some of the numbers may be larger than expected, and larger than actual, due to him not accounting for flow attenuation when determining inflow. He also points out that the number of reversals indicated in the study may not be realistic, since there was no threshold limit in determining a reversal. Keeping these considerations in mind, Erich asks the group for any questions.

Ray and Bill A. ask Erich why he decided to use hourly data instead of daily data, which was also available. Erich says he felt like the hourly variability would have been lost if he used a daily average, and that hourly variability is what he wanted to capture through this study. He reiterates that if it is noted that the units were changed from daily to hourly in the IHA software, it doesn't matter which data is used. Gerrit agrees, stating that American Rivers was interested in seeing the changes in flows in regards to how they affect the river. It is important to examine how the hourly fluctuations affect the aquatic environment. Ray points out that although it may seem like a simple substitution, the model may have been built with constraints that could skew the hourly data. Since the software was designed to handle only daily data, using hourly may not just be a simple substitution, as this type of software is often very complex.

Jon then adds his comments on the study. He says that he doesn't agree with the surrogate river used as part of the study to determine the pro-rating ratio. He also mentions he would like to see a more robust modeling system used. He says that selection of specific periods in time is not representative of an entire year or decade. Jon believes that it should be easy to run this same analysis on a continual basis to gain a greater understanding of what's typical for this stretch of the Broad River. He adds that straight line proration is not appropriate to use here. Erich responds by saying that 83% of the study areas is covered by gages, so only 17% of the data was prorate, which he believes is fairly insignificant. Erich adds that he thinks it is important to show what Project operations are capable of doing. Gerrit agrees with Jon and says that the Project can and should be studied more robustly, but that Erich's study contains some important results and can be used as a starting point for future study. Jon says that he just doesn't want the results of the study to be misinterpreted as what the Project is definitely doing. He thinks this is an example of what the Project can do, but not what is actually happening. He points out that any dam is going to alter the flow regime of a river. However, determining the actual effects that the Project is having is what's important, and since Jon doesn't believe the study is taking into account typical operations (since periods of time were chosen to study versus a continuous time period that stretched back one or several years) the actual effects are not accurately represented.

After discussion on Erich's paper concluded, Ray presents the group with information on Parr Hydro project regulation effects, the Project's license compliance summary, and an overview of the Parr and Fairfield plants. These presentations are attached at the end of these notes. Several questions arose during these presentations and are discussed below.

Scott asks Ray if the evaporation numbers included as part of the inflow/outflow values take into account the evaporation from the nuclear plant. Ray answers yes the evaporation is calculated over the entire Monticello reservoir.

Gerrit asks how low the gates can operate at the Parr Dam and how low the units can operate. Malcolm then asks if they have any water quality issues regarding nitrogen due to aeration. Ray says he doesn't have the answers to these questions, but that he will find out and get back with the group.

After lunch, Alan leads the group in a discussion on identifying any information needs and how the group would like to address these needs. Bill A. brings up a list of information needs that were identified early on by the agencies and NGOs to use as a starting point.

The group first tackles the issue of determining what effects Project operations have on the Congaree River. Bill S. adds that we need to look at how operations impact fisheries and aquatic resources, along with flood inundation at the Congaree National Park (CNP). Alan asks the group what specific information is needed, and how do we go about getting that information? He also asks if we want to use a long term record, or just a snap shot. Gerrit says a snap shot can be used to simulate how the flows would be without the Project. Ray adds that we would then have to develop a hydrologic model. We can then determine how the Project affects flows, river levels and ultimately the national park.

Jon suggests the use of a model known as HEC-EFM, which can use any timescale, and can be tied directly to GIS information. Gerrit mentions that the CNP already collects data over many transects across the park and it would be great if this HEC-EFM model could interact with the one already used. Jon says that if the model already used at the CNP is HEC-RAS, the information can easily be transferred into the HEC-EFM. Ray points out that if you have HEC-RAS model information you can then use the HEC-EFM model to produce the GIS data that can potentially be used with any GIS application available. Bill S. mentions a model known as TUFLOW has been used at CNP. Jon says that this model is very different from the HEC-EFM, which is much more user friendly. Scott asks if the models take into account the downstream attenuation. Jon says he knows that the HEC-EFM does, but he isn't sure about the TUFLOW.

Jon and Ray agree that routing can be done using a one dimensional approach, as a 2-D model might give more information than is actually needed. Gerrit agrees.

Jon tells the group that metrics need to be determined to develop an effective HEC-EFM model. Gerrit says that species of importance have already been determined as part of the IFIM study.

The group agrees that it will be important to examine the Broad River and the Saluda River, since both have an effect on the Congaree River. The group then discusses how this will be possible, through the use of historical data to create a baseline model. Jon points out that developing the various models will not be difficult instead the hard part of the process will be to develop the metrics. The group tells him that some of the metrics will be determined based on the IFIM study, while the others have already been established for the CNP.

The group decides to use the existing USGS data to establish a baseline, and then create an operations model utilizing this baseline and the already determined metrics. Scott wants to know if a reasonable model can be built that will accurately capture the complexity of the Project. Jon says that it can, but it will be difficult and the resulting model will be very complex. He adds that as with any model, everyone needs to keep in mind that the results will be greatly simplified.

The group then discusses the creation of a water budget, or allocation model. Gerrit mentions there is a possibility that a statewide basin model might be created in the near future, and that could be utilized here. However, he states that we won't know until August if this project will be funded. A water allocation budget will be part of the operations model that was discussed earlier. It will be used as a constraint within the model.

The possibility of a sediment management plan is mentioned. The group is reminded that the Water Quality TWC is working through this issue and will report back to the Operations RCG on what they determine. Currently the Water Quality TWC is considering whether a sediment management plan is needed or not, and if not, addressing the need for a plan to be in place to handle future sediment management considerations.

As the meeting wraps up, Ray and Jon plan to get together to begin initial development of the operations model, with plans to get Scott involved further in the process. Gerrit asks if the group wants to evaluate Erich's study any further. Jon says that more information along the lines of his study will be coming out of the operations model.

The group will plan to reconvene in the late September/early October timeframe to discuss a study plan for the operations model. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Ray and Bill A. will follow up with answers to some of the operations questions that were asked during Ray's presentation.
- Jon Quebbeman will prepare an outline of development of the Operations Model for distribution to RCG.

- What effects do dam operations have on the Congaree River? It is noted that operations appear to affect the minimum (lower) and maximum (higher) outflows relative to corresponding inflows and that flow pulses increase with flow. Are these measureable at Congaree? The Jobsis (Erich Miarka) study is referenced. (Operations)
    - Effects on aquatic resources
    - Effects at Columbia USGS gauge
    - Effects on the Congaree National Park
    - Magnitude and frequency of flows at CNP gauge
    - What are we trying to compare?
    - Inflow vs what is seen at Columbia USGS gauge and CNP
    - HEC- EFM (ecosystem function model)
    - First cut – one dimensional, unsteady state conditions model
    - Possibly build HEC-RAS model of Congaree River reach
    - What is happening now?
    - What changes could be made to improve flow conditions?
    - Use USGS data that already exists
    - Might need to develop an operations model in addition to our flow routing model
    - Time step to be used – hourly???

- Description of current operations and proposed future operations at the project and related effects on instream flows. (Operations)
    - Related to Broad River
    - Not proposing any change in future operations at this time
    - Evaluating current operations and potential operations that may benefit IFIM results and CNP needs
    - Effects of Parr Project on downstream flow – similar to IHA analysis

- Water budget/allocation model– (Operations)
    - Project effects on downstream water budget – (Operations)
    - What are the projected long term water demands on the Broad River? This will require coordination with the City of Columbia and analysis of their plans for projected population growth and water supply demands. It will also have to consider future demand from facilities like VC Summer and other water users. (Operation)
    - daily operations, low flows, drought, & flood
    - operational constraints
        - Water allocation assessment/budget
        - Inflow patterns/data set – potential changes in future inflow patterns and water demands (constraints in flow model from above)
        - Potential to use statewide model to address this issue
        - Develop future inflow series
        - This will be in a checklist format

- Information sheet: A comprehensive explanation of the hydro operations at the Parr Shoals Project. Including: daily operations, low flows, drought, flood and status on existing units (working condition) (Operation)
    - Addressed in today's presentation
    - Additional group information needs will be addressed as they arise

- Information sheet: A comprehensive explanation of the operations at the Fairfield Pump Storage station. Including: daily operations, low flows, drought, & flood. (Operation)
    - Addressed in today's presentation
    - Additional group information needs will be addressed as they arise

- Future operational plans
    - TBD

- Instream flow compliance records
    - Will be provided after this meeting

- Sediment management plan
    - Is there a sediment management plan needed
    - If not, is there a plan to address this concern if it is determined to be needed at a later date
    - Let WQ TWC address this and what information is needed to look into a management plan

- Low Flow Protocol – LFP
    - To be determined during relicensing

- Develop inflow determination protocol – streamflow gauging process, determine inflow to project at a given time, look into scaling of gauges

Flow Effects of the Parr Hydroelectric Project

Erich Miarka
University of South Carolina

MEERM 2012

Outline

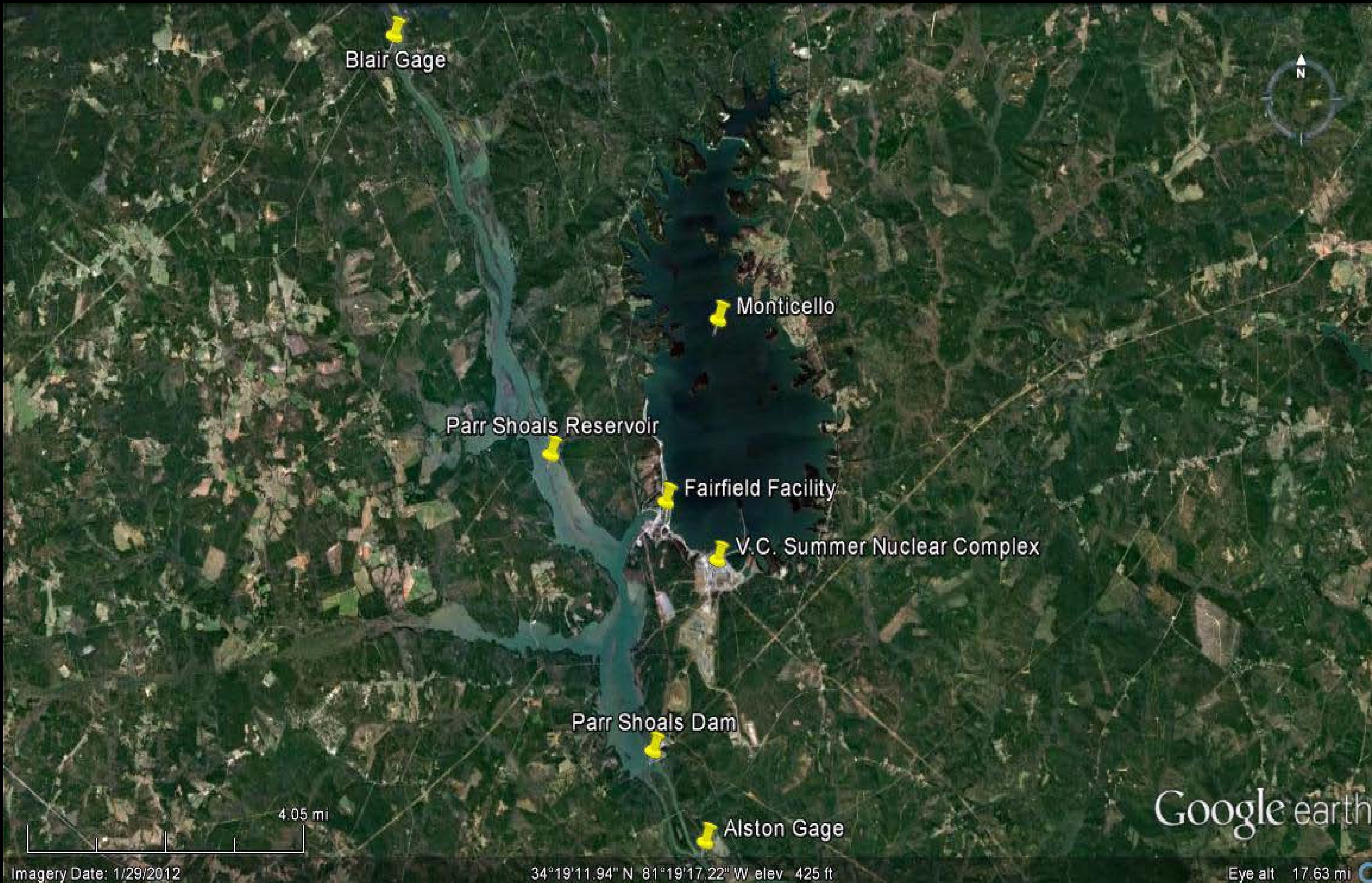
- Brief Description and Background
- Advisors and Internship Site
- Study Area
- Objective of Study
- Methods & IHA
- Results & Implications

Overview

- The Parr Hydroelectric Project is owned and operated by South Carolina Electric and Gas Company (SCE&G)
- License with the Federal Energy Regulatory Commission expires in June 2020
  - SCE&G will likely begin relicensing procedure within next year
- Stakeholders will have a chance to intervene in relicensing process

Internship Site & Advisors

- American Rivers
  - Gerrit Jöbsis: Southeast Regional Director
  - Rebecca Haynes: Associate Director, Southeast Conservation
- University of South Carolina
  - Dr. Allan James: Professor, Department of Geography
  - Dr. John Grego: Associate Professor, Department of Statistics

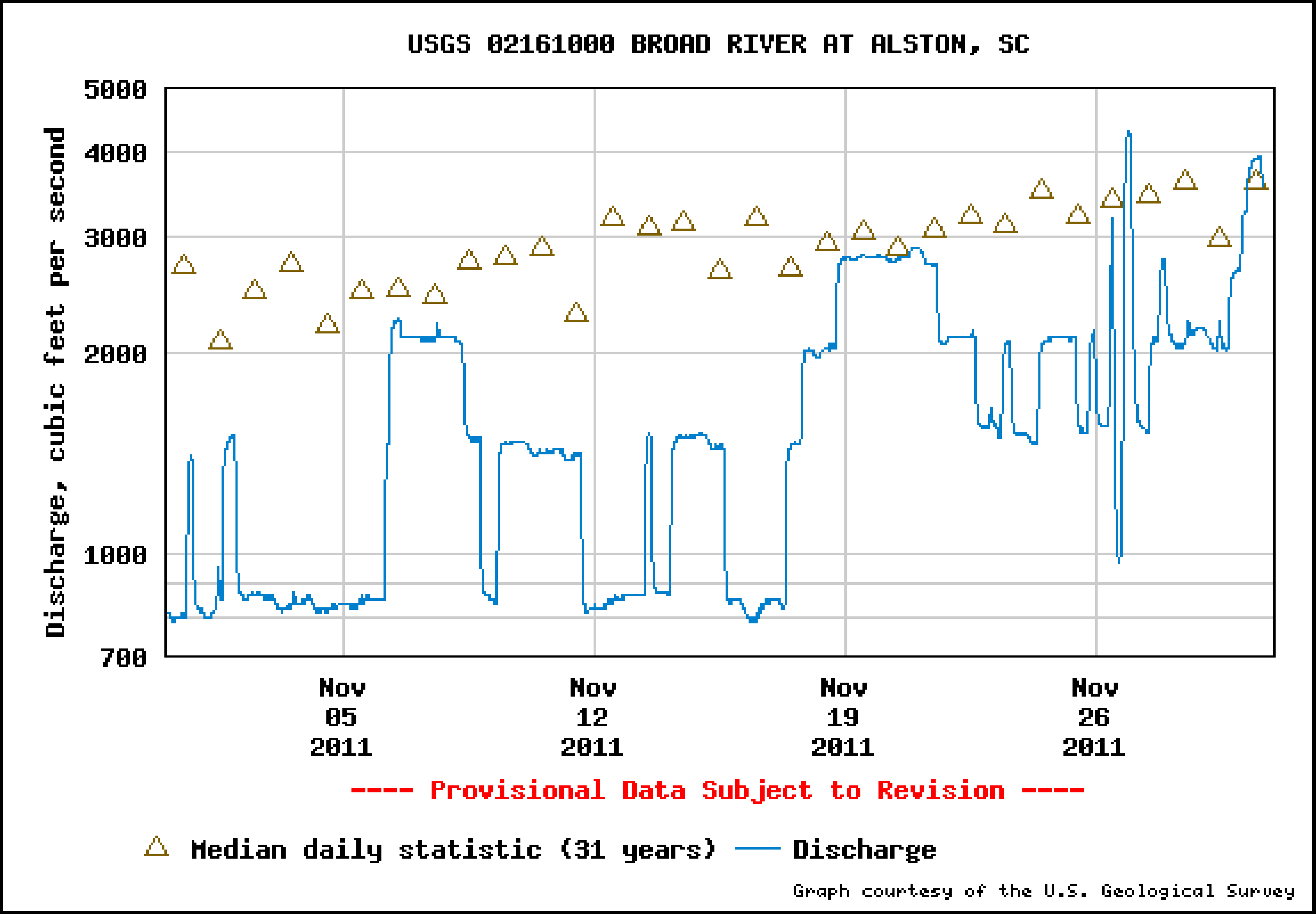

Blair Gage
Monticello
Parr Shoals Reservoir
Fairfield Facility
V.C. Summer Nuclear Complex
Parr Shoals Dam
Alston Gage
N
4.05 mi
Google earth
Imagery Date: 1/29/2012
34°19'11.94" N 81°19'17.22" W elev 425 ft
Eye alt 17.63 mi

Research Question

- What effect is the Parr Hydroelectric Project having on flow?
  - What ability does it have to alter the flow regime it receives?

Critical Steps

- Calculate inflow to the Project
- Analyze flow data below the Parr Shoals Dam
- Determine frequency and severity of flow alteration
  - Pulses in water release
- Results to be used in FERC relicensing procedures for Parr Hydroelectric Project by American Rivers


USGS 02161000 BROAD RIVER AT ALSTON, SC
Discharge, cubic feet per second
5000
4000
3000
2000
1000
700
Nov 05 2011
Nov 12 2011
Nov 19 2011
Nov 26 2011
---- Provisional Data Subject to Revision ----
Median daily statistic (31 years)
Discharge
Graph courtesy of the U.S. Geological Survey

The River System

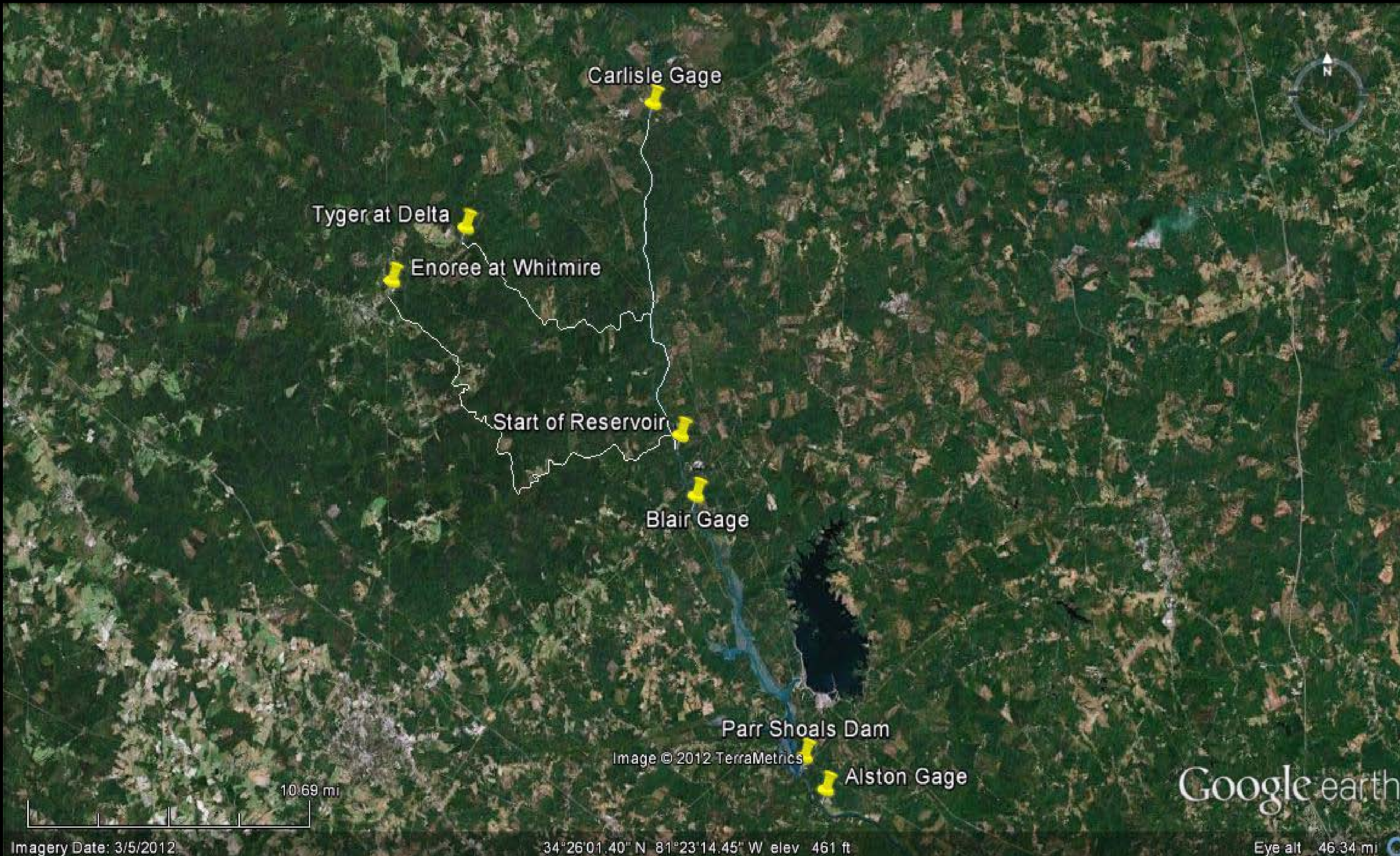
- Source of human recreation
- Home to many species
  - Shortnose sturgeon, Carolina darter
- Nourishes Congaree National Park
  - River flooding sustains the park’s ecosystem
  - Largest continuous tract of old growth bottomland hardwood forest in the U.S.

Methods

- Calculate inflow to the Parr Hydroelectric Project
  - Project begins at the start of the Parr Reservoir
- Allot for flow travel time into Project
- Compare to outflow of Project
  - Indicators of Hydrologic Alteration

Inflow

- Three gages above Parr Hydro Project
  - Carlisle on the Broad, Tyger at Delta, and Enoree at Whitmire
  - Hourly flow data available from each site
- Each river shares similar characteristics
  - Piedmont style river
  - Different flow regimes
- Characterize each river's low, medium, and high flows
  - 25^{th}, 50^{th}, and 75^{th} percentiles



Carlisle Gage
Tyger at Delta
Enoree at Whitmire
Start of Reservoir
Blair Gage
Parr Shoals Dam
Image © 2012 TerraMetrics
Alston Gage
10.69 mi
Google earth
Imagery Date: 3/5/2012
34°26'01.40" N 81°23'14.45" W elev 461 ft
Eye alt 46.34 mi

Proration Method

- Gages for tributaries not at mouth of river
- 460 mi^2 along Broad River unaccounted for by gages
  - Need to account for flows into the Broad above project but below gages
- Proration method used to extrapolate flow values to mouth of river (at Broad River)

Proration Method Example

- Enoree gage drains 444 mi^2, entire river drains 731.3 mi^2

(Discharge/444) * 731.3 = Prorated Discharge

- Also done for Tyger River and the 460 mi^2 of area along Broad River (prorated off Carlisle)

Travel Times - Surrogate

- Need to account for flow travel times
  - Each gage above Project is different distance away
- Surrogate river used to calculate a per mile travel time
  - Lower Saluda River
- Different flow periods timed
  - Low, medium, and high flows

River	Flow Level, Per Mile Rate	Distance to Reservoir (miles)	Total Travel Time (hours)
Broad, Carlisle	Low, .300	12.73	3.819
Broad, Carlisle	Medium, .286	12.73	3.646
Broad, Carlisle	High, .232	12.73	2.955
Tyger	Low, .300	15.88	4.764
Tyger	Medium, .286	15.88	5.548
Tyger	High, .232	15.88	3.686
Enoree	Low, .300	20.55	6.165
Enoree	Medium, .286	20.55	5.886
Enoree	High, .232	20.55	4.770

Indicators of Hydrologic Alteration

- Software developed by The Nature Conservancy
- Analyzes daily streamflow data
  - 33 statistical parameters
- Need to "lie" to software
  - Change timestamp from hourly to daily
- 2 parameter groups wanted
  - Pulse characteristics
  - Rate and frequency of water condition changes

Results: Min & Max

- Outflows amplified
  - Maximum flows higher in outflow
  - Minimum flows lower in outflow
- Range of flows increases with flow category
  - Average increase of low flow range: 716 cfs
  - Average increase of medium flow range: 3,454 cfs
  - Average increase of high flow range: 6,005 cfs

Results: Number of Pulses

- Pulses increase with flow
- Low Flow Periods:
  - No noticeable change in pulses
- Medium Flow Periods:
  - 6 low pulses
  - 4 high pulses
- High Flow Periods:
  - 6 low pulses
  - 10 high pulses

Results: Duration of Pulses

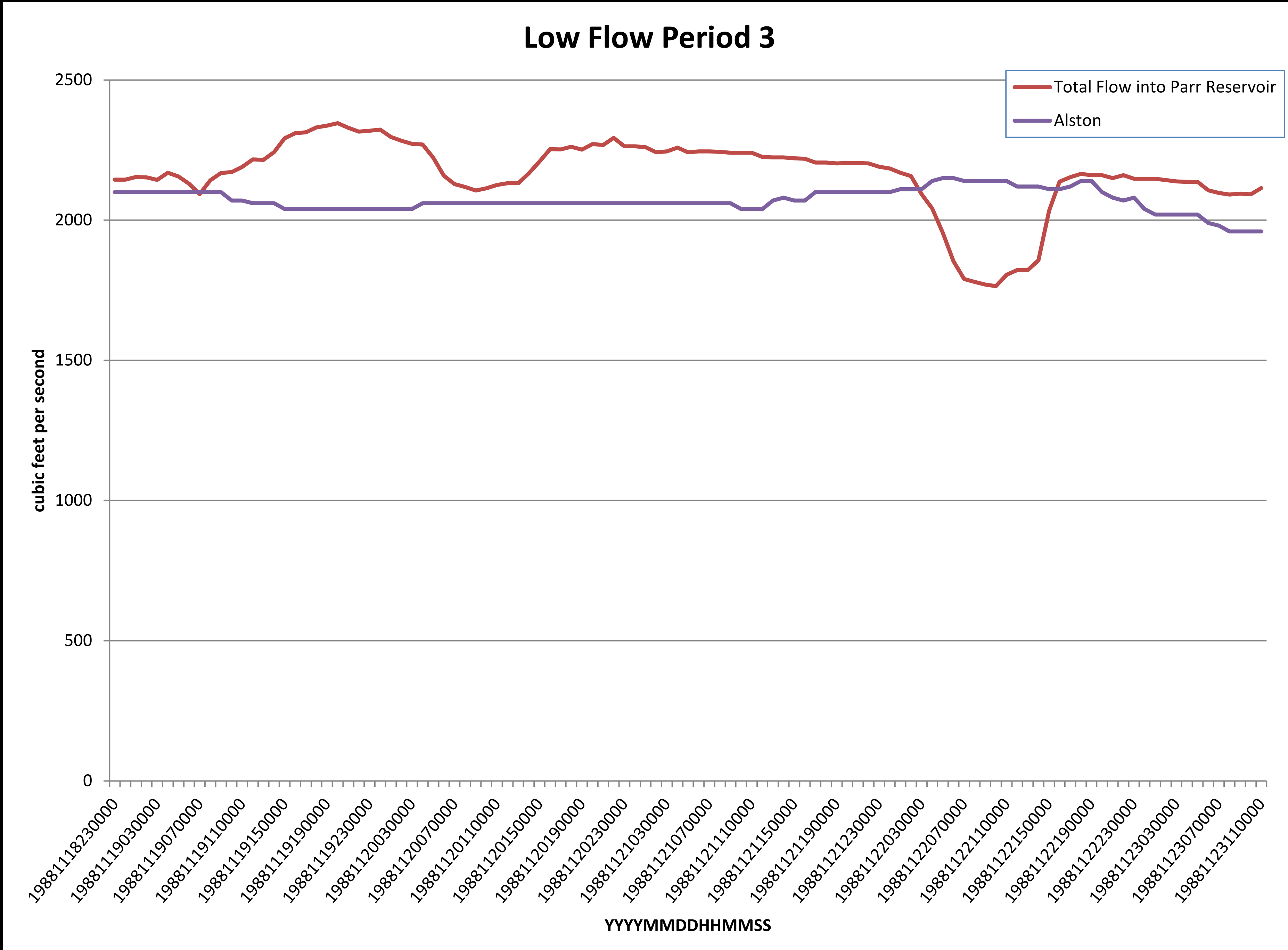
- Pulse duration decreases as flow increases
- Low Flow Periods:
  – No noticeable change in pulses
- Medium Flow Periods:
  – Low pulses: 12.67 hours
  – High pulses: 20.5 hours
- High Flow Periods:
  – Low pulses: 3.67 hours
  – High pulses: 12.83 hours

Results: Flow Reversals

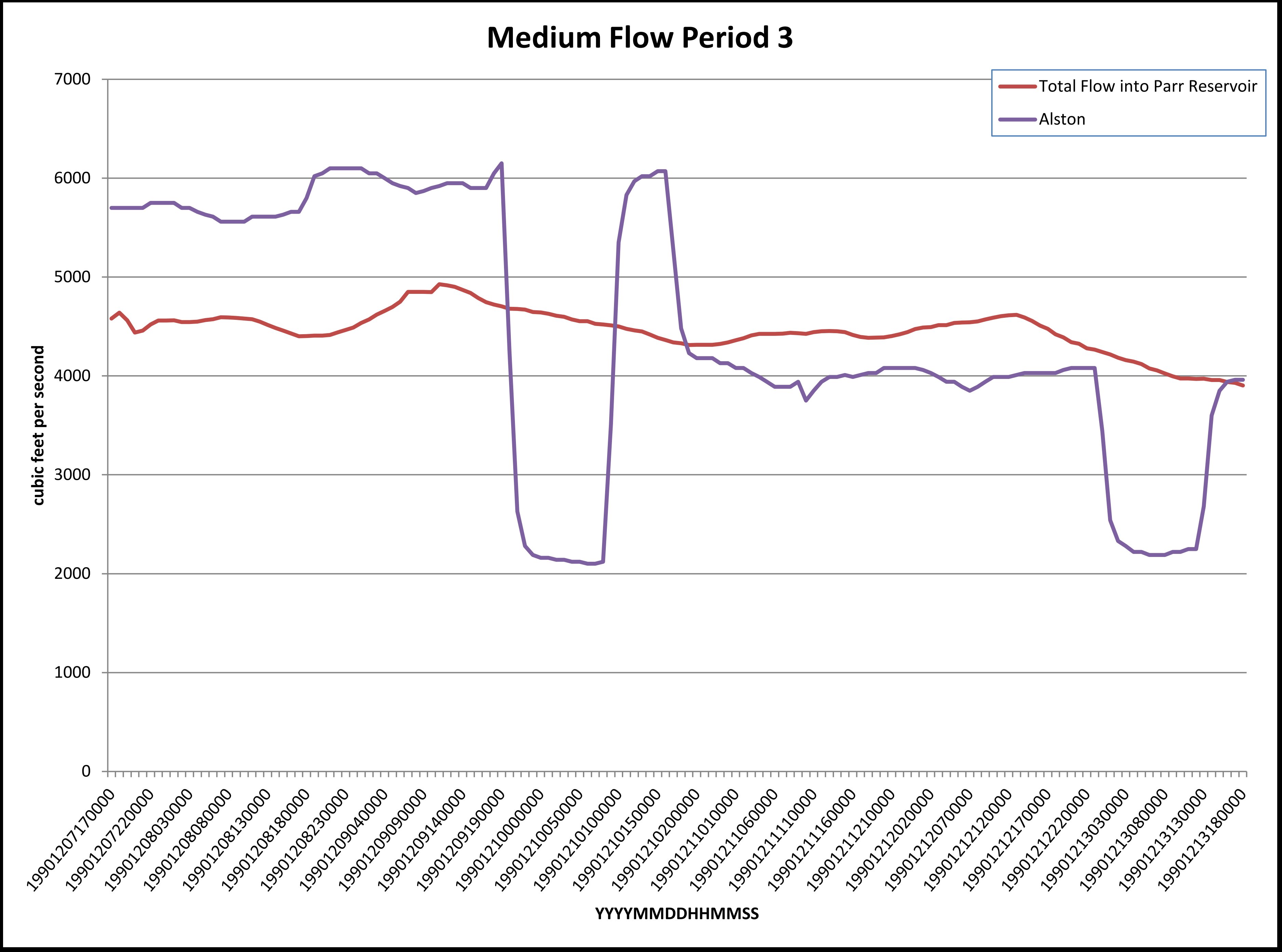
- Low flow periods:
  - Reversals decreased from 25.67 to 12
- Medium flow periods:
  - Reversals decreased from 26.67 to 19.33
- High flow periods:
  - Reversals increased from 18.33 to 23.67
  - Only these three periods increased in reversals

Results: Rise and Fall Rates

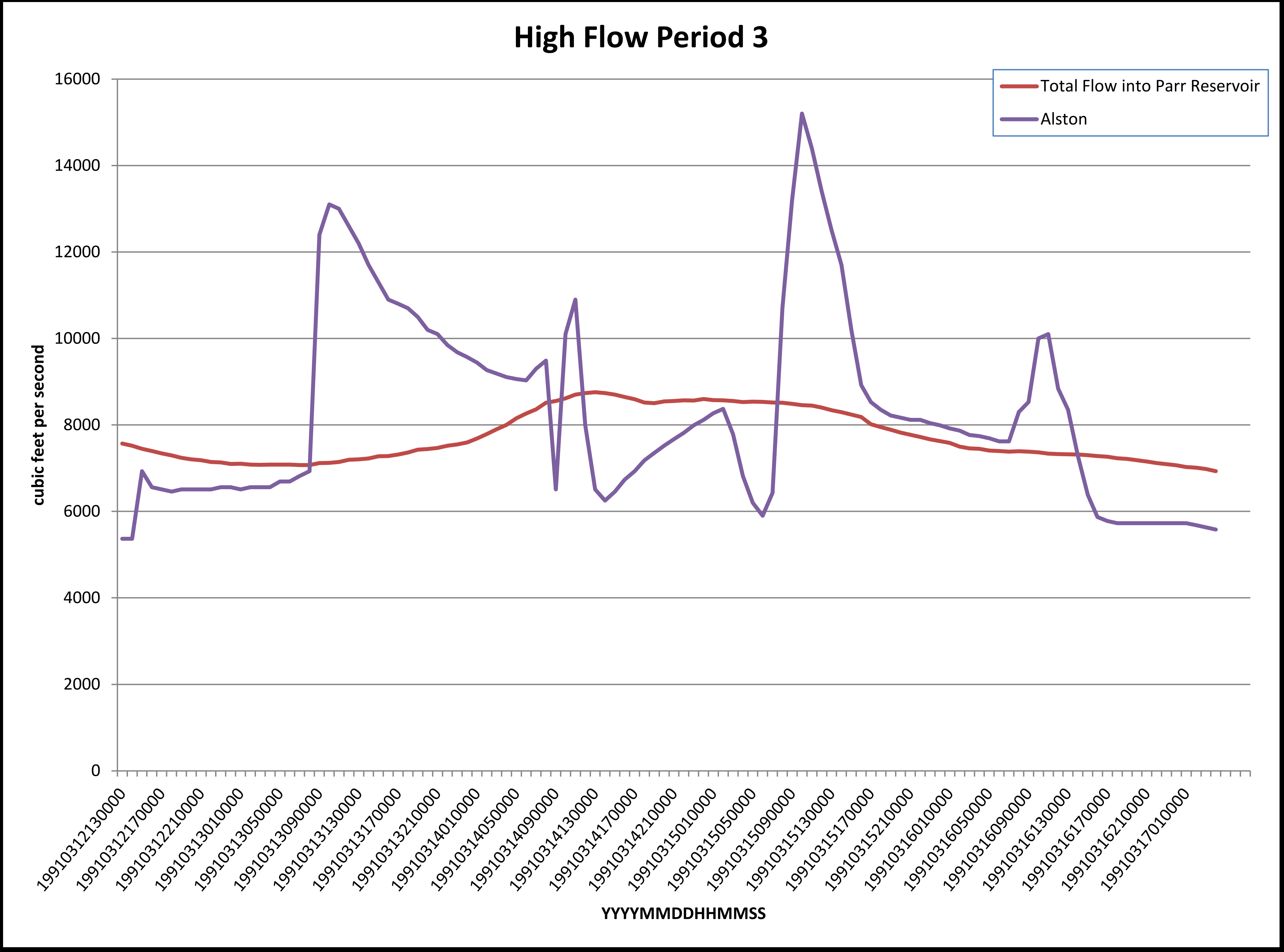
- Low flow periods:
  - Slight increase in rise and fall rates
- Medium flow periods:
  - Rise rate increased from 11.32 to 55
  - Fall rate increased from -14.39 to -65
- High flow periods:
  - Rise rate increased from 29.53 to 250
  - Fall rate increased from -27.95 to -210



Low Flow Period 3
Total Flow into Parr Reservoir
Alston
cubic feet per second
2500
2000
1500
1000
500
0
19881118230000
19881119030000
19881119070000
19881119110000
19881119150000
19881119190000
19881119230000
19881120030000
19881120070000
19881120110000
19881120150000
19881120190000
19881120230000
19881121030000
19881121070000
19881121110000
19881121150000
19881121190000
19881121230000
19881122030000
19881122070000
19881122110000
19881122150000
19881122190000
19881122230000
19881123030000
19881123070000
19881123110000
YYYYMMDDHHMMSS

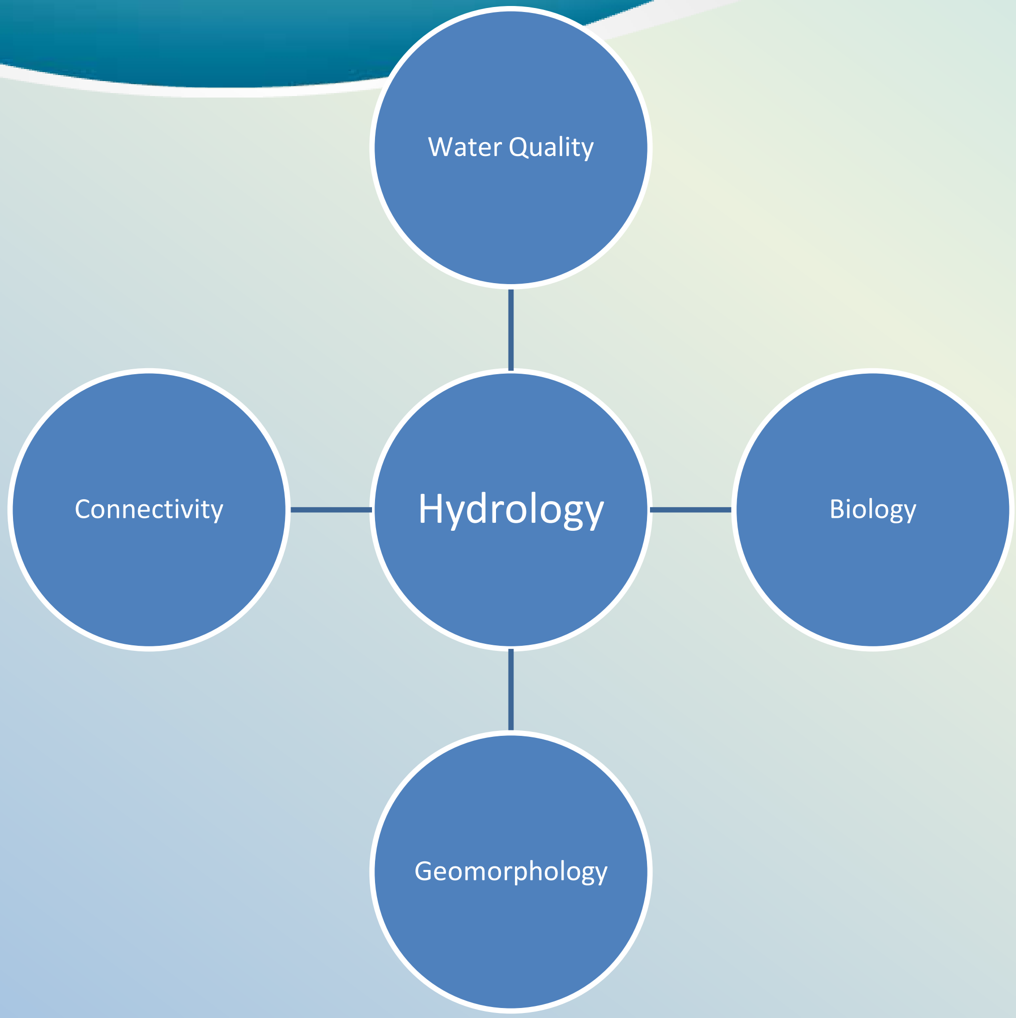


Medium Flow Period 3
Total Flow into Parr Reservoir
Alston
7000
6000
5000
4000
3000
2000
1000
0
cubic feet per second
19901207170000
19901207220000
19901208030000
19901208080000
19901208130000
19901208180000
19901208230000
19901209040000
19901209090000
19901209140000
19901209190000
19901210000000
19901210050000
19901210100000
19901210150000
19901210200000
19901211010000
19901211060000
19901211110000
19901211160000
19901211210000
19901212020000
19901212070000
19901212120000
19901212170000
19901212220000
19901213030000
19901213080000
19901213130000
19901213180000
YYYYMMDDHHMMSS



High Flow Period 3
Total Flow into Parr Reservoir
Alston
16000
14000
12000
10000
8000
6000
4000
2000
0
cubic feet per second
19910312130000
19910312170000
19910312210000
19910313010000
19910313050000
19910313090000
19910313130000
19910313170000
19910313210000
19910314010000
19910314050000
19910314090000
19910314130000
19910314170000
19910314210000
19910315010000
19910315050000
19910315090000
19910315130000
19910315170000
19910315210000
19910316010000
19910316050000
19910316090000
19910316130000
19910316170000
19910316210000
19910317010000
YYYYMMDDHHMMSS

Implications: Riverine Ecology



Annear, Thomas C. *Instream Flows for Riverine Resource Stewardship.* Cheyenne, WY: Instream Flow Council, 2004. Print.

Implications

- Fast rise rates serve as spawning cues to some fish
  - Artificial high pulses may cause inappropriate spawning
- Flashiness can leave natives susceptible to nonnative takeover
- Increased maximum and minimum flows can leave soil too moist or too dry

Further Questions

- How does altered hydrology affect the biological, connectivity, geomorphological, and water quality on the Lower Broad?
- How can the Project be better managed to mimic the natural hydrograph or incoming flows?

Considerations

- Reversals should have a threshold limit before considered a reversal (e.g. ±10%)
  - Too many reversals on inflow, too sensitive
  - Incorporating attenuation could help
- Inflow should account for attenuation of flow from gage sites
  - Reversals and rise/fall rates would be reduced for inflow

- "the natural flow regime of virtually all rivers is inherently variable and that this variability is critical to ecosystem function and native biodiversity."
  - Poff et al. 1997

Acknowledgements

- Gerrit Jöbsis
- Rebecca Haynes
- Dr. Allan James
- Dr. John Grego
- Sarah Ellisor
- Scott Harder
- Bill Argentieri

Questions?

References

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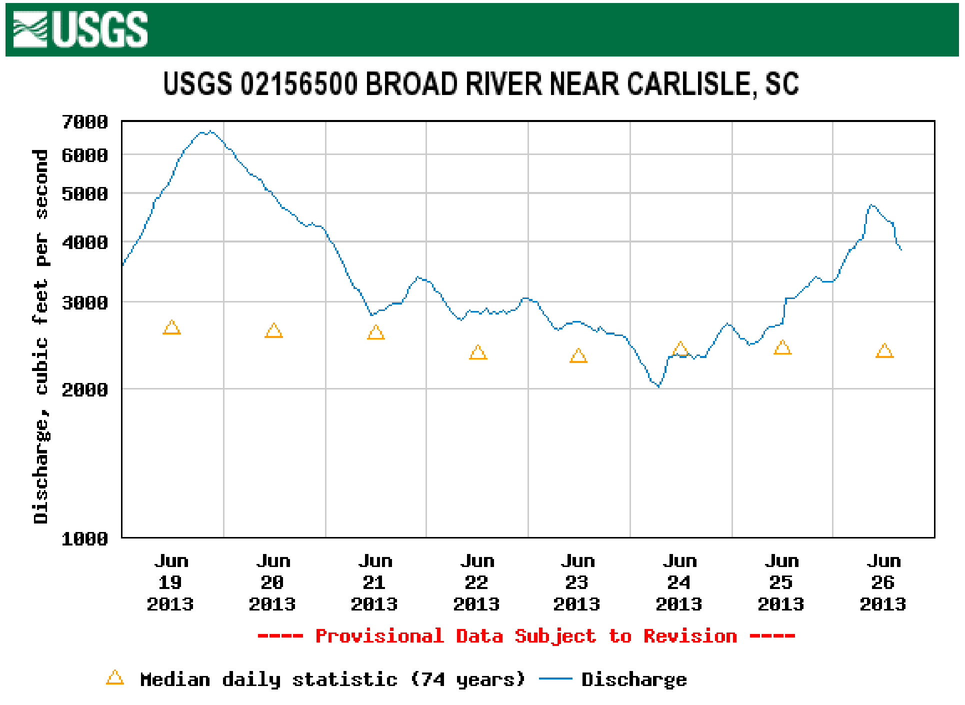
- Richter, Brian D, Jeffrey V Baumgartner, Jennifer Powell, and David P. Braun. "A Method for Assessing Hydrologic Alteration Within Ecosystems." *Conservation Biology.* 10.4 (1996). Print.
- Annear, Thomas C. *Instream Flows for Riverine Resource Stewardship.* Cheyenne, WY: Instream Flow Council, 2004. Print.
- The Nature Conservancy. Indicators of Hydrologic Alteration Manual. April 2009.
- Poff, N L. J D. Allan, Mark B. Bain, and James R. Karr. "The Natural Flow Regime." *Bioscience.* 47.11 (1997): 769. Print.

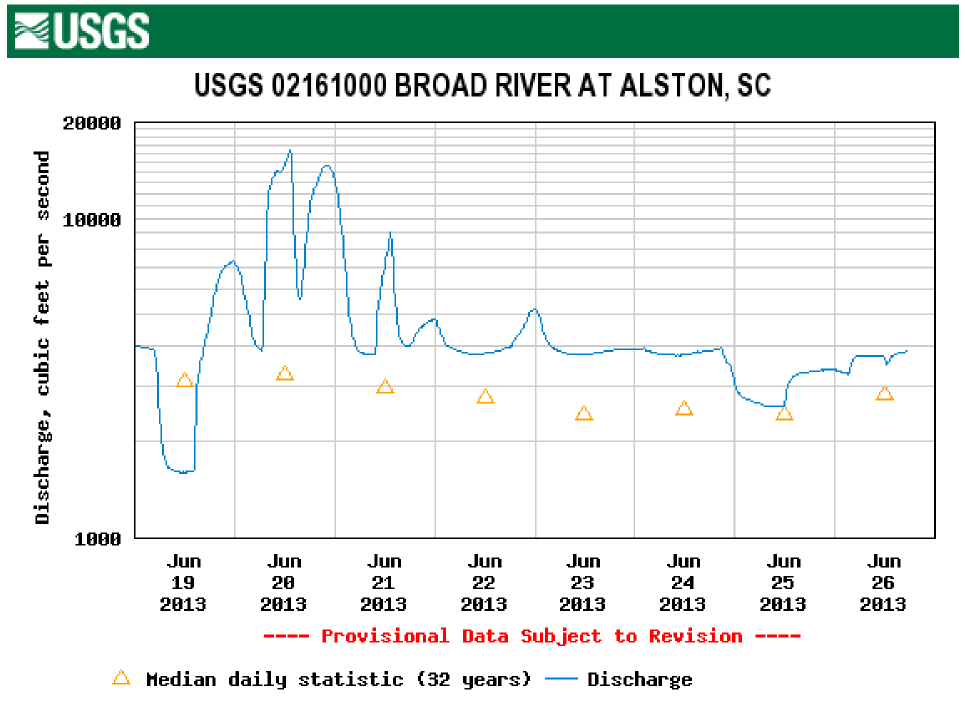
Past 7 days

Carlisle

vs.

Alston



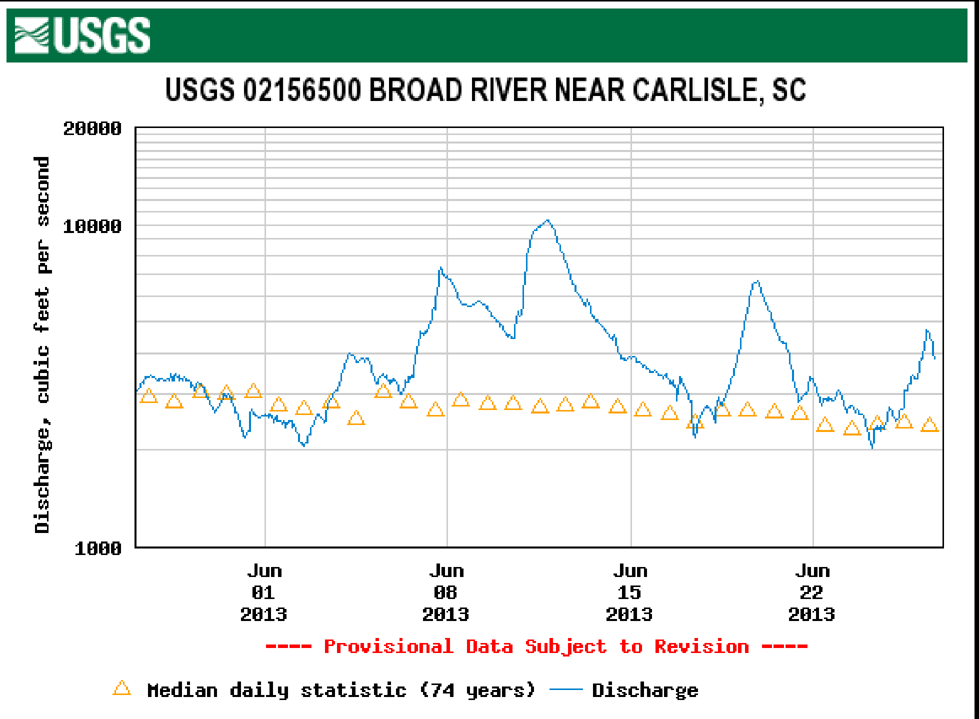


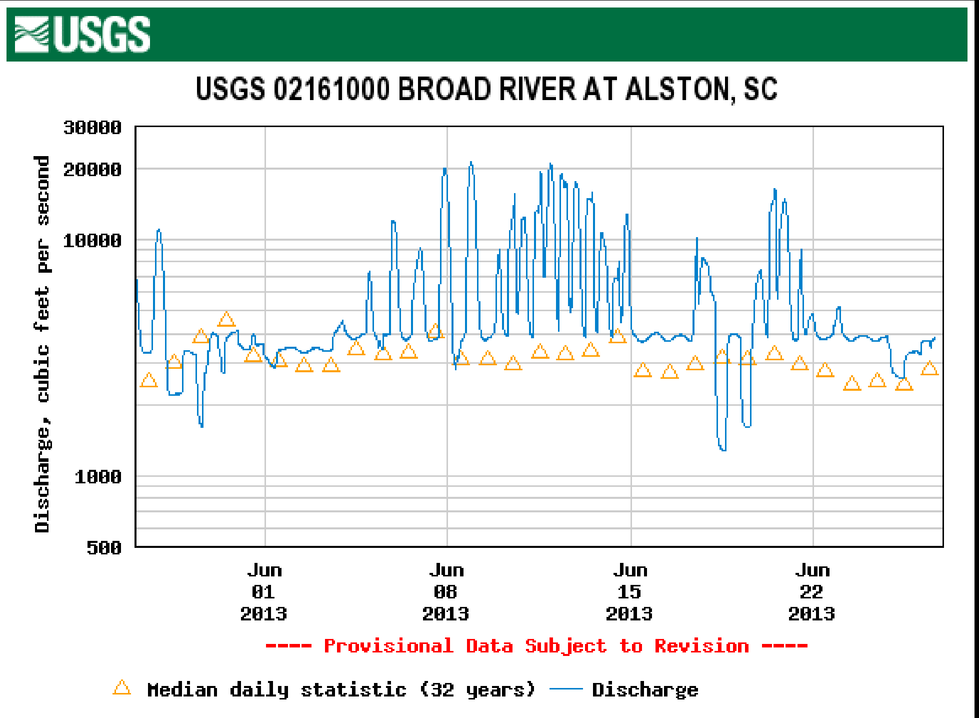
Past 30 days

Carlisle

vs.

Alston





PARR HYDROELECTRIC PROJECT
PARR & FFPS PLANT OVERVIEW
FERC PROJECT No. 1894 - SC

JUNE 27, 2013

SCE&G
A SCANA COMPANY

PARR
Relicensing Project

TOPICS

- Table of Standard Project Numbers
- Parr Hydro:
  - Plant Overview & Basic Data
  - Drag Rake Description & Operation
  - Spillway and Crest Gates
- Fairfield Pumped Storage:
  - Plant Overview & Basic Data
  - Intake and Tailrace
- Project Operation Overview

Parr Hydroelectric Project P-1894

Table of Standard Project Numbers

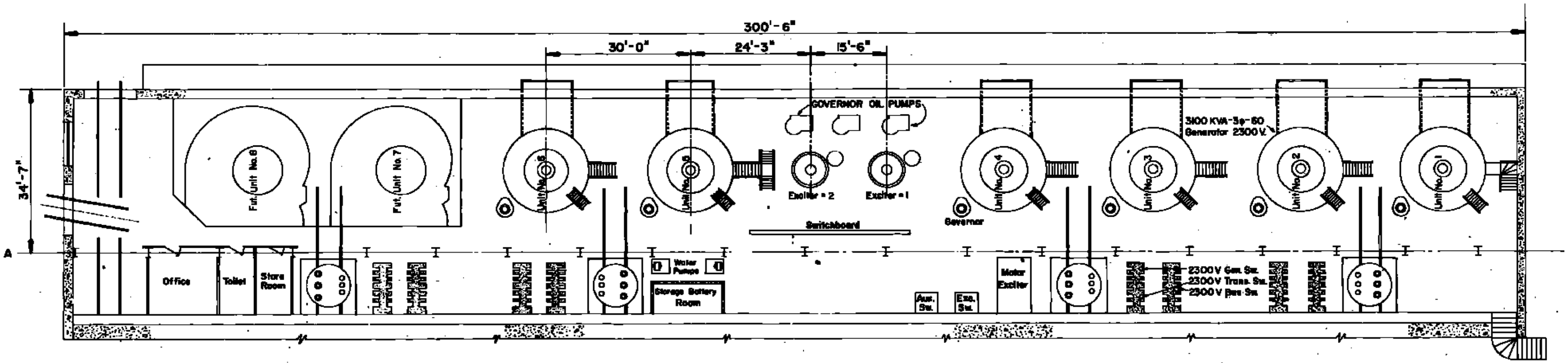
DESCRIPTION	NUMBER OR FACT (PARR SHOALS DEVELOPMENT)	NUMBER OR FACT (FAIRFIELD PUMPED STORAGE DEVELOPMENT)
Project Location	25 mi northwest of City of Columbia; Fairfield and Newberry Counties	27 mi northwest of City of Columbia; Fairfield County
GENERAL		
Project drainage area	4,750 sq. miles	4,750 sq. miles (lower res.) 9,400 acres (upper res.)
Station rated generating capacity	14,880 kW	511,200 kW
Estimated reliable capability	7,000 kW	511,200 kW
Annual gross generation	54,086 MWh (2000 thru 2010)	708,636 MWh (2000 thru 2010)
Discharge at rated capacity	6,000 CFS	50,400 CFS (Generating); 41,800 CFS (Pumping)
Minimum recorded daily average flow	800 CFS (at USGS Alston Gage Site)	0 CFS (into Parr Reservoir)
DAM & RESERVOIR		
Dam Type & Dimensions	Concrete gravity spillway, 37 ft. high, 2000 ft. long, crest el. 257.0 ft. NGVD29	(4) Primary earth embankments, all with crest el. 434.0 ft. NGVD29: Dam A: 85 ft. high, 3,130 ft long Dam B: 160 ft. high, 4,700 ft. long Dam C: 60 ft. high, 2,000 ft. long Dam D: 30 ft. high, 1,300 ft. long (2) Perimeter freeboard embankments on east side of reservoir
Max. Res. Oper. Level (Full Pool) & Area	El. 266.0 ft. NGVD29; 4,400 ac.	El. 425.0 ft. NGVD29; 6,800 ac.
Min. Res. Oper. Level	El. 256.0 ft. NGVD29	El. 420.5 ft. NGVD29
Total storage at full pool	32,000 ac-ft	400,000 ac-ft
Active storage	29,000 ac-ft in 10 ft. operating range	29,000 ac-ft in 4.5 ft. operating range
SPILLWAY		
Spillway Gates Number and Type	(10) Bottom hinged bascule crest gates, each 200 ft. long and 9 ft. high.	None
Discharge Capacity	230,000 CFS (Inflow Design Flood) 427,000 CFS (Probable Maximum Flood)	N/A
POWERHOUSE		
Construction type	Steel framed brick masonry	Reinforced concrete
Dimensions	300 ft. long, 60 ft. wide, 50 ft. high	520 ft. long, 150 ft. wide, 108 ft. high (below grade)
INTAKE STRUCTURE		
Type and Dimensions	Integral with powerhouse	Reinforced concrete, 300 ft. long, 260 ft. wide, 50 ft. high
Head Gates Number and Type	(6) Bottom hinged steel	(4) Vertical lift steel had gates; (8) vertical lift steel tail gates

Parr Hydroelectric Project P-1894

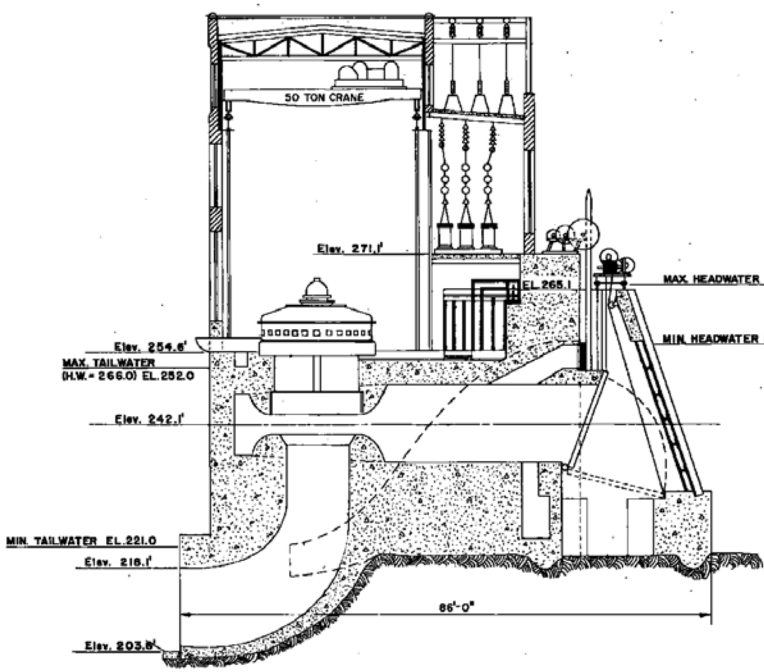
Table of Standard Project Numbers

DESCRIPTION	NUMBER OR FACT (PARR SHOALS DEVELOPMENT)	NUMBER OR FACT (FAIRFIELD PUMPED STORAGE DEVELOPMENT)
PENSTOCKS		
Number, Type and Dimensions	(6) Concrete, integral with powerhouse	(4) Steel, 800 ft. long, 26 ft. diameter (each serves 2 units)
TURBINES		
Number & Manufacturer	(6) Allis Chalmers	(8) Allis Chalmers
Type	Vertical Francis	Vertical Francis Reversible Pump-Turbines
Rated net head/TDH	35 ft.	150 to 167 ft. (Turbine mode); TDH 158 to 173 ft. (Pump mode)
Approximate min. discharge capacity	150 CFS	2,500 CFS
Rated maximum discharge capacity	1,000 CFS	6,300 CFS (generating); 5,225 CFS (avg. pumping)
Draft tube invert elevation	El. 203.6 ft. NGVD29	El. 189.0 ft. NGVD29
HP rating at rated head	3,600	95,375 to 108,570
Synchronous speed (rpm)	100	150
GENERATORS		
Manufacturer	Allis Chalmers	Westinghouse
Type	AC	AC Motor-Generators
Phases	3	3
Voltage	2,300	13,800/13,200 V @ 60° C/80° C
Frequency	60 Hz	60 Hz
KVA rating	3,100	71,000 (generating); 74,570 (pumping, 100,000 HP equiv.)
Power factor	0.8	0.9 (generator); 1.0 (pump)
KW output	2,480	63,900
TRANSFORMERS		
Number & Type	(3) OA/FA	(4) FOA (each serves 2 units)
Voltage (Primary/Secondary)	2.4/13.8-kV	13.8/230-kV
Phases	3	3
KVA Rating @ Temp. Rise	6,000/6,720 KVA (OA), @ 55 °C/65° C rise 7,500/8,400 KVA (FA), @ 55 °C/65° C rise	160/80/80 MVA @ 55° C rise (160 MVA 230 kV primary wye connected, 2-80 MVA 13.8 kV secondaries each connected to 1 motor-generator); 179.2/89.6/89.6 MVA @ 65° C rise

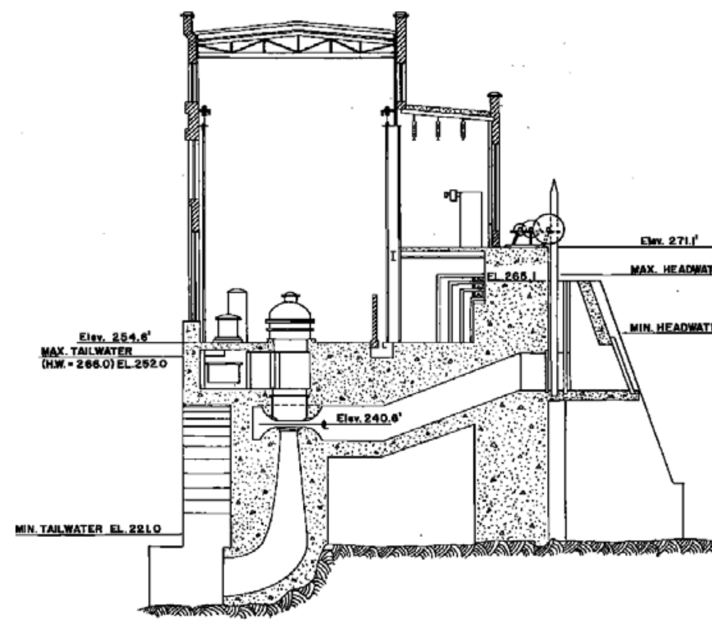
Parr Hydro Plant Overview and Basic Information



PLAN OF GENERATOR FLOOR



SECTION THRU MAIN UNIT



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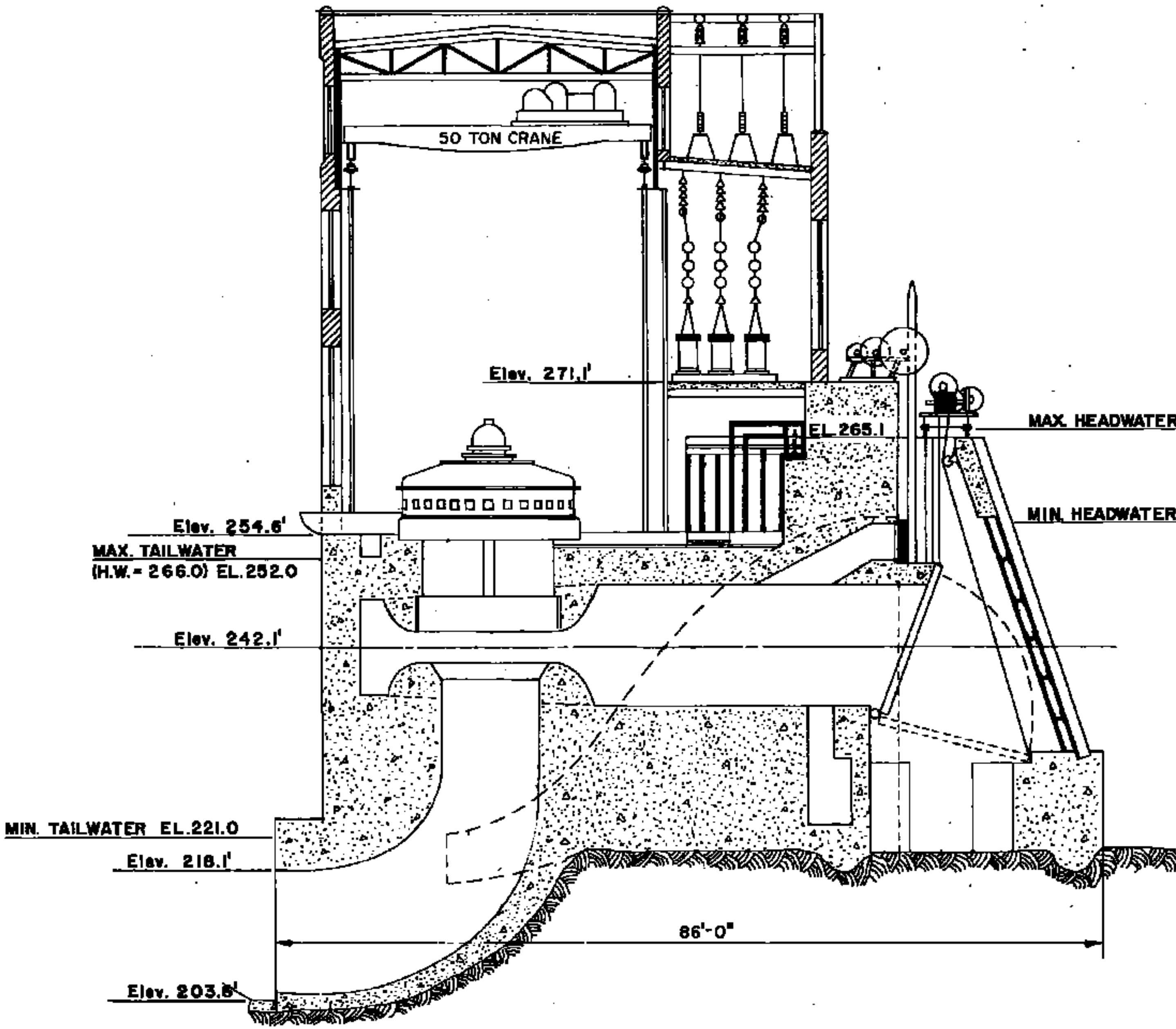

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EXIT


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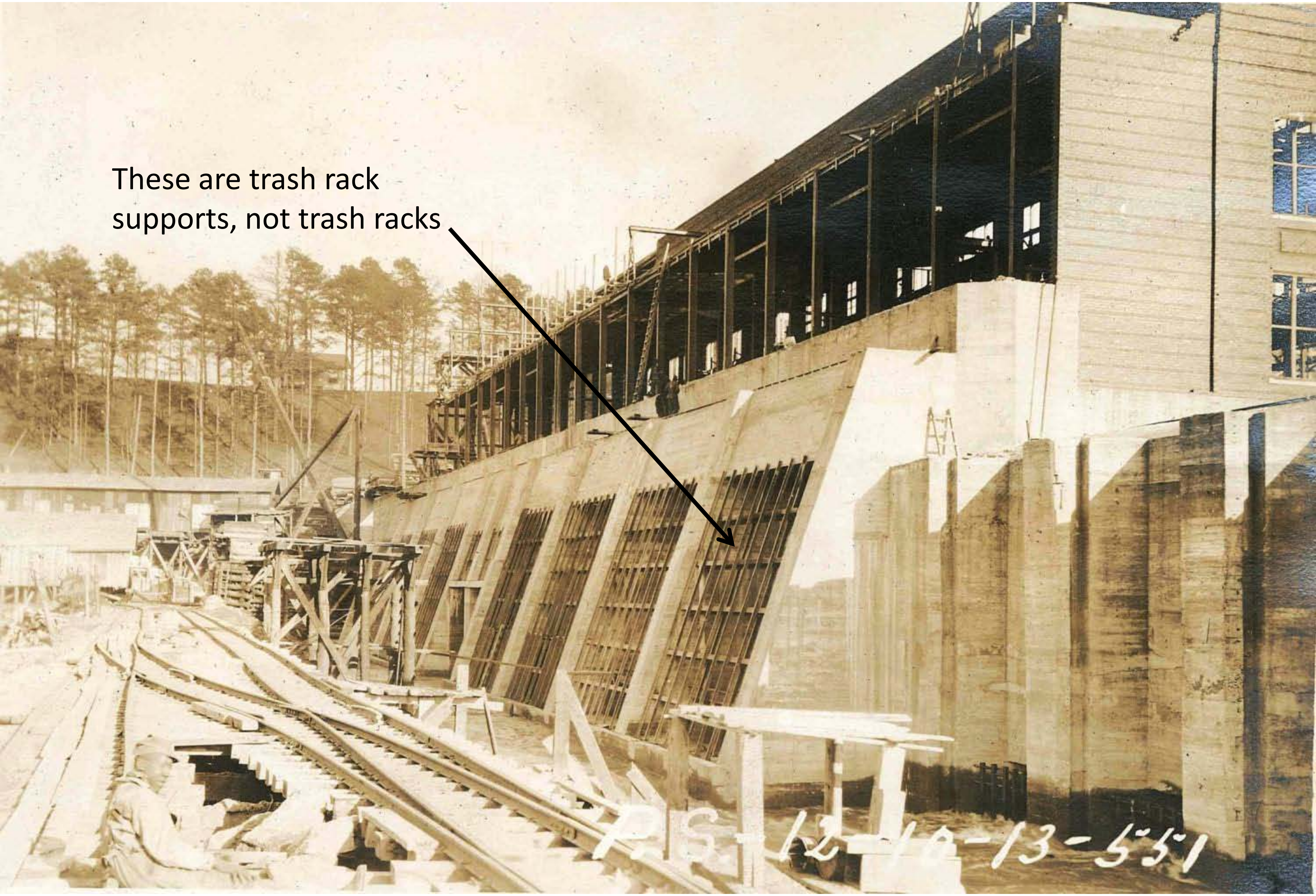
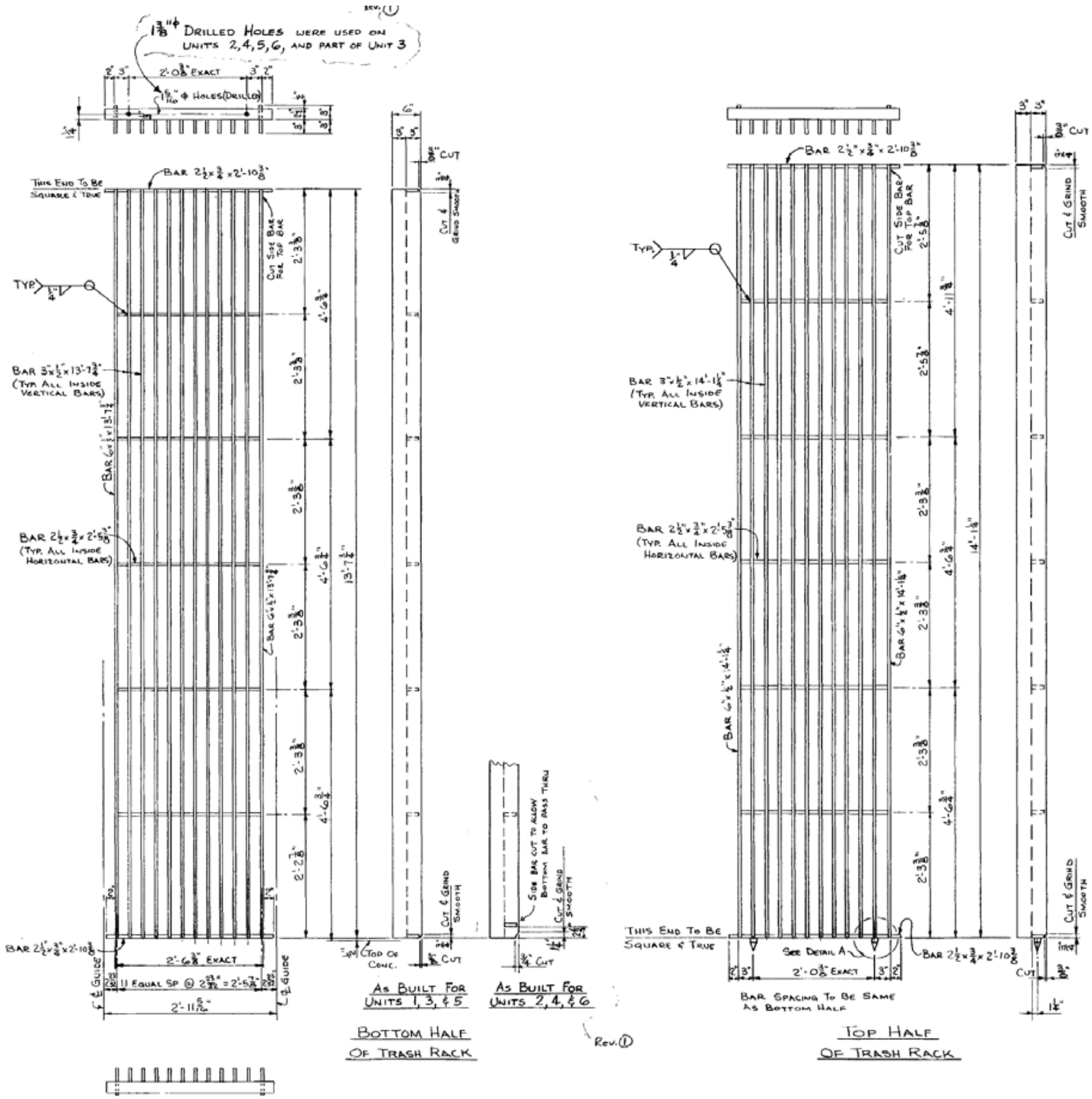
Parr Hydro
Intake and Drag Rake System



1913 Photo of Parr Hydro Intakes

Parr Hydro Trash Racks

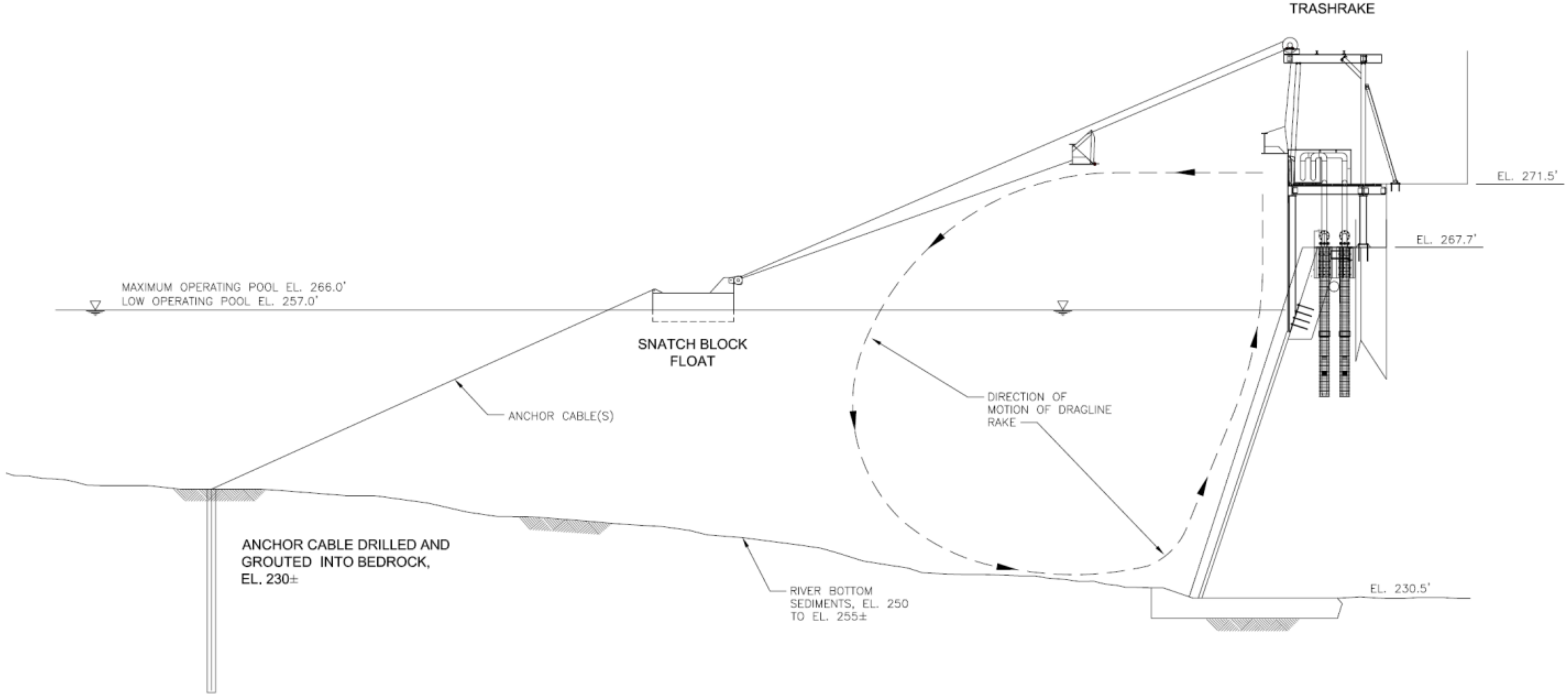
- 8 trash racks, 1 per turbine.
- Each trash rack is 27 ft. wide, 28 ft. tall.
- Vertical bars are ½ in. thick with 2-¼ in. clear between bars.
- Racks are made in 3 ft. wide panels, 9 panels per rack.



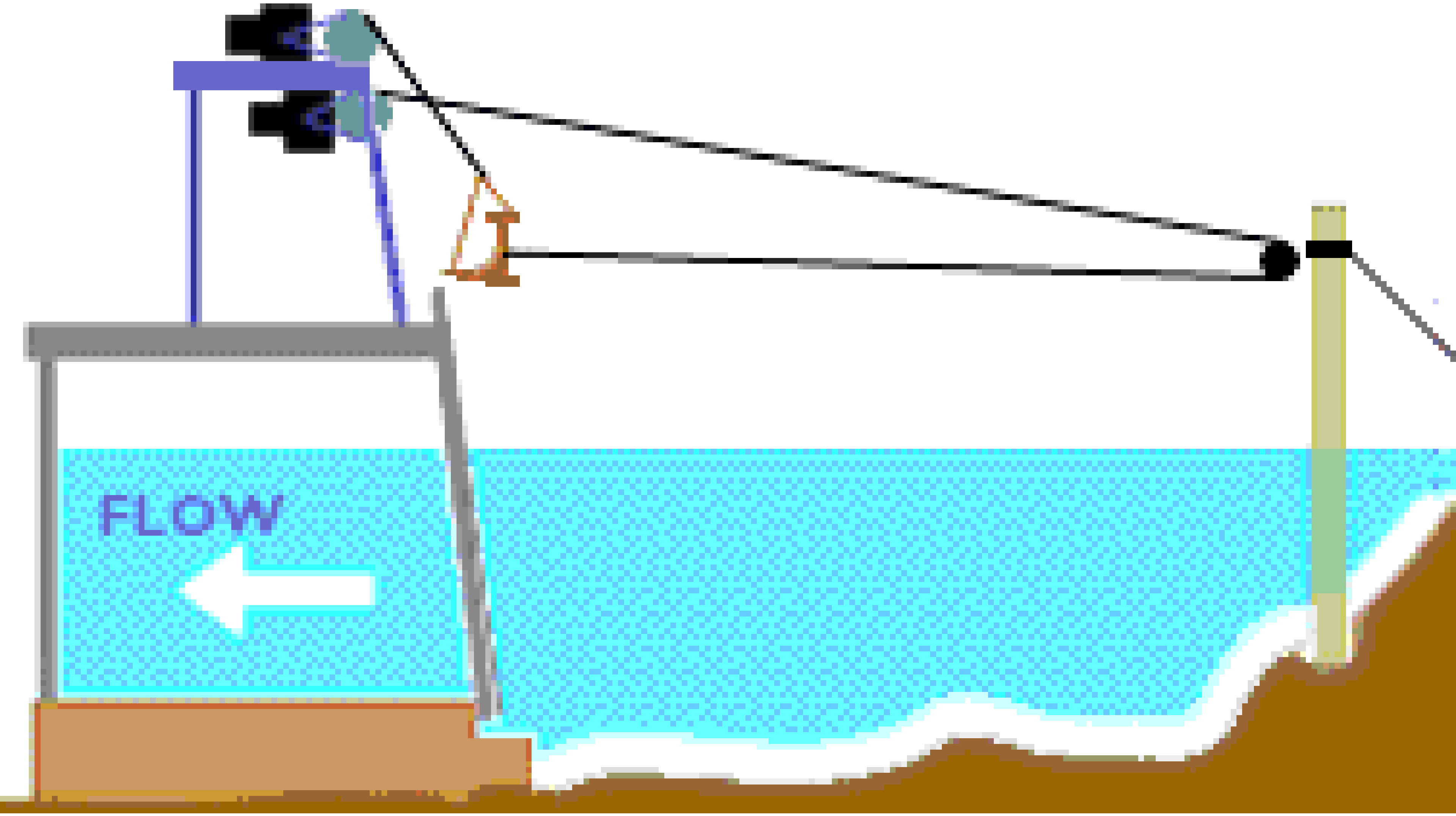
Parr Hydro Trash Rack Panel (9 panels per rack)

Trash Handling Crane (prior to Drag Rake Installation)


Drag Rake System Installed



Parr Hydro Drag Rake System

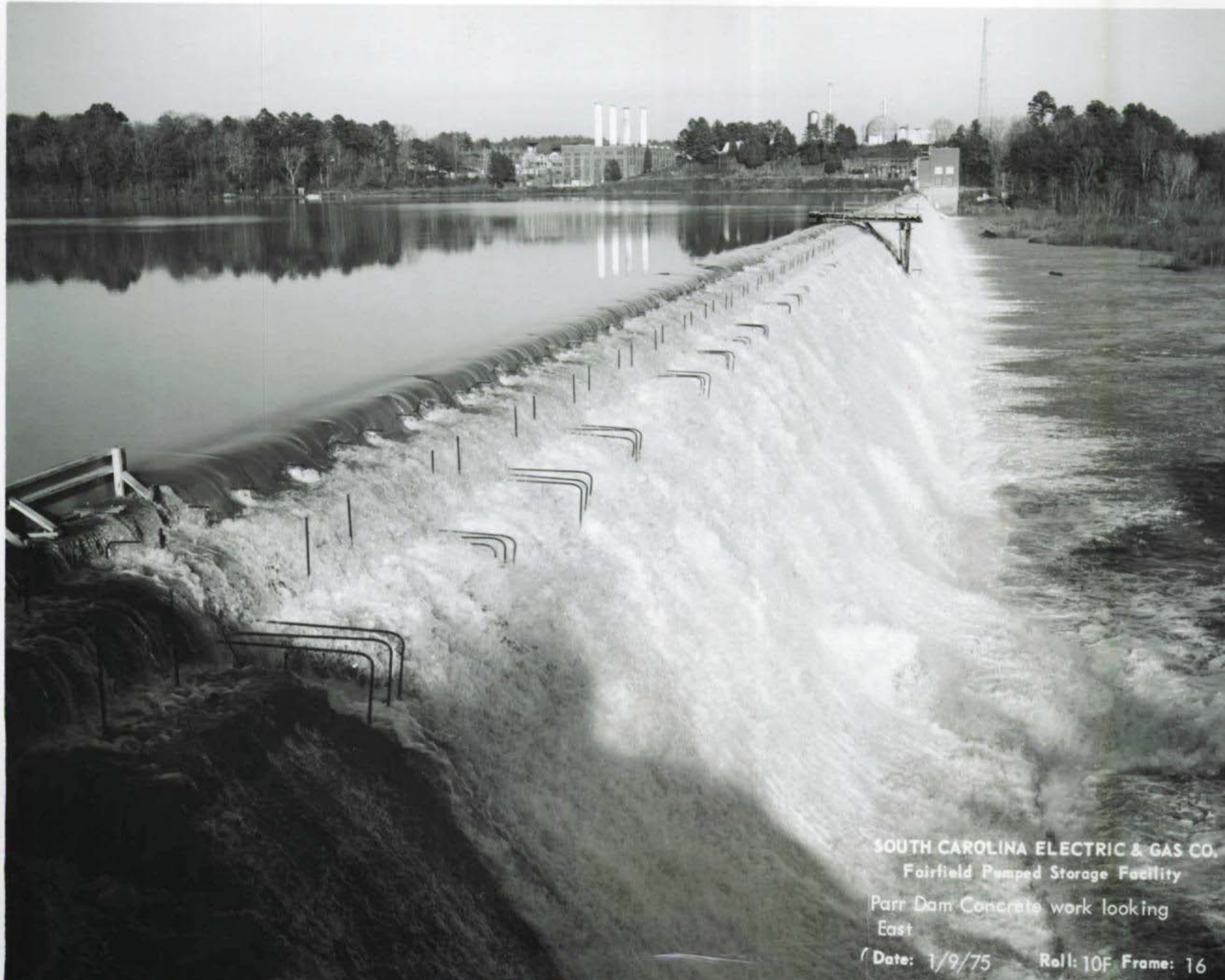


Drag Rake Operation Animation
(Courtesy North Fork Electric Co.)

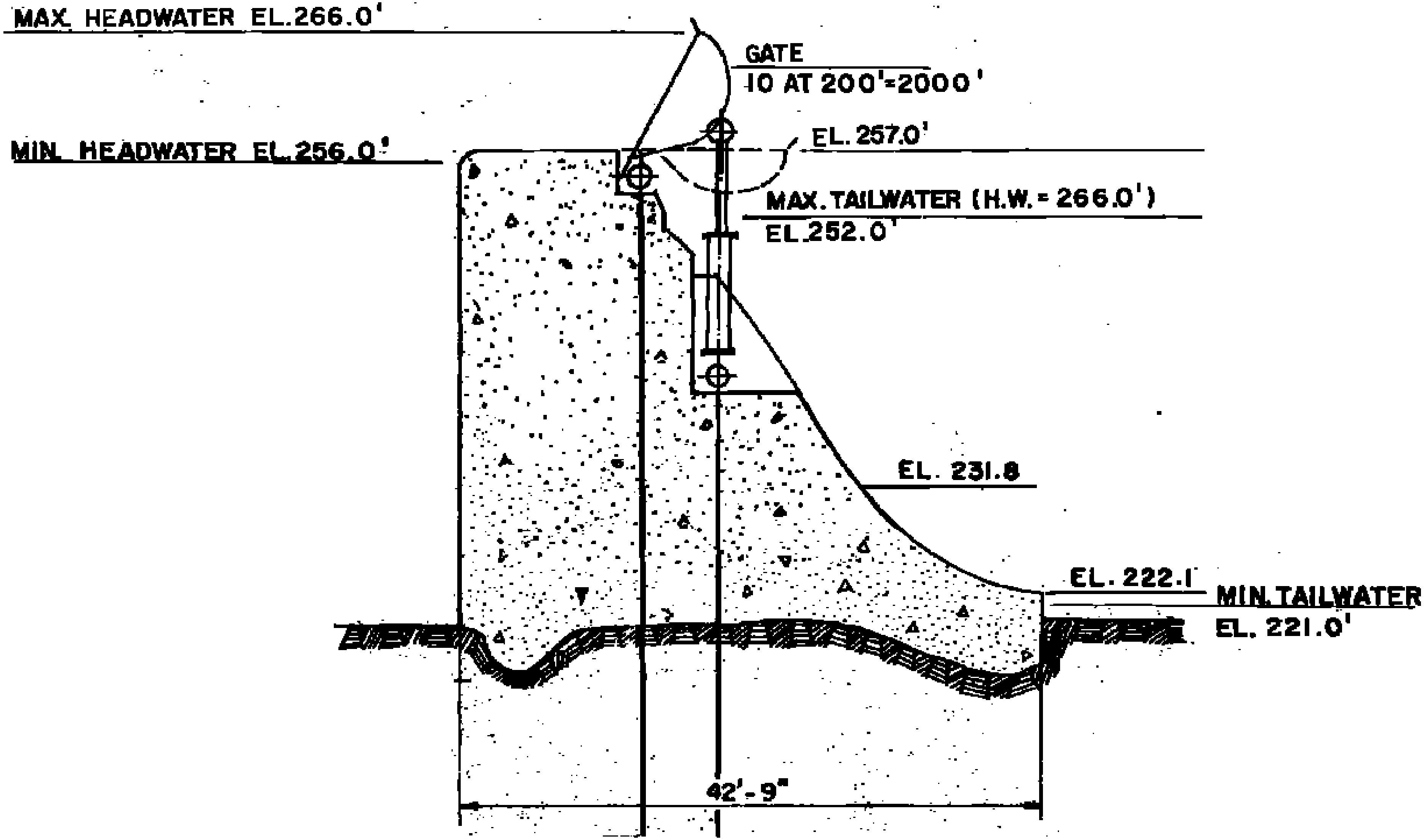
Intake Deck showing debris and sluice trough

Parr Spillway and Crest Gates

Parr Dam Under Construction - 1913

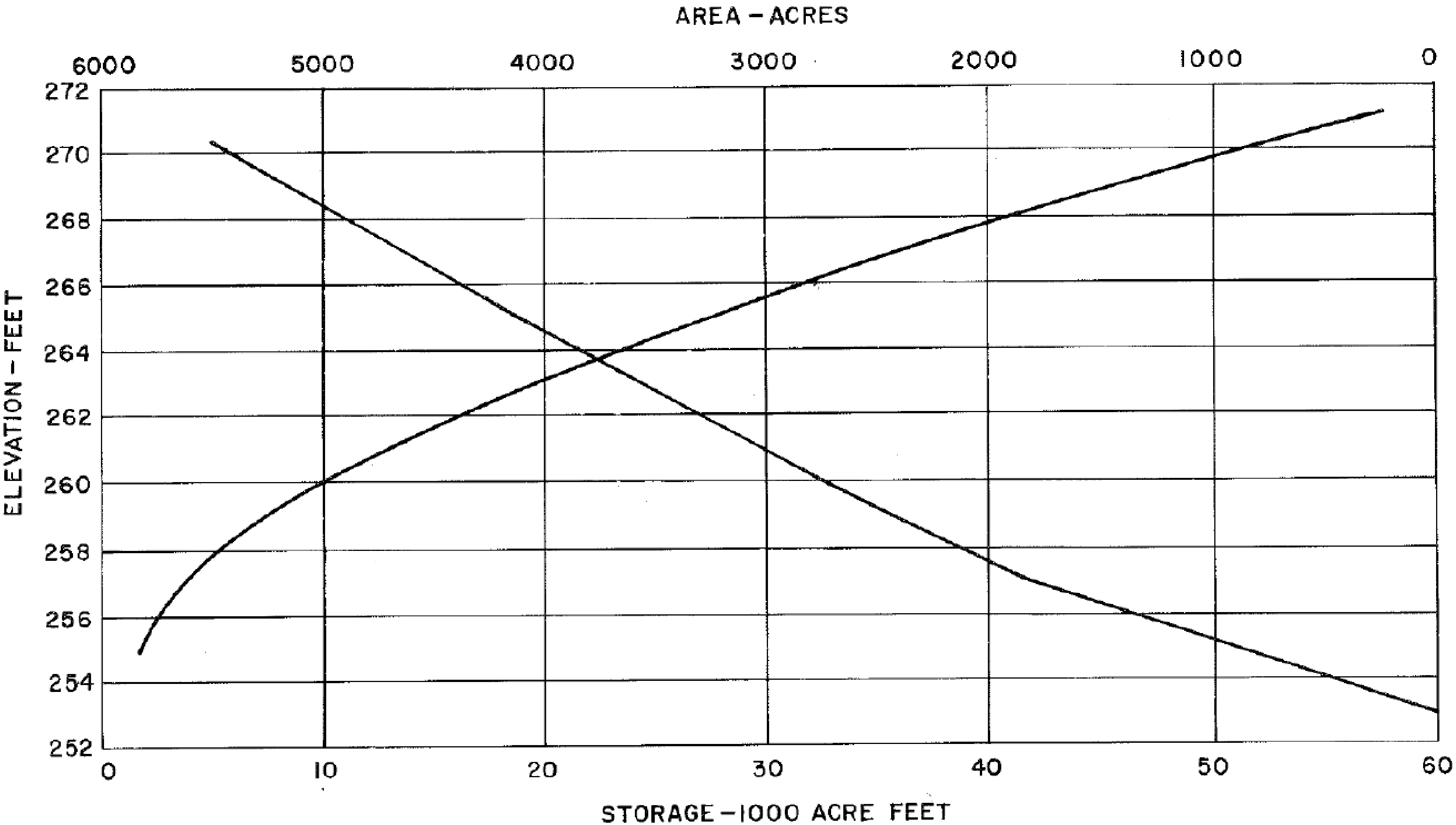

SOUTH CAROLINA ELECTRIC & GAS CO.
Fairfield Pumped Storage Facility
Parr Dam Concrete work looking East
Date: 1/9/75
Roll: 10F Frame: 16

Parr Dam and Crest Gates


MAX. HEADWATER EL.266.0'
GATE
10 AT 200'=2000'
MIN. HEADWATER EL.256.0'
EL. 257.0'
MAX. TAILWATER (H.W. = 266.0')
EL.252.0'
EL. 231.8
EL. 222.1
MIN. TAILWATER
EL. 221.0'
42'-9"

Parr Spillway Information

- Crest length = 2,000 feet
- 10 gates at 200 ft. each
- Gates operate in pairs
- Crest elevation = 257.0 ft. NGVD
- Spillway capacity at reservoir el. 266.0 ft. NGVD = 161,500 CFS (all gates down)
- Maximum rated capacity 229,113 CFS at reservoir el. 268.5 ft. NGVD.



Parr Reservoir Area Capacity Curves

Fairfield Pumped Storage Plant Overview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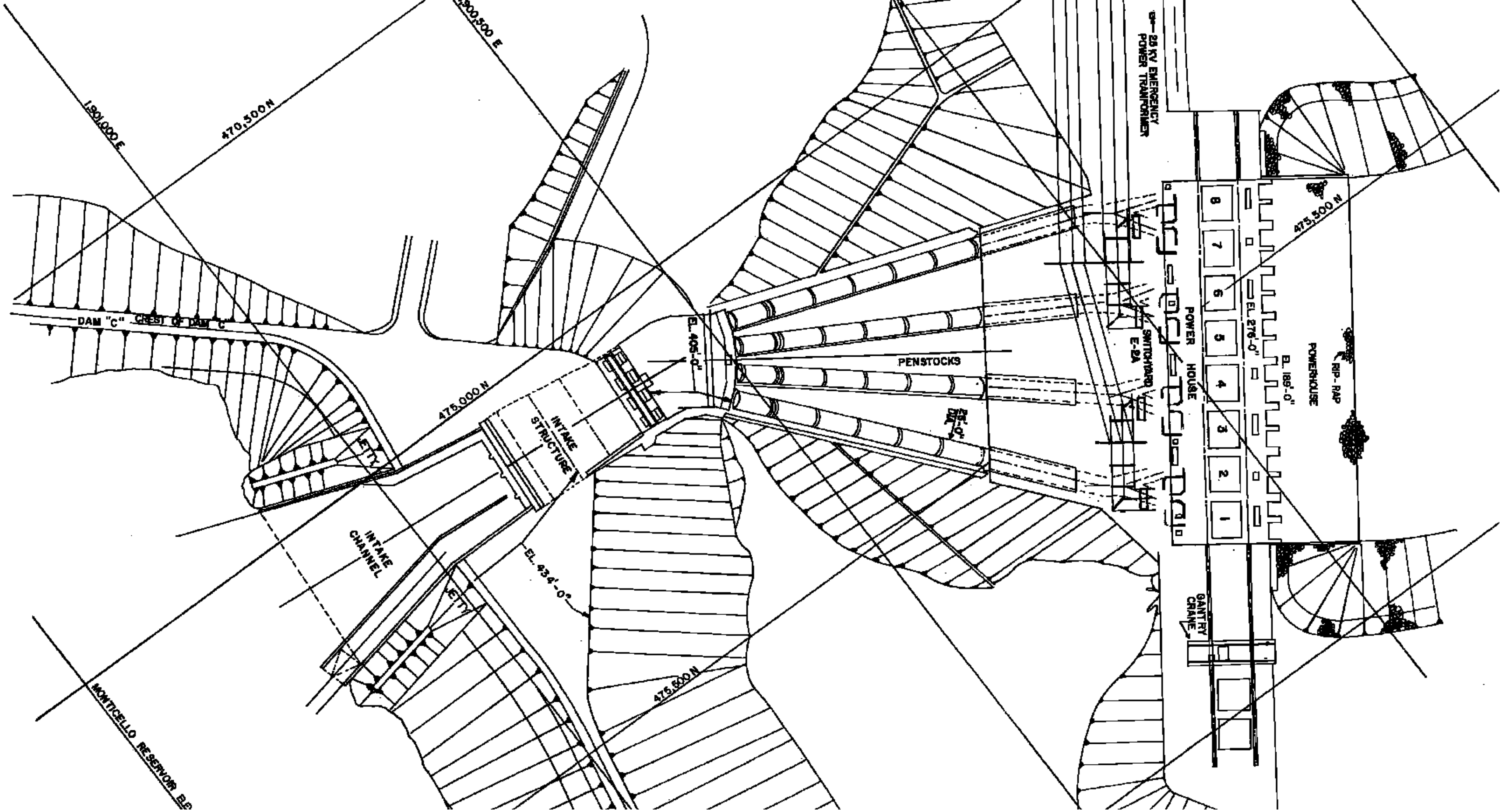
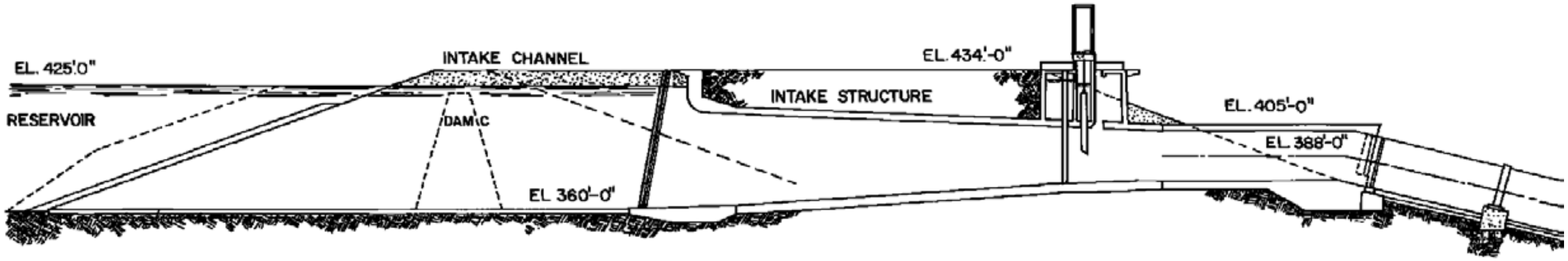
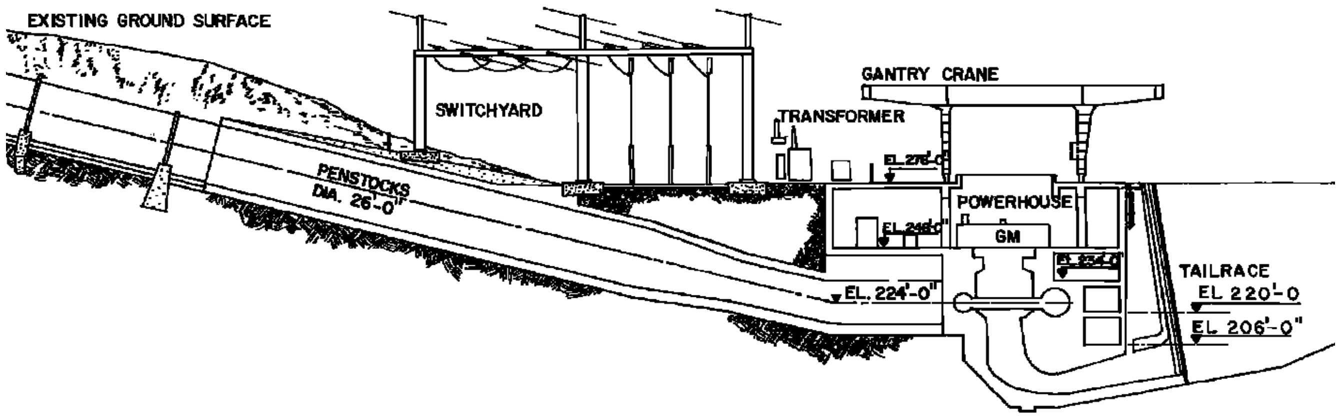


Fairfield Plan View

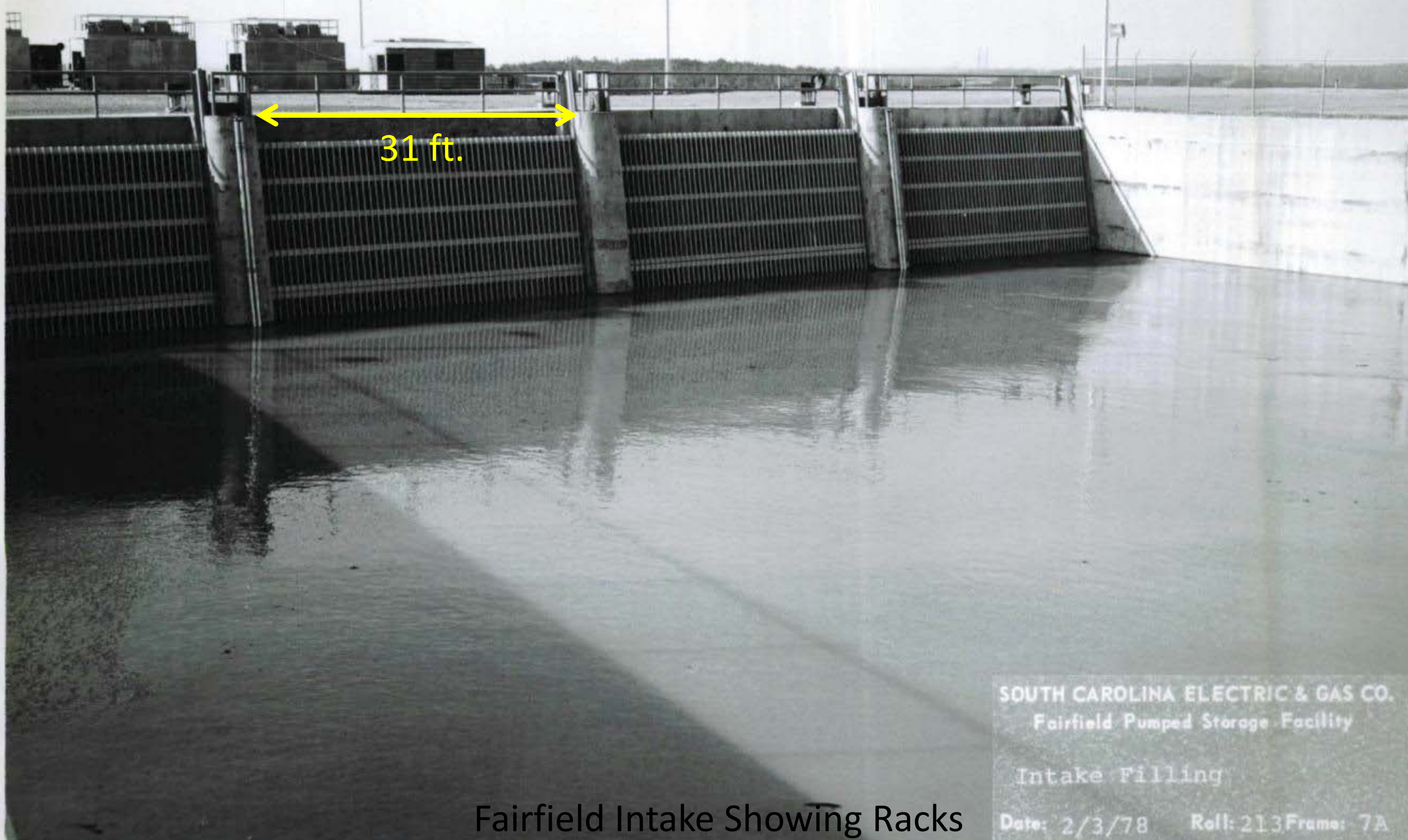




Fairfield Cross Sections at Intake and Powerhouse

Basic Information

- Intake Structure:
  - 265 ft. long, 132 ft. wide, 74 ft. tall.
  - Intake channel is 300 ft. long, tapers from 260 ft. wide to 132 ft. wide at intake racks.
  - Four trash racks, each 31 ft. wide, 73 ft. tall.
  - Each rack bay serves 2 units (one penstock).
  - Vertical bars are 1 in. wide on 7 in. centers = 6 in. clear spacing (horizontal).

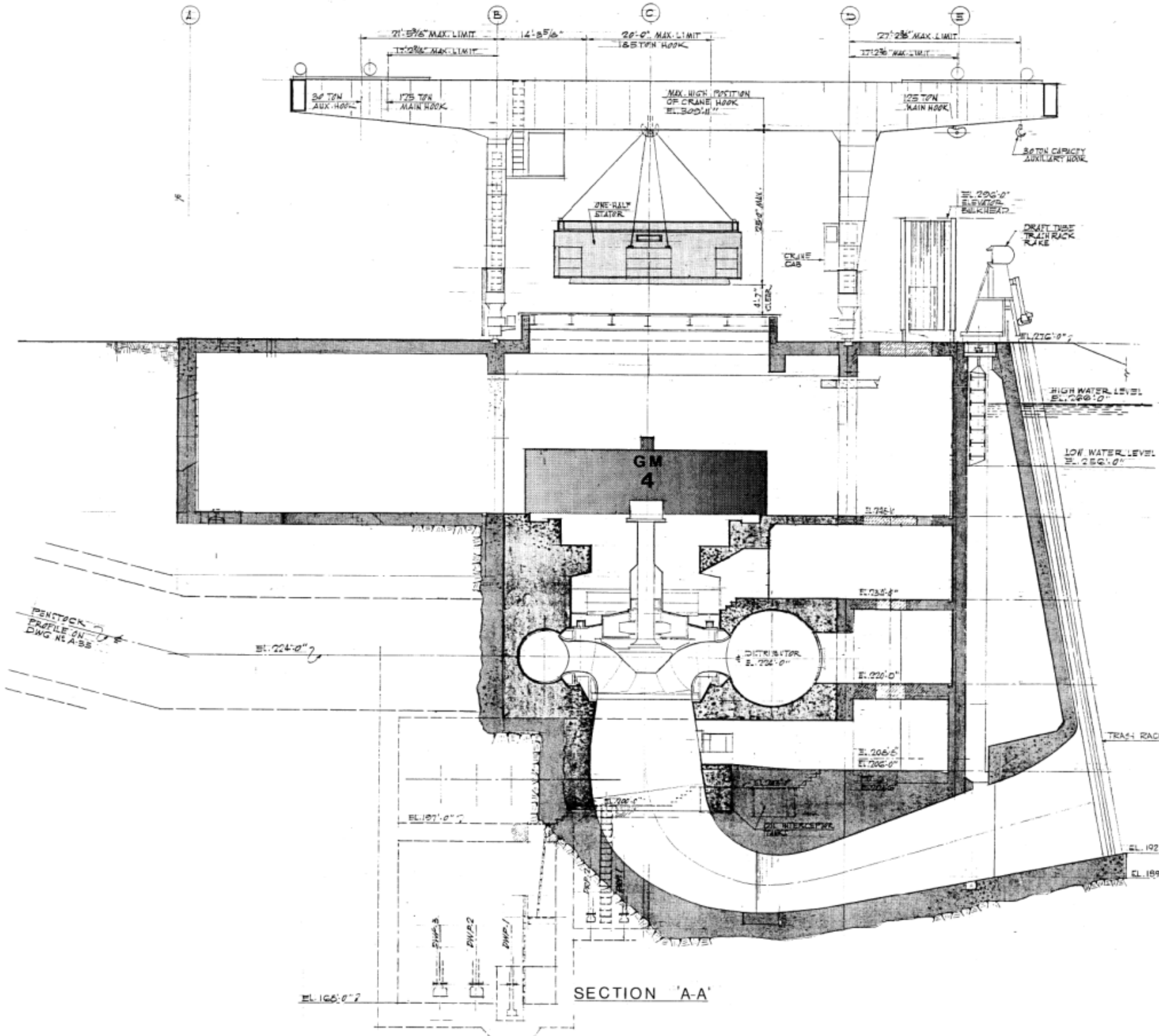


Fairfield Intake Showing Racks


SOUTH CAROLINA ELECTRIC & GAS CO.
Fairfield Pumped Storage Facility
Intake Structure
Date: 9-1-76 Roll: 177 Frame: 20A

Basic Information

- FFPS Powerhouse:
  - 520 ft. long, 150 ft. wide, 108 ft. tall.
  - Eight 65 ft. wide bays, each with one pump-turbine-motor-generator unit.
  - 16 draft tube racks at tailrace, each rack is 24.5 ft. wide, 23 ft. tall.
  - Vertical bars are 1 in. wide on 7 in. centers = 6 in. clear spacing (horizontal).



Fairfield Cross Section Through Powerhouse

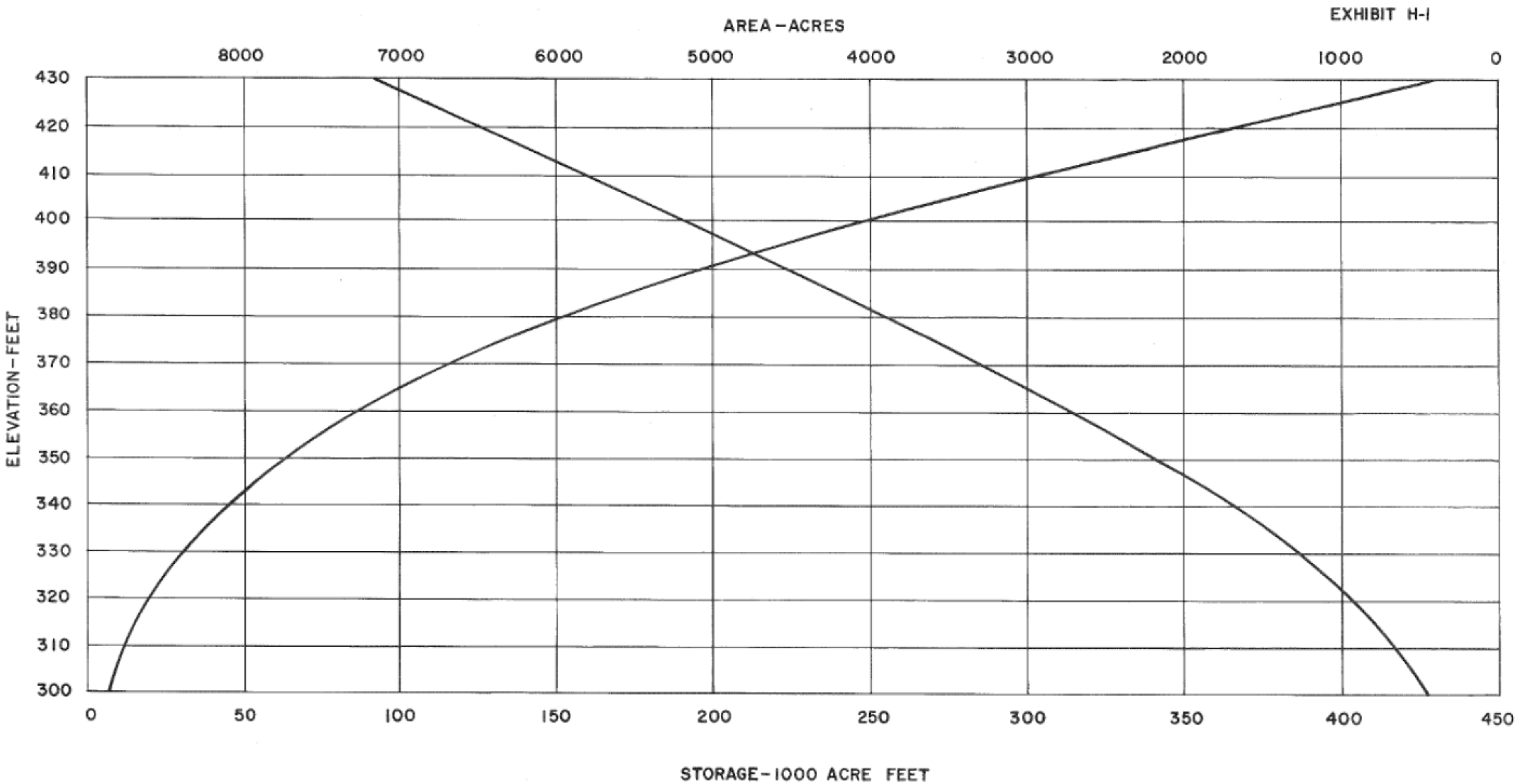

SOUTH CAROLINA ELECTRIC & GAS CO.
Fairfield Pumped Storage Facility
Powerhouse - Facing Northeast
Date: 6-1-76
Roll: 172
Frame: 1A


24 ft.

Initial Filling of Monticello Reservoir

Plant Upgrades Since Construction

- 2000: New stainless steel water wheels, generators rewedged, turbine runners and partial rotor poles replaced on Units 7 and 8.
- 2001: New stainless steel water wheels, generators rewedged, turbine runners and partial rotor poles replaced on Units 3 and 4. Exciters replaced on Units 5 and 6.
- 2002 – 2003: Generators rewedged, turbine runners replaced, and tailrace trash racks replaced on Units 1 and 2. Partial rotor pole replaced on Unit 1. Exciters replaced on Units 3 and 4.
- 2004 – 2005: Exciters replaced on Units 1 and 2. Generators rewedged, turbine runners replaced, partial rotor pole replaced, controls and governors upgraded, and individual servo replaced with a slip ring mechanism on Units 5 and 6.
- Tailrace trash racks and exciters replaced on Units 7 and 8.



Monticello Reservoir Area-Capacity Curves

Operation Overview

Project Operation at Various Flow Ranges

- Inflow ≤ 6,000 CFS:
  - No need for natural flow regulation since Parr Reservoir is capable of storing the entire upper reservoir active storage, and Parr Hydro is capable of discharging the natural river flow.
  - Parr crest gates maintained in fully raised position, no spill occurs.
  - FFPS generation not limited.

Project Operation at Various Flow Ranges

- Inflow Between 6,000 and 40,000 CFS:
  - Some natural flow regulation will occur as crest gates are lowered to maintain Parr Reservoir at allowable elevations.
  - Spill plus Parr generation may exceed natural inflow.
  - Some upper reservoir water will be spilled when FFPS is generating, and will be recaptured from natural river flow during subsequent pump cycle.
  - FFPS generation limited as necessary to maintain total discharge from project ≤ 40,000 CFS.

Project Operation at Various Flow Ranges

- Inflow > 40,000 CFS:
  - No natural flow regulation will occur as all crest gates are lowered fully and FFPS generation is ceased.
  - Parr Hydro will generate with all available units.
  - Parr generation plus spill equals natural inflow.
  - No water released from Monticello Reservoir.

Questions?

Parr Hydroelectric Project Regulation Effects

Raymond R. Ammarell, P.E.

Operations RCG Meeting

June 27, 2013

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PARR Relicensing Project

Topics

- Review of existing USGS flow data
- Comparison of inflow vs. outflow correlations
- Broad River flow-duration comparison for inflow and outflow
- Downstream effects – normal and high flows
- License compliance summary

USGS Flow Data

- Four gauges are used to operate Parr Hydro Project:
  - Broad River near Carlisle (02156500)
  - Tyger River near Delta (02160105)
  - Enoree River near Whitmire (02160700)
  - Broad River at Alston (02161000)
- Continuous daily flow record for all 4 gauges from 10/1/1980 to present (approved data to 9/30/2012, 32 years).

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PARR Relicensing Project

USGS Flow Data

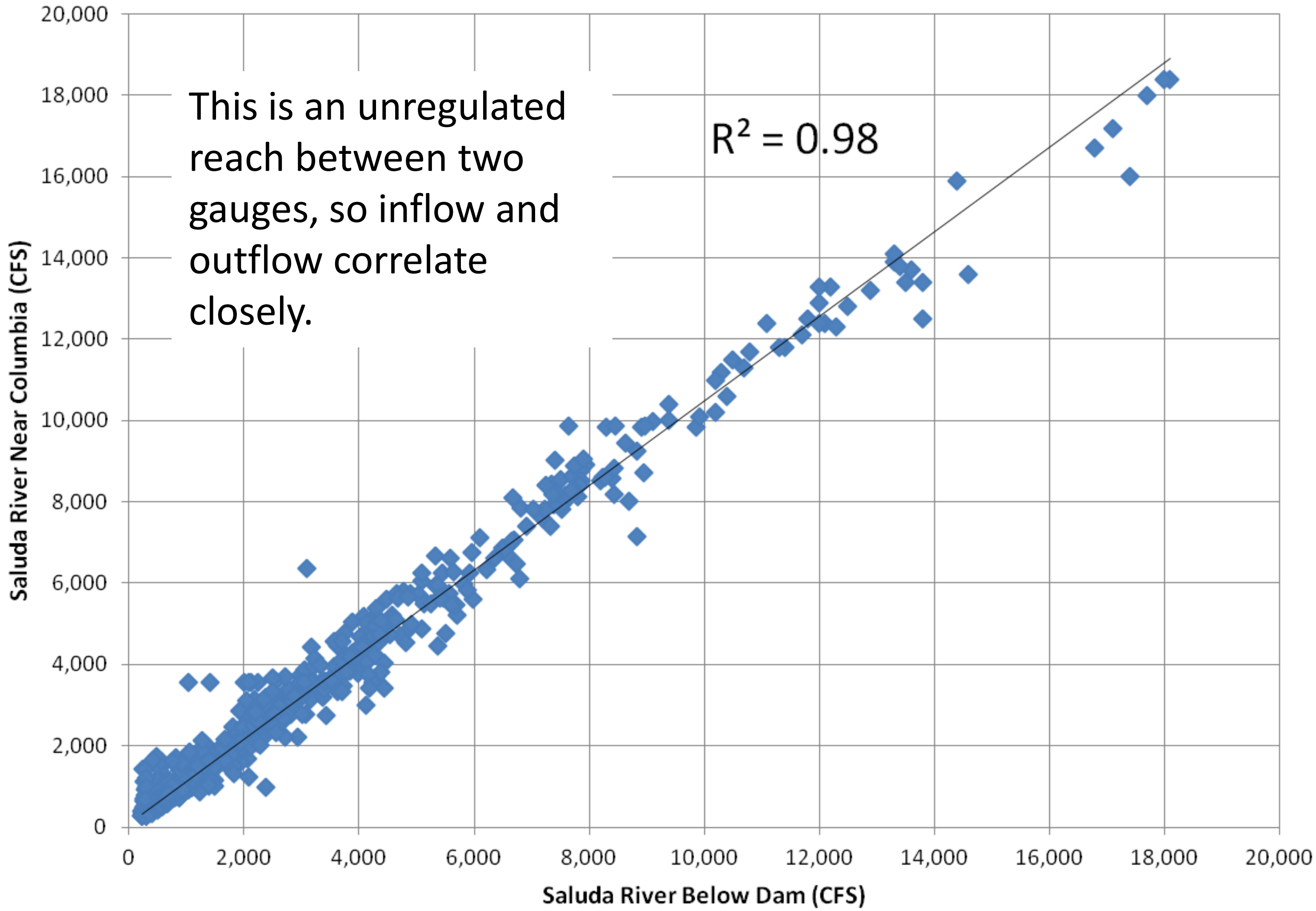
- Daily flow statistics (for 10/1/1980 to 9/30/2012):

	Mean (CFS)	Median (CFS)
Inflow	4,573	3,256
Outflow	5,163	3,440

Inflow-Outflow Correlation

- Plotting inflow vs. outflow provides an indication of the degree of regulation a reservoir provides.
- No regulation = good correlation (r^2 close to 1)
- Much regulation = poor correlation ($r^2 << 1$)
- Example: look at lower Saluda River and Lake Murray.

Inflow vs. Outflow - No Regulation



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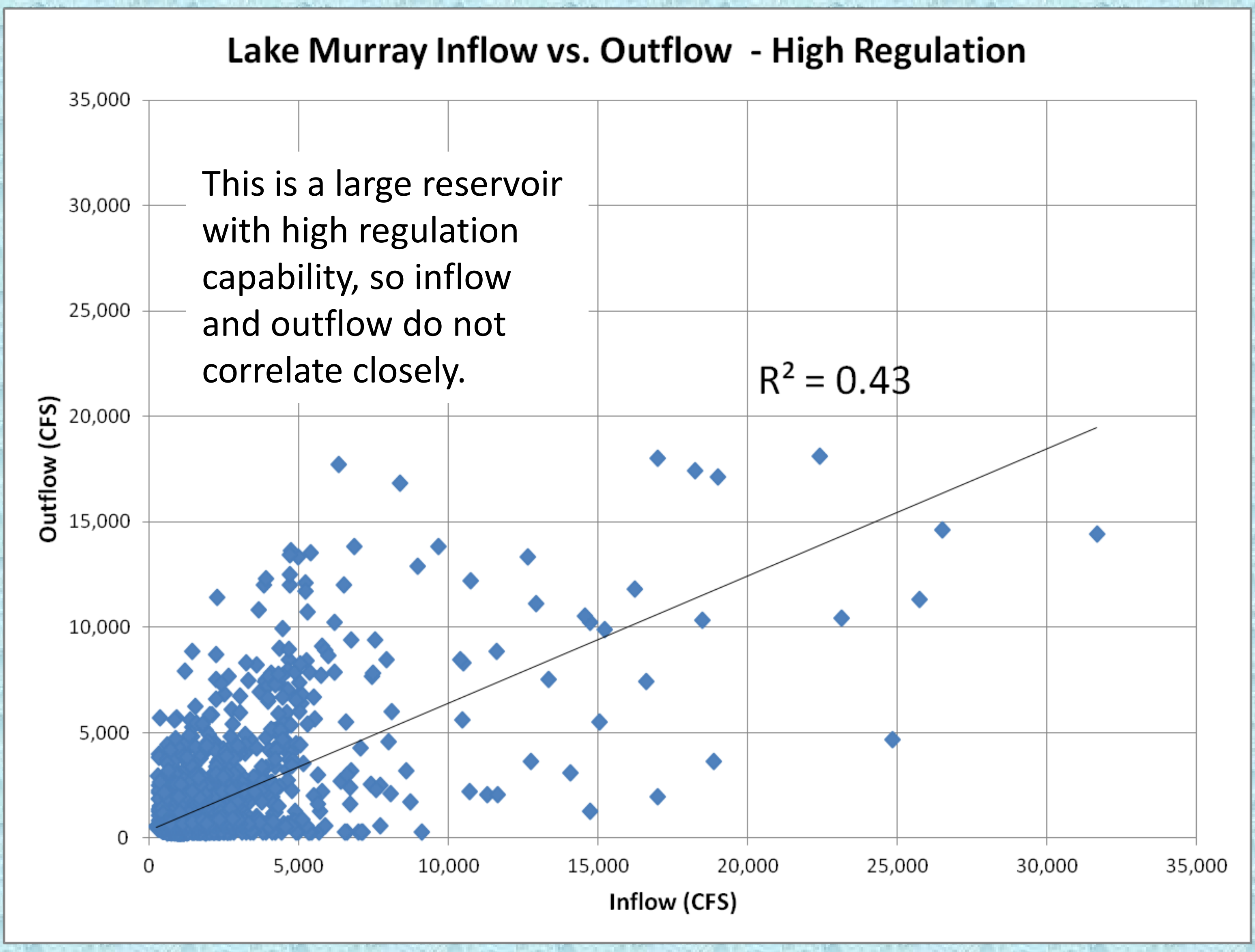
PARR Relicensing Project


Lake Murray Inflow vs. Outflow - High Regulation
This is a large reservoir with high regulation capability, so inflow and outflow do not correlate closely.
R² = 0.43
Outflow (CFS)
Inflow (CFS)
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
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Relicensing Project

Inflow-Outflow Correlation

- Now look at Parr Project inflow vs. outflow
- Inflow is sum of three upstream gauges
- Outflow is Alston gauge

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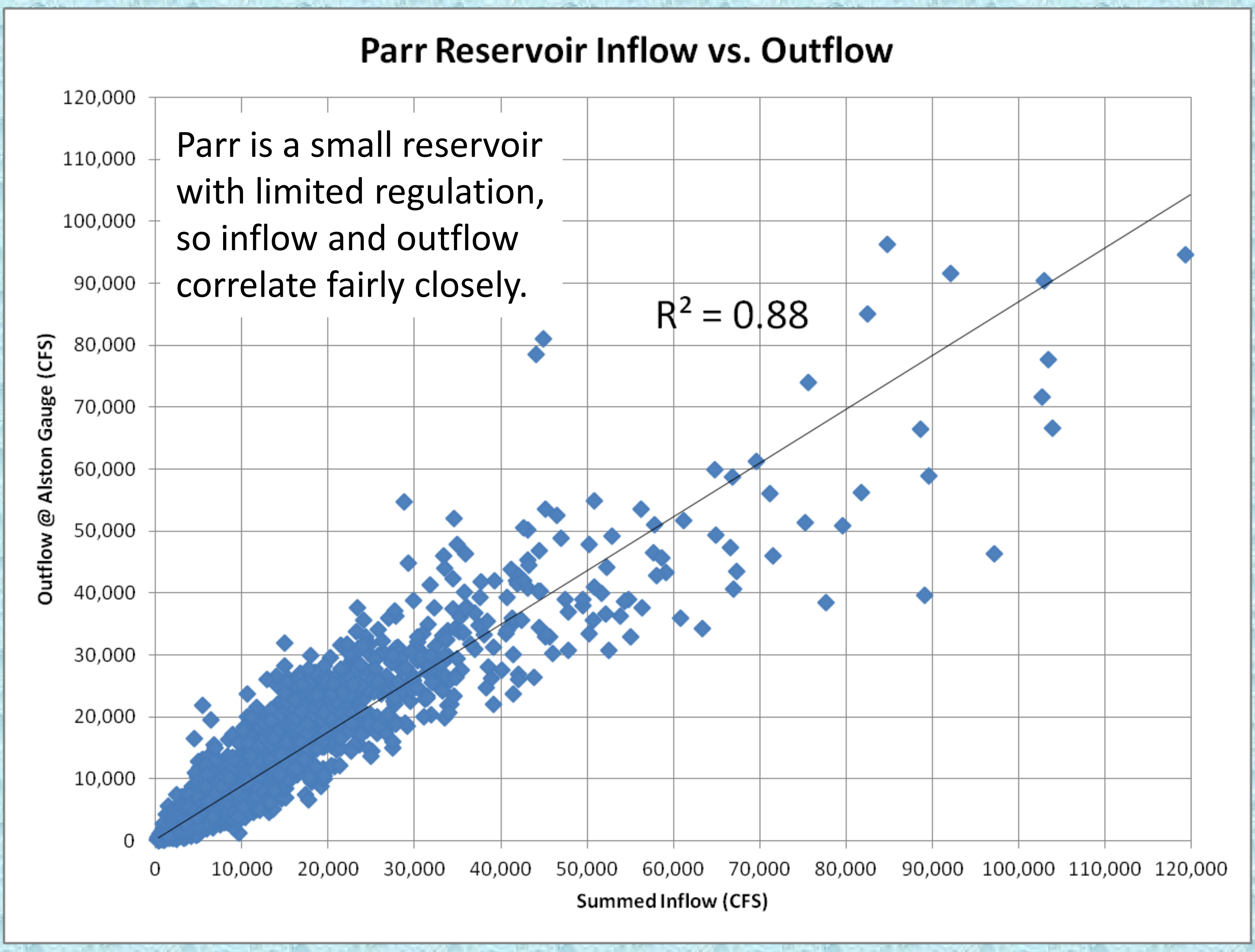
Relicensing Project


Parr Reservoir Inflow vs. Outflow
Parr is a small reservoir with limited regulation, so inflow and outflow correlate fairly closely.
R² = 0.88
Outflow @ Alston Gauge (CFS)
Summed Inflow (CFS)
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000

Parr Inflow-Outflow Correlation

- Parr project provides a fairly low degree of regulation.
- Daily inflow correlates fairly closely with daily outflow.
- Scatter at higher flows may be due to timing effects as the hydrographs move down the basin.

Broad River Flow Frequency

- Compare flow duration curves for inflow and outflow for Parr Project.
- Curve shows how often a given flow has been exceeded during the period of interest.
- Can show effect of regulation if project is increasing or decreasing the frequency of certain ranges of flow.
- Also shows effect of license conditions.

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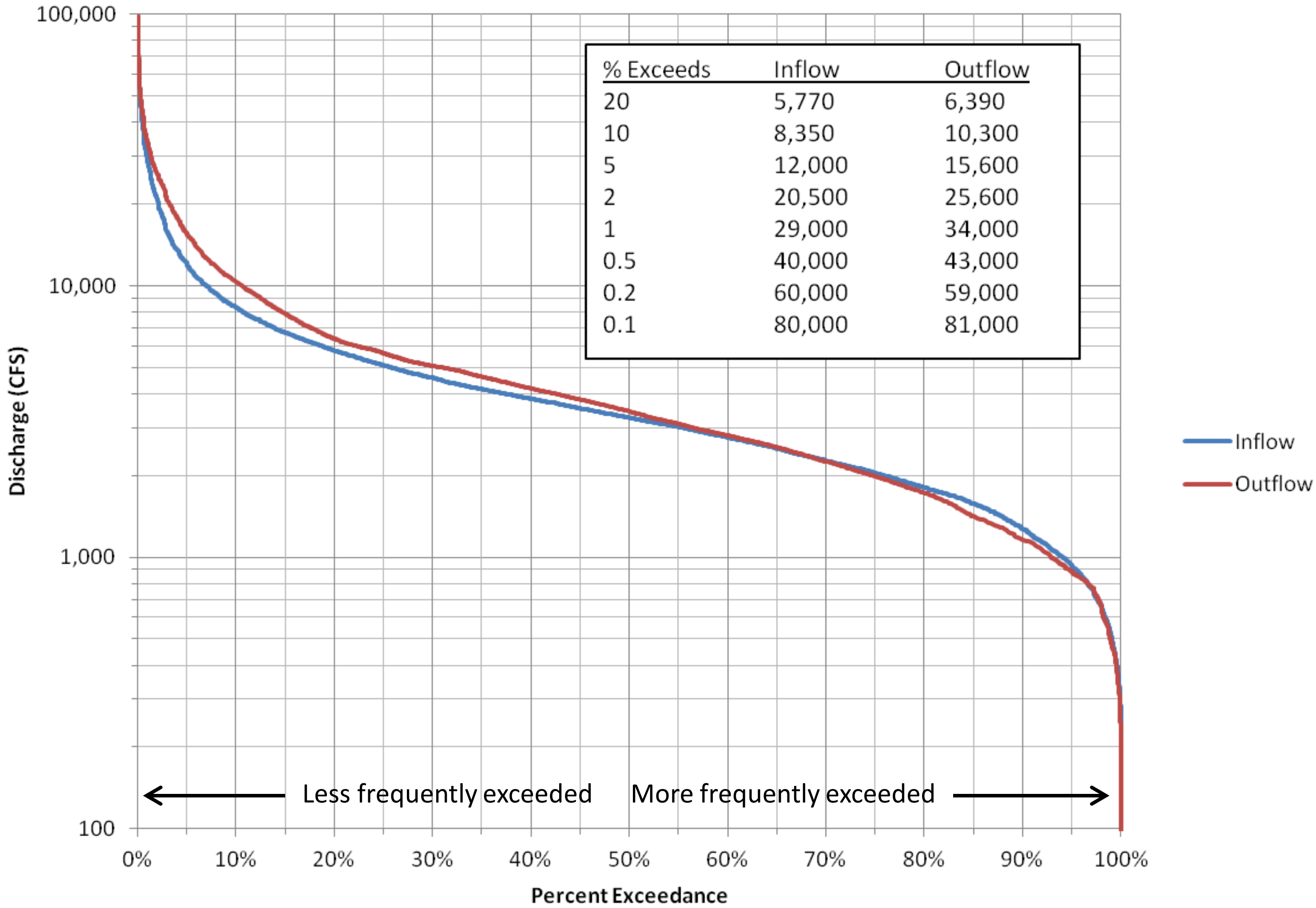
PARR Relicensing Project

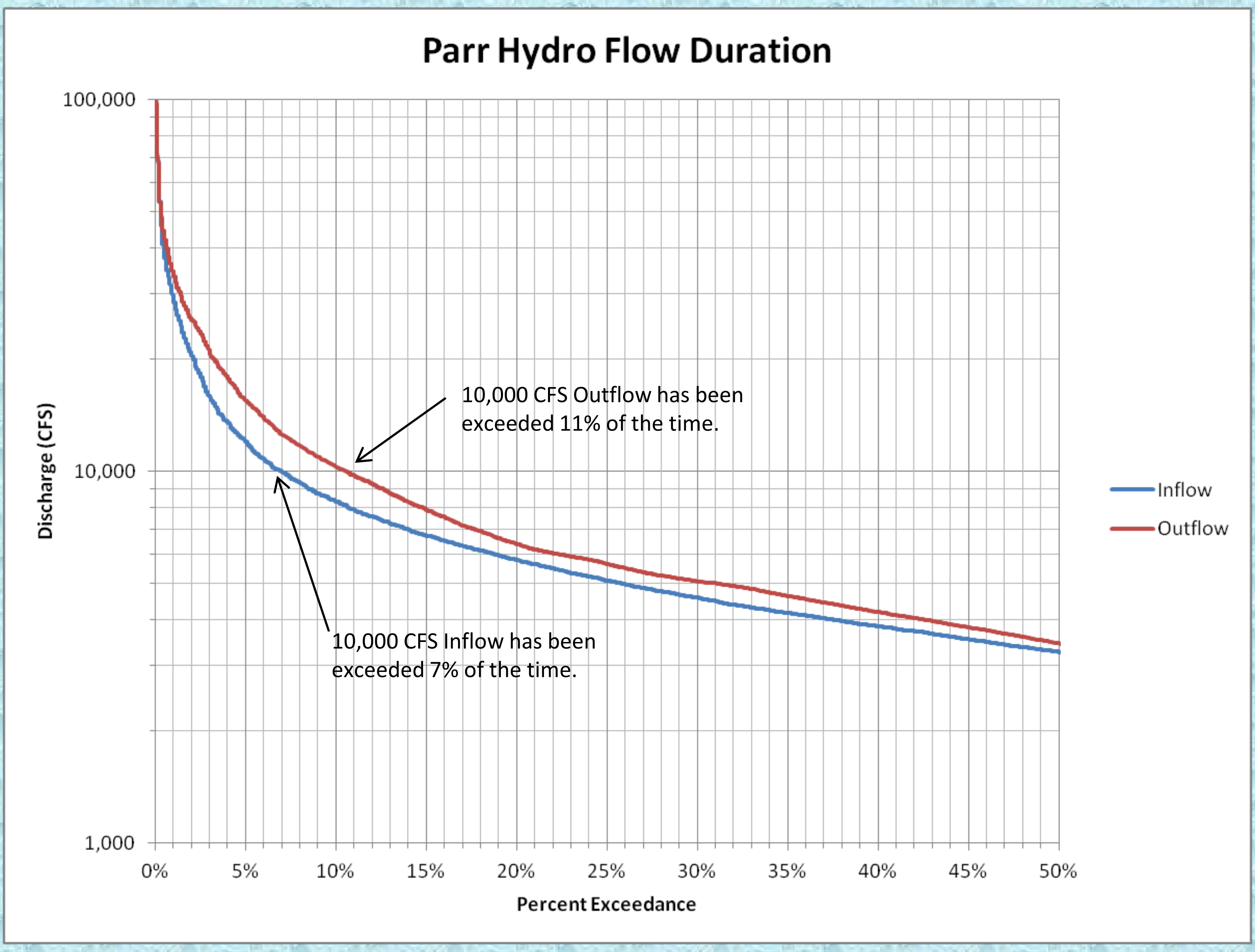
Broad River Flow Frequency

- Current operating constraints:
  - Must pass inflow (minus evaporation) for inflows < 800 CFS (1,000 CFS spring).
  - Plant hydraulic capacity is 6,000 CFS – above this flow some spill will occur.
  - When Fairfield is generating and gates are down, upper reservoir water will be spilled (adds to natural river flow at Alston).
  - Cannot exceed 40,000 CFS downstream with Fairfield operating.

Parr Hydro Flow Duration



% Exceeds	Inflow	Outflow
20	5,770	6,390
10	8,350	10,300
5	12,000	15,600
2	20,500	25,600
1	29,000	34,000
0.5	40,000	43,000
0.2	60,000	59,000
0.1	80,000	81,000



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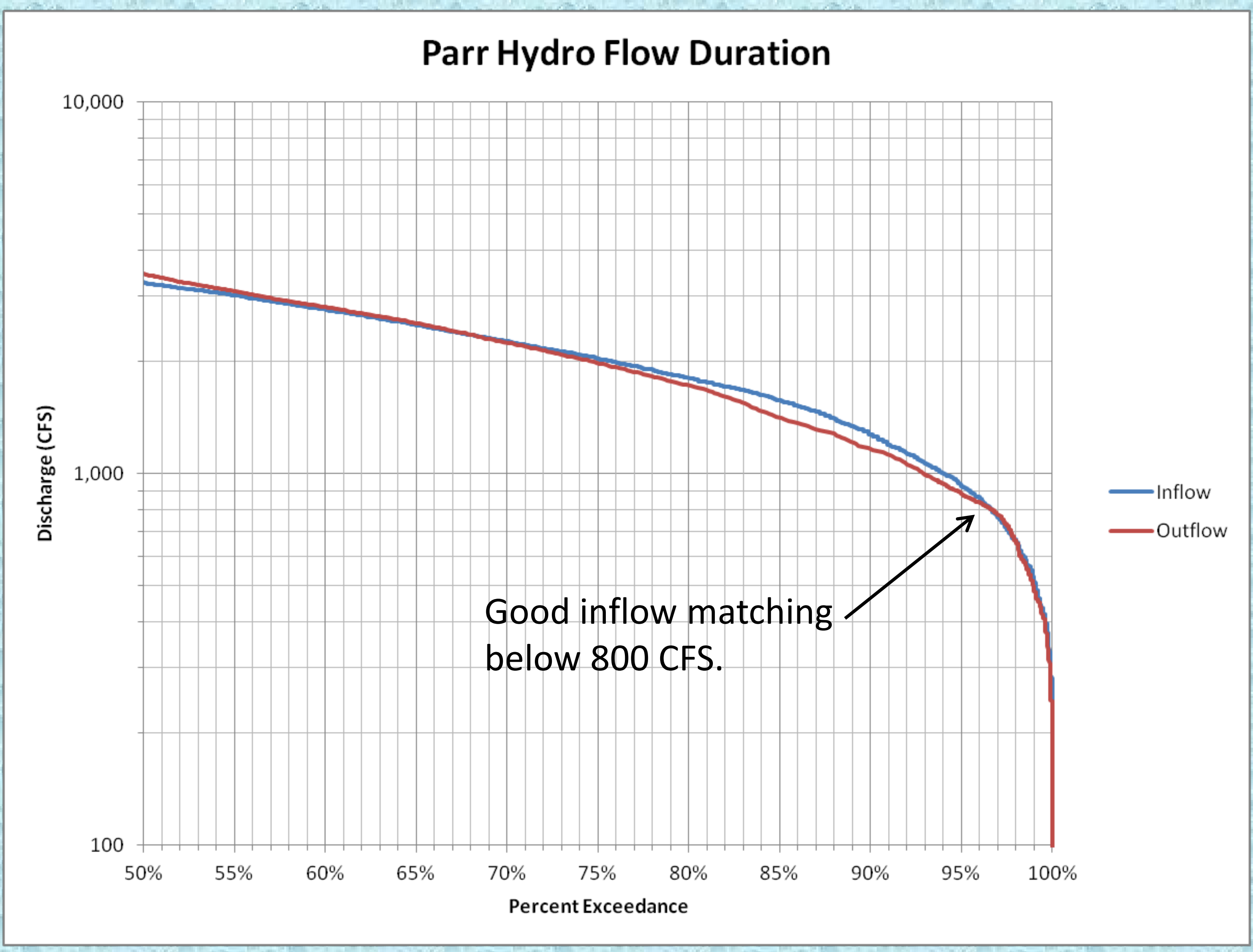
PARR Relicensing Project



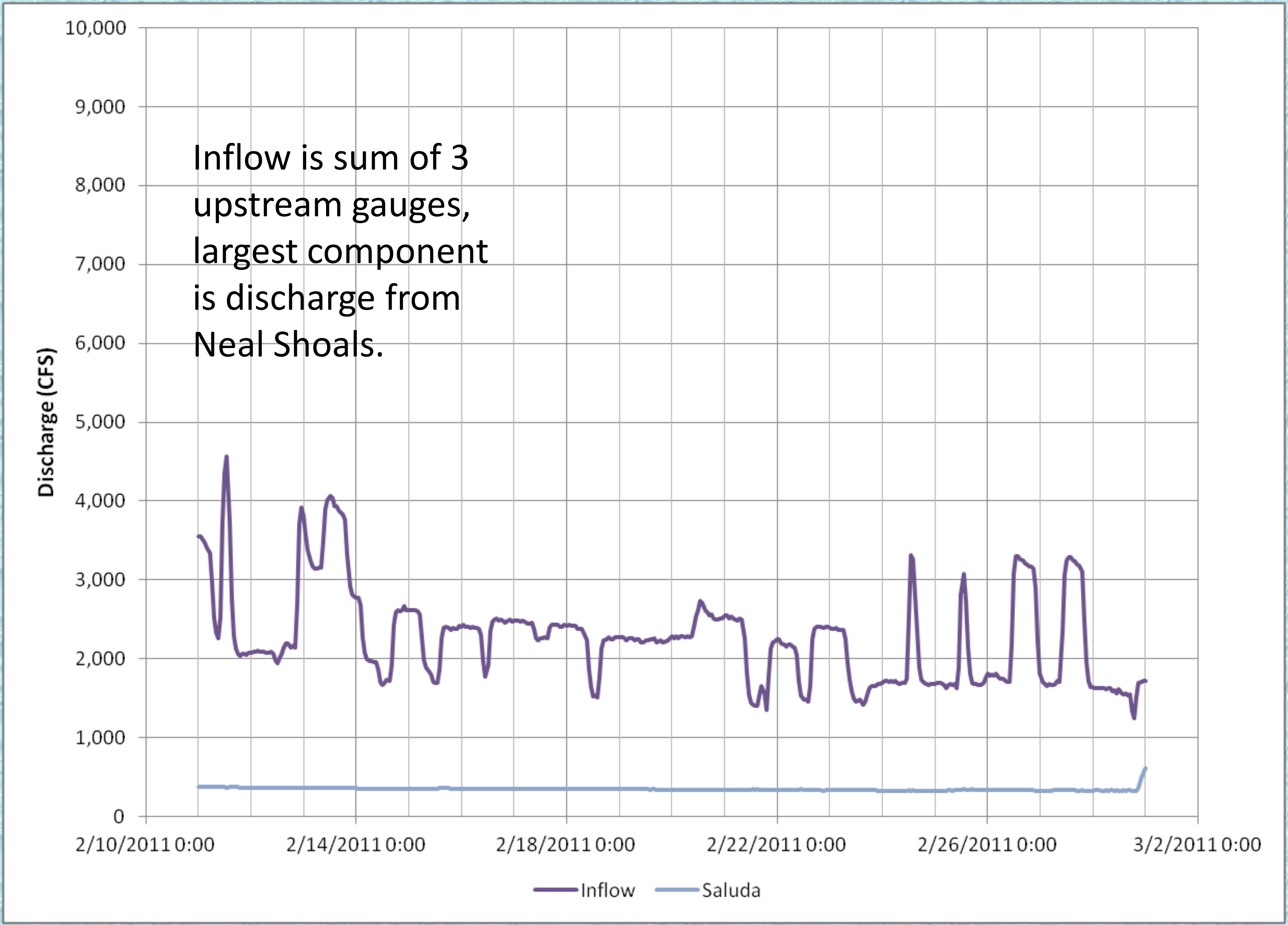
Parr Hydro Flow Duration
10,000
1,000
100
Discharge (CFS)
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%
100%
Percent Exceedance
Inflow
Outflow
Good inflow matching
below 800 CFS.

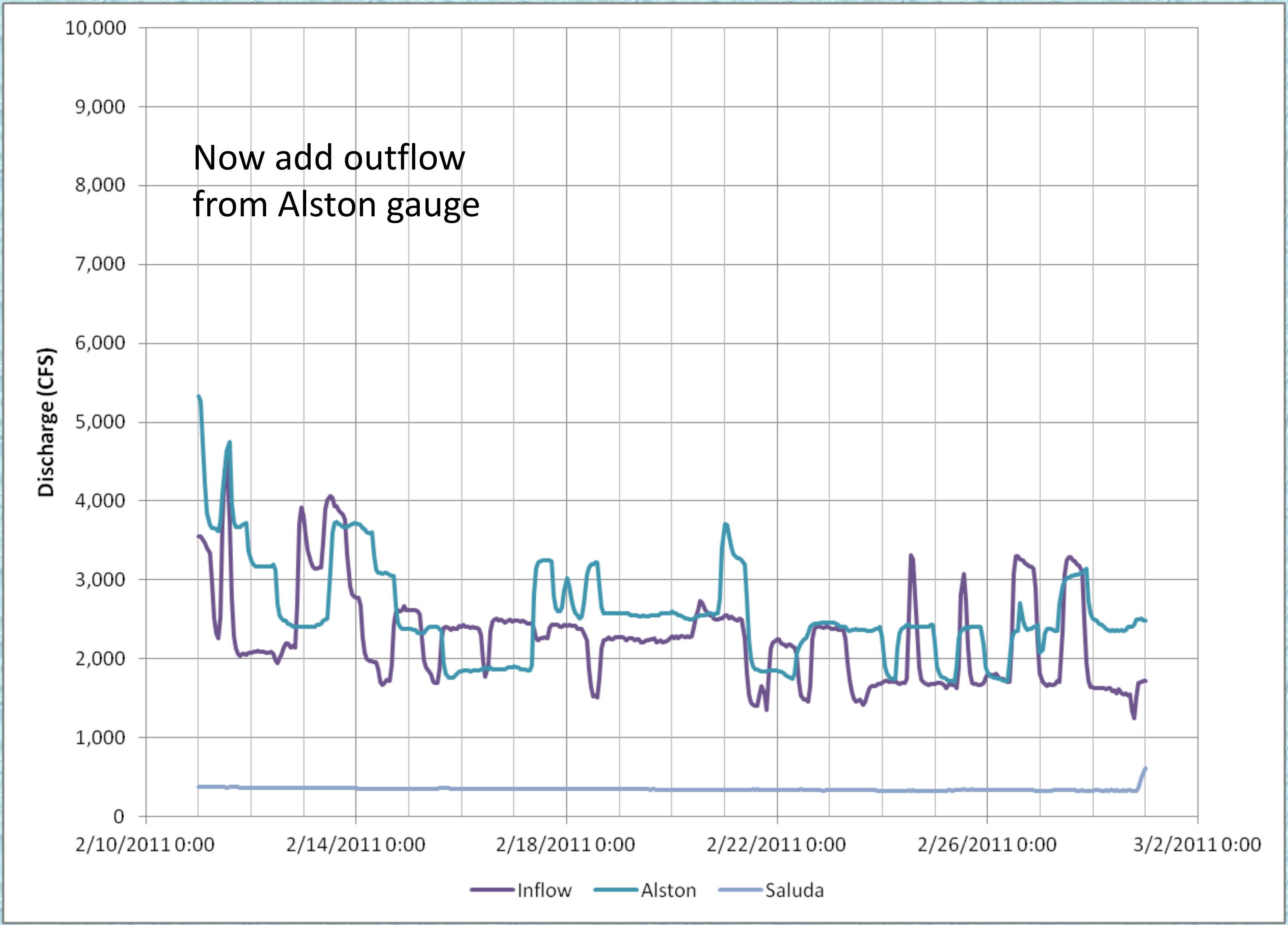
Broad River Flow Frequency

- Conclusions:
  - Good flow frequency matching on a daily basis below 800 CFS.
  - Between 800 and 1,500 CFS, daily outflow appears to be slightly less than daily inflow due to regulation.
  - Between 1,500 and 40,000 CFS, daily outflow appears to be greater than daily inflow.
  - Good flow frequency matching on a daily basis over 40,000 CFS.

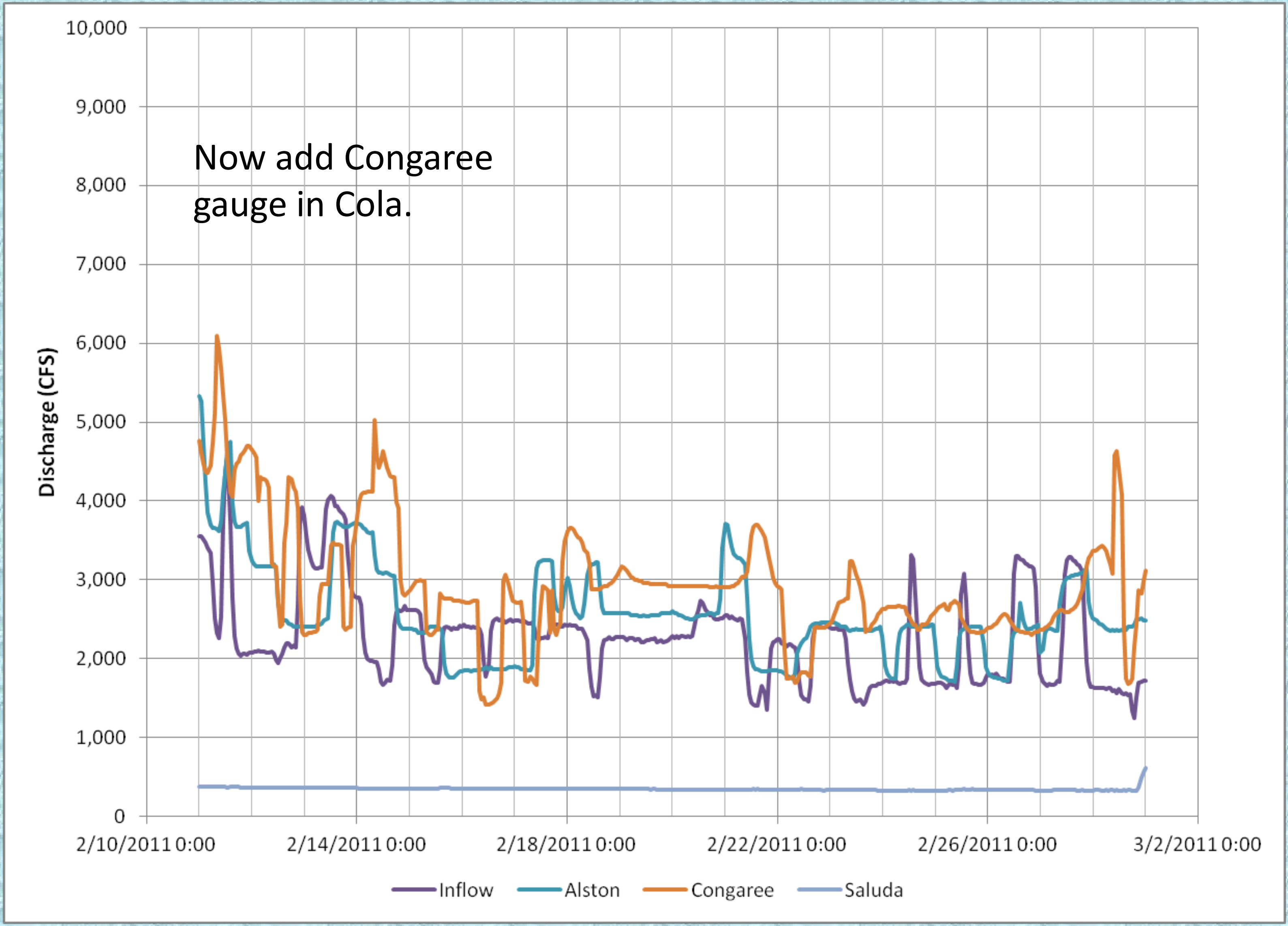
Parr Operation Flow Effects During "Normal" Flow Periods

- Look at typical period with inflow < 6,000 CFS.
- Normal Parr Hydro operation with all gates up.
- Compare inflow hydrograph with Alston and Congaree gauges.
- No Saluda Hydro Operation during this period.


10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Discharge (CFS)
Inflow is sum of 3 upstream gauges, largest component is discharge from Neal Shoals.
2/10/2011 0:00
2/14/2011 0:00
2/18/2011 0:00
2/22/2011 0:00
2/26/2011 0:00
3/2/2011 0:00
Inflow
Saluda



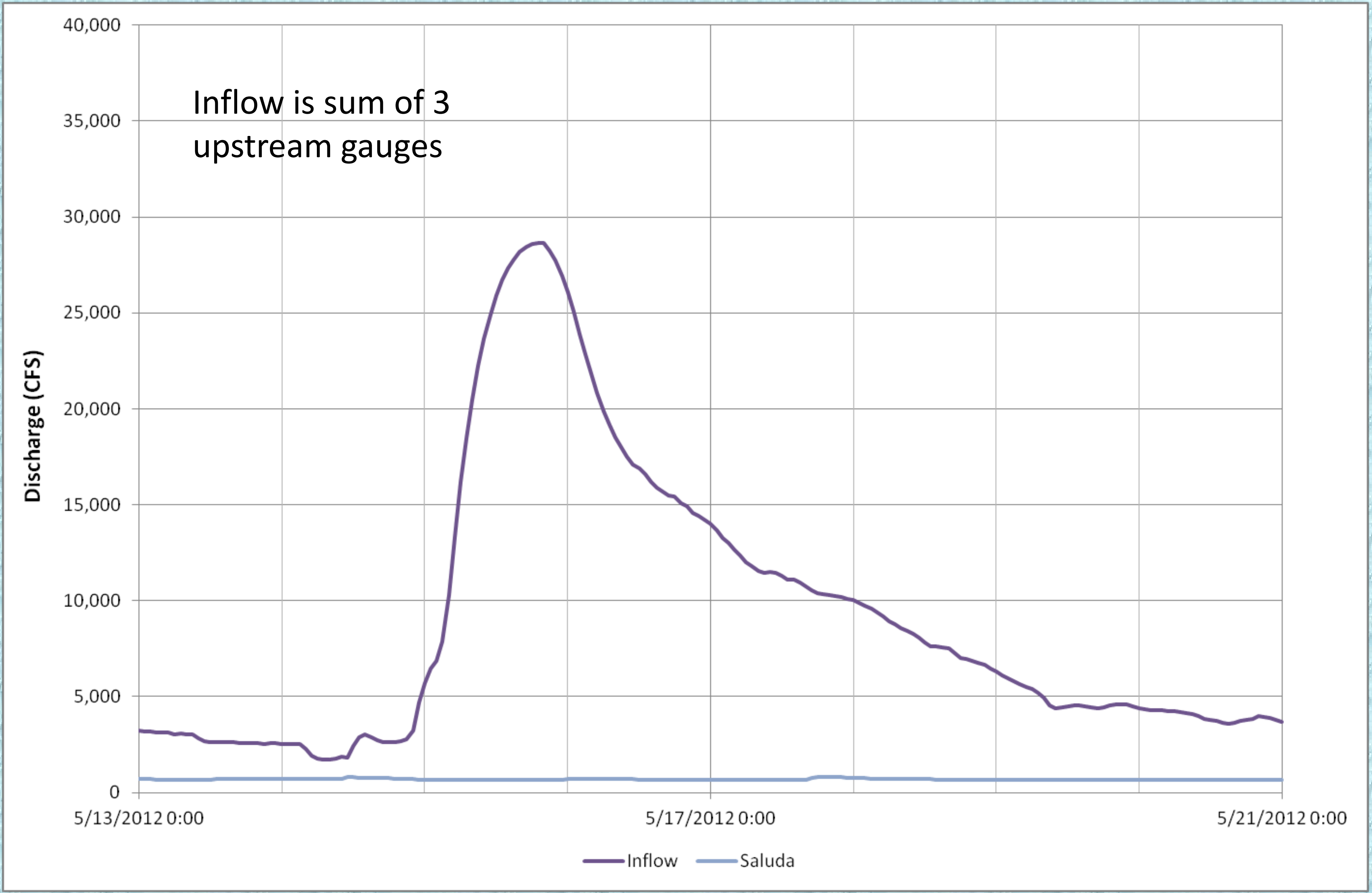
Now add outflow
from Alston gauge
Discharge (CFS)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2/10/2011 0:00
2/14/2011 0:00
2/18/2011 0:00
2/22/2011 0:00
2/26/2011 0:00
3/2/2011 0:00
Inflow
Alston
Saluda



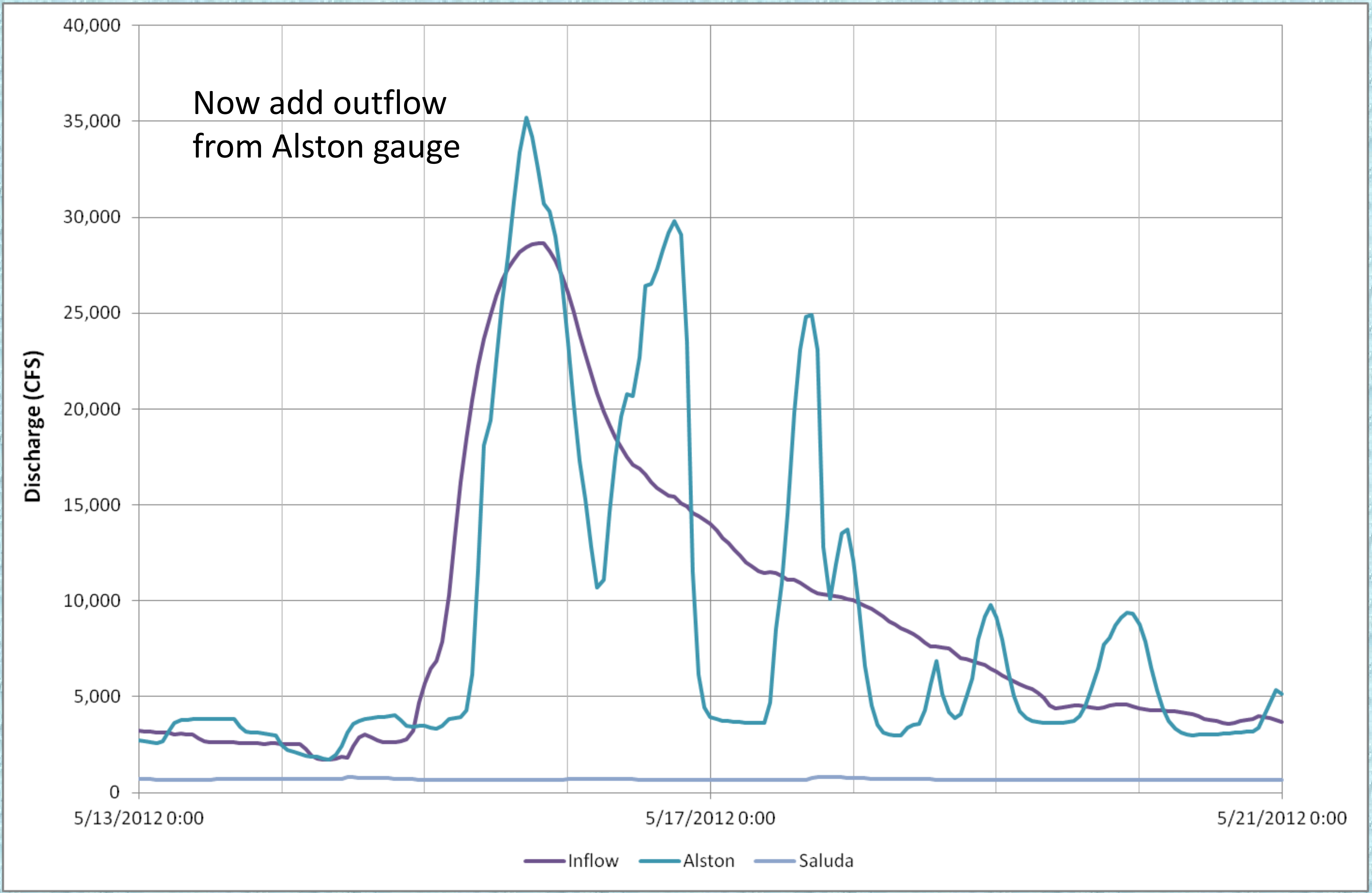
Now add Congaree
gauge in Cola.
Discharge (CFS)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2/10/2011 0:00
2/14/2011 0:00
2/18/2011 0:00
2/22/2011 0:00
2/26/2011 0:00
3/2/2011 0:00
Inflow
Alston
Congaree
Saluda

Downstream Effects of FFPS Operations During High Flows

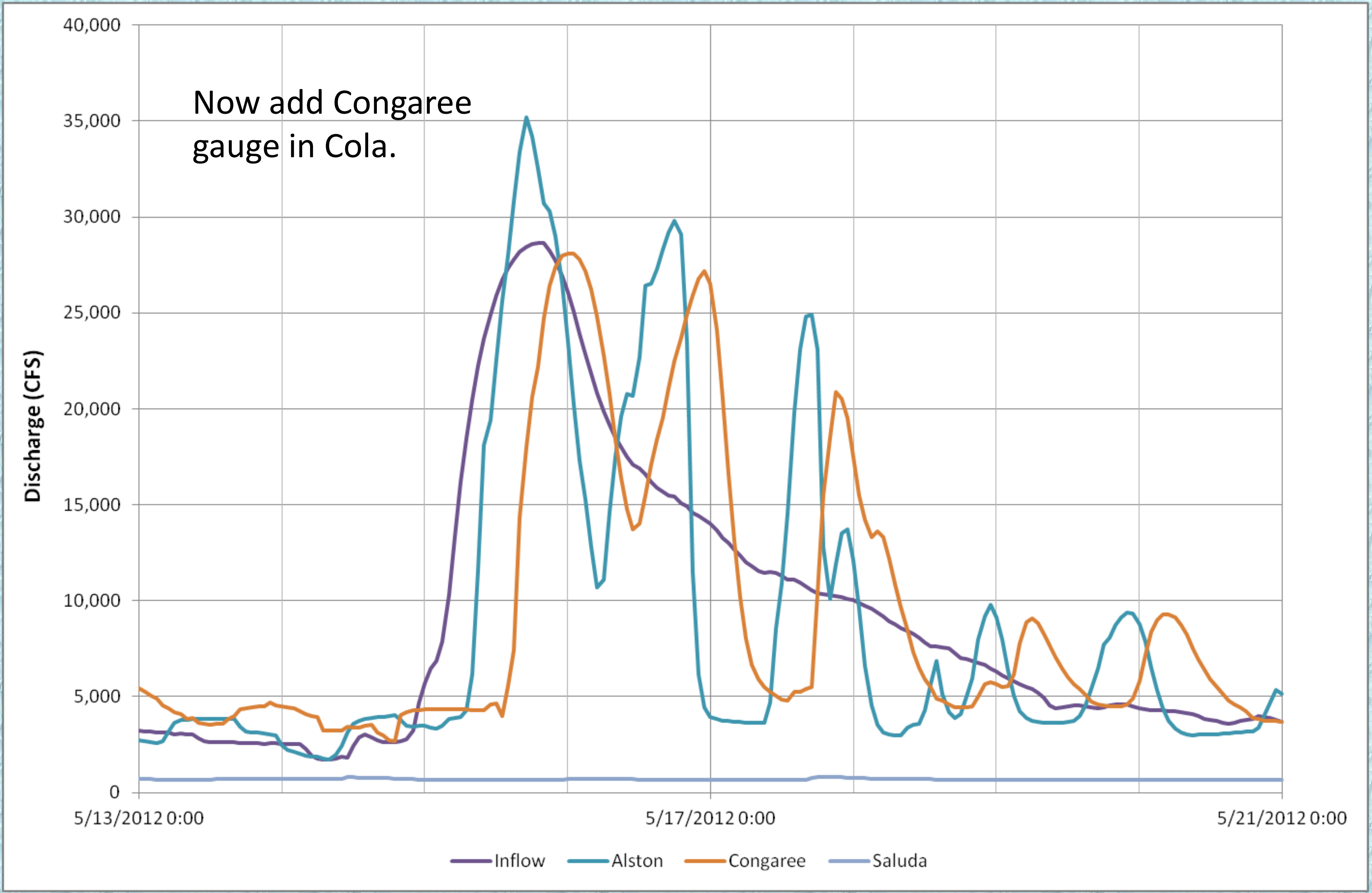
- Look at a typical hydrograph from minor flood event – May 2012.
- Peak Inflow of 28,000 CFS
- Peak Outflow of 35,000 CFS
- Illustrates effect of FFPS operation when Parr gates are down.
- Discharge increased during generation and reduced during pumping.
- No Saluda Hydro operation during this event.



Inflow is sum of 3 upstream gauges
Discharge (CFS)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
5/13/2012 0:00
5/17/2012 0:00
5/21/2012 0:00
Inflow
Saluda



Now add outflow
from Alston gauge
Discharge (CFS)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
5/13/2012 0:00
5/17/2012 0:00
5/21/2012 0:00
Inflow
Alston
Saluda



Now add Congaree gauge in Cola.
Discharge (CFS)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
5/13/2012 0:00
5/17/2012 0:00
5/21/2012 0:00
Inflow
Alston
Congaree
Saluda

License Compliance Summary

Parr Hydro Minimum Flow Compliance Summary

Year	Lowest Hourly Project Discharge During Year @ Alston Gauge (CFS)	Number of Days Daily Average Discharge < (Inflow minus Evaporation)	Minimum Recorded Daily Inflow During Year (CFS)
2000	122	18	641
2001	122	17	564
2002	26	43	266
2003	301	1	2401
2004	301	0	1412
2005	437	0	1267
2006	106	8	906
2007	163	14	298
2008	170	2	153
2009	246	0	709
2010	340	0	486
2011	270	6	290
2012	444	0	860

Parr Reservoir Elevation Summary

Year	Minimum Recorded Reservoir Elevation (ft. NGVD)	Maximum Recorded Reservoir Elevation (ft. NGVD)
2000	255.9	266.2
2001	255.6	266.2
2002	255.9	266.4
2003	256.0	266.5
2004	255.9	266.5
2005	256.1	266.5
2006	254.9	266.1
2007	255.7	266.2
2008	256.0	266.6
2009	256.9	266.3
2010	256.1	266.3
2011	256.1	266.2
2012	256.5	266.4

Monticello Reservoir Elevation Summary

Year	Minimum Recorded Reservoir Elevation (ft. NGVD)	Maximum Recorded Reservoir Elevation (ft. NGVD)
2000	420.5	425.0
2001	420.5	425.0
2002	420.0	425.0
2003	420.5	425.0
2004	420.0	425.0
2005	420.5	425.0
2006	420.6	425.0
2007	420.5	425.0
2008	420.5	425.0
2009	420.6	425.0
2010	420.0	425.0
2011	420.5	425.0
2012	420.6	425.0

Questions?

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

July 31, 2013

Final KDM 08-20-13

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Gerrit Jobsis (American Rivers)
Shane Boring (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Vivianne Vejdani (SCDNR)
Frank Henning (Congaree National Park)
Chad Altman (SCDHEC)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA) via conf. call
Steve Summer (SCANA)
Brandon Kulik (Kleinschmidt) via conf. call
Dick Christie (SCDNR)
Tom McCoy (USFWS)
Byron Hamstead (USFWS)
Rusty Wenerick (SCDHEC)
Fritz Rohde (NOAA)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

After introductions, Alan opens the meeting by reviewing the agenda. He then turns the meeting over to Brandon and Shane to give an overview of the IFIM recon trip that was held June 18th and 19th. Brandon reviews the notes from the trip, which were provided to the group via email on July 10th, giving a description of each of the ten study sites. Study site 7 was noted by Ron to be a very unique stretch of the river and a very important study area. He said this area has a defined drop with an obvious glide that is highly utilized by fish. Ron says this area of the river is unique because of the size of the drop, but it is also quite representative of the river overall, due to the types of habitats it provides. The group agreed that Site 7 should be evaluated using the DNR's navigation criteria and that other sites should also be considered.

Brandon and Ron then discussed the pool that was located at study site 7 and whether this area was going to be included in the study. Brandon says while pools don't really influence flow decision-making, this area should be documented. Frank H asked if the pool areas need to be studied from a sediment standpoint, to determine if there is enough flow to flush sediment out of the pool, and prevent sediment trapping. Ron and Shane both agree that this shouldn't be an issue, as there is plenty of flow to keep the sediment moving. Ron says the pools will be mapped during the mesohabitat study, and agrees with Brandon that transects aren't needed here.

Brandon then describes how a 2D model works, which is a possible option for study site 9. 2D modeling uses a honeycomb type of data gathering, which fit together to form a picture. This gives a different view of a site versus a straight transect. The group decided that a 2D model should be used at study site 10, at Bookman Island. Gerrit asks how the analysis for the 2D modeling will be

Kleinschmidt

conducted, with the flows being at the selected levels. Brandon says that field data will be collected at Bookman and then used to see what flow range makes the most sense for modeling. Alan asks if the entire Bookman Island complex will be used for modeling at Huffman Island, or will just a piece of the complex be used. Brandon says the entire Bookman Island complex will be used. He adds that the two island complexes will not be mathematically linked, but instead an empirical examination will be used to determine similarities between the two (i.e., a field verification, similar to what was done for the Saluda Project) of flow recommendations, to ensure that recommendations developed are based on work at Bookman are applicable to Huffman Island.

Gerrit mentions the importance of determining how the channels at Bookman are linked, and how some of the smaller channels may be isolated during periods of lower flow. Brandon assures Gerrit that the 2D modeling will include the small cross-channels around the islands, so that these areas may be studied as well. Gerrit says he wants to make sure the study plan captures not only the analysis using HSI curves, but also how various flows affect these small channels. He would like to have a site visit to examine Huffman and Bookman Islands during several different flows to ground truth 2D modeling results.

With this, Alan notes that there seems to be concurrence within the group on the study approach, and asks Brandon if he has enough information to develop a study plan. Brandon says he does and will begin developing a study plan to bring back to the group for review.

The group then begins discussing the HSI curves that Brandon sent to the group to review. Brandon proposes that we use the Hightower curves for the American shad. Alan mentions that these curves are the ones sent to the group by Prescott Brownell a month earlier.

Ron then questions some of the guild classifications for the various fish species. He disagrees with some of the guild assignments and Alan and Dick suggest we work through the information until everyone can agree. The group discusses the difference between shallow versus deep and fast versus slow. The group also discusses the addition of other species at various life stages to the list. Ron suggests listing all life stages for the smallmouth bass in the study plan. Ron disagrees with the curve that corresponds to the smallmouth bass spawning, saying that spawning tends to decrease in waters deeper than approximately 4.5 feet. Brandon agrees, recommending the curve be changed to a stair step, with spawning increasing after reaching a depth of approximately 0.5 feet. Shane agrees to do some research on smallmouth bass spawning and work with Brandon to develop a modified curve for this species for discussion within the TWC.

The group discussed brassy jumprock curves and the need to change the guild for adults to Deep Fast and the guild for juveniles to Shallow Fast.

Gerrit recommends that striped bass spawning lifestage be included in the study. Ron agrees. The group discussed applicable curves from the Pee Dee IFIM study and Crance. Gerrit recommended that we bring in DNR striped bass expert Dr. Jim Bulak to help determine/develop appropriate curves.

The group discussed the importance of adding snail bullhead juvenile lifestage to the study and the need to review bullhead and catfish lifestage curves.

Gerrit and Ron ask for clarification regarding the channel index scale. Brandon explains the scale where 0 corresponds to detritus, 1 to fines, 2 to small gravel, 3 to large gravel, 4 to small cobble, 5 to large cobble, 6 to small boulder, 7 to large boulder, 8 to smooth bedrock, and 9 to irregular bedrock. Shane adds that a table from Wentworth will be included in the study plan that describes these substrates. Gerrit observes that the curves use different channel indices and recommends that all curves use the same channel index.

The group then focuses on modifying the guilds and habitat suitability criteria that Brandon provided. These modifications are included at the end of these notes. Gerrit mentions that the original studies should be referenced in the study plan and not just the broader study in which they were last used, such as the Pee Dee River IFIM.

The group discusses the range of operational flows that modeled as part of the IFIM study, as well as what calibration flows would be needed to model that range. Alan mentions that a range of 250 cfs to 2100 cfs was modeled during the IFIM study for the Saluda Relicensing Project. Brandon suggests putting some level loggers out in the river ahead of the study. Gerrit suggests that a dual flow analysis should be evaluated, to determine Project effects. The group decides on the following calibration flows to allow for modeling of the full range of operational flows: low flow of 400 cfs, with a medium flow of 2000 cfs and a high flow of 10,000 cfs.

After lunch, the group discusses the mesohabitat definitions that Shane provided. Tom says he likes the measurements that are included in the Bettinger definitions and the extra details that are included in the Catawba Wateree definitions. He would like to combine these two with the Saluda definitions. Ron says he doesn't want hard lines to be set for each definition with regards to depth as depths change depending on river flow. He would like to see the depths to be used as guides, but not exact measurements. Brandon suggests adding general depths and flows to the definitions for each habitat. Brandon points out that many of these habitats have already been identified on the river by the group during the IFIM recon trip. The group just needs to agree on the wording for each definition. The group discusses the differences between a glide versus a run, deciding that the slope upstream or downstream is a determining factor. The group works to modify the Saluda definitions and these modifications are included at the end of these notes.

SCE&G and Kleinschmidt personnel will begin to develop the study plans for the IFIM study and Mesohabitat Assessment and will have a draft ready for TWC review and approval by the beginning of October. The group plans to meet or have a conference call before the mesohabitat assessment is started. Any action items stemming from this meeting are included below.

ACTION ITEMS:

- Shane will research the smallmouth bass spawning and will work with Brandon develop a new HSI curve for review within the TWC.
- Shane will refine the mesohabitat definitions and distribute to the group for approval.

DRAFT MEMORANDUM

TO: Parr-Fairfield Hydro: Instream Flow/Aquatic Habitat TWC

FROM: Brandon Kulik

DATE: July 9, 2013

RE: **PROPOSED HABITAT SUITABILITY CRITERIA**

On May 7, 2013, the Instream Flow/Aquatic Habitat Technical Working Committee (TWC) agreed upon species and lifestages for which habitat suitability should be evaluated on the Broad River below the Parr-Fairfield Project as a part of AN IFIM study (Table 1)..

Table 1: Evaluation species elected by the TWC

- Smallmouth Bass
- American Shad
- Brassy Jumprock
- Whitefin Shiner
- Robust Redhorse
- Santee Chub
- Striped Bass
- Piedmont Darter
- Snail Bullhead
- Redbreast Sunfish
- Channel Catfish

The purpose of this memo is to recommend potential Habitat Suitability Criteria (HSC) for use in this study that are applicable to the above species. Smallmouth bass and redbreast sunfish criteria were sourced from the Saluda study, as the TWC has already vetted these curves. Although the Saluda study had employed TWC-approved American shad HSC, these criteria have recently been refined, based on the research of Joe Hightower in North Carolina (Hightower, *et. al*, 2012) and provided to us by NOAA Fisheries. We propose that the TWC consider using these updated criteria.

The remaining species do not have well developed, individual HSC. However, the Pee Dee IFIM study addressed habitat suitability for these species by classifying each of them into applicable guilds. This information was provided to the Saluda IFIM TWC during study scoping (Gerrit Jobsis, October 16, 2006). Based this information (Table 2), we classified the remaining Parr-Fairfield evaluation species and lifestages into proposed guild categories (Table 3)

Attachment A displays the coordinates for the resulting HSC proposed for use, based on the source material identified in Table 3.

Table 2. Guild classification for individual species and lifestages, from Pee Dee River IFIM study (2004)

Species and Habitat Guild Assignment Table for the Pee Dee River Instream Flow Study. Revision 2 - July 9, 2004.

Scientific Name	Common Name	Habitat Types and Guilds[1, 2, 3]			
		Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Petromyzontidae	**Lampreys**				
Petromyzon marinus	sea lamprey		A		
Acipenseridae	**Sturgeons**				
Acipenser oxyrinchus	Atlantic sturgeon				S
Acipenser brevirostrum	shortnose sturgeon				S
Lepisostedidae	**Gars**				
Lepisosteus osseus	longnose gar	A, J		A, J, S	
Amidae	**Bowfin**				
Amia calva	bowfin			A, S	
Anguillidae	**Freshwater eels**				
Anguilla rotstrata	American eel	J		A, J	J
Clupeidae	**Herrings**				
Dorosoma cepidanum	gizzard shad	A, J		A, J, S	
Dorosoma petenense	threadfin shad	A, J		A, J, S	
Alosa mediocris	hickory shad			J, S	
Alosa sapidissima	American shad			J	J, S
Alosa aestivalis	blueback herring			J, S	
Cyprinidae	**Carps and Minnows**				
Cyprinus carpio	common carp	J, S		A, J, S	
Notemigonus crysoleucas	golden shiner	A, J, S		A, J, S	
Hybognathus regius	Eastern silvery minnow	J, S		A, J, S	
Nocomis leptocephalus	bluehead chub		A, S		
Cyprinella analostana	satinfin shiner	A, J, S		A, J, S	
Cyprinella nivea	whitefin shiner	A, J	S	A	
Cyprinella pyrrhomelas	fieryblack shiner	A, J	S	A	
Notropis altipinnis	highfin shiner	J, S		A	
Notropis amoenus	comely shiner	A, J	S	A, J	
Notropis hudsonius	spottail shiner	A, J	S	A, J	
Notropis petersoni	coastal shiner	A, J	S	A	
Notropis scepticus	sandbar shiner	A, J	S	A	
Catostomidae	**Suckers**				
Catostomus commersoni	white sucker	J	S	A, J	A
Minytrema melanops	spotted sucker	J	S	A	
Scartomyzon spp.	brassy jumprock	J	S	A	A
Moxostoma macrolepidotum	shorthead redhorse	J	S	A	A[4]
Moxostoma anisurum	silver redhorse	J	S	A, J	
Moxostoma robustum	robust redhorse		S	A, J	
Moxostoma sp.	Carolina redhorse		S	A, J	
Carpiodes cyprinus	quillback		S	A	S
Erimyzon oblongus	creek chubsucker	S?		A, J, S?	
Carpiodes velifer	highfin carpsucker		S	A	S
Ictiobus bubalus	smallmouth buffalo	J	A	A, S	A
Ictiobus cyprinellus	bigmouth buffalo			A	

Table 2.
Continued

Scientific Name	Common Name	Habitat Types and Guilds[1,2,3] Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Ictaluridae	**Bullhead catfishes**				
Ictalurus punctatus	channel catfish			A, J	J
Ictalurus furcatus	blue catfish			A, S	A
Ameiurus catus	white catfish			A	A, J
Ameiurus brunneus	snail bullhead			A	
Ameiurus nebulosus	brown bullhead			A	
Ameiurus platycephalus	flat bullhead			A	
Pylodictus olivaris	flathead catfish	J		A, J, S	
Esocidae	**Pikes**				
Esox americanus americanus	redfin pickerel			A, J, S	
Esox niger	chain pickerel			A, J, S	
Umbridae	**Mudminnows**				
Umbra pygmaea	Eastern mudminnow			A, J, S	
Poeciliidae	**Livebearers**				
Gambusia holbrooki	Eastern mosquitofish			A, J, S	
Aphredoderidae	**Pirate perches**				
Aphredoderus saynus	pirate perch			A	
Atherinidae	**Silversides**				
Labidesthes sicculus	brook silverside			A	
Percichthyidae	**Temperate basses**				
Morone americana	white perch	J	S	A, J	S
Morone chrysops	white bass	J	S	A, J	S
Morone saxatilis	striped bass				A, S
Centrarchidae	**Sunfishes**				
Lepomis auritus	redbreast sunfish	J, S		A, J, S	
Lepomis cyanellus	green sunfish			A, J, S	
Lepomis gibbosus	pumpkinseed	J, S		A, J, S	
Lepomis macrochirus	bluegill	J, S		A, J, S	
Lepomis microlophus	redear sunfish			A, J, S	
Lepomis punctatus	spotted sunfish			A, J, S	
Micropterus salmoides	largemouth bass	J, S		A, J, S	
Pomoxis nigromaculatus	black crappie			A, J, S	
Percidae	**Perches**				
Etheostoma olmstedi	tessellated darter	A, J	S	A	
Percina crassus	Piedmont darter		A, S		
Perca flavescens	yellow perch			A, J, S	

[1]Habitat types based on predominant habitat types present in the Pee Dee River derived from the aerial videography study.

[2]Life stages: A = adult, J = juvenile, including young-of-year, and S = spawning.

[3]Classification of species and life stages into habitat types based on Becker (1983), Hamilton and Nelson (1984), Aadland et al. (1991), Jenkins and Burkhead (1994), Rhode et al. (1994), Leonard and Dilts (2003), and Progress Energy (2003).

[4]Foraging adults based on Jenkins and Berkhead (1994).

Table 3. Proposed HSC source data for Parr-Fairfield IFIM study

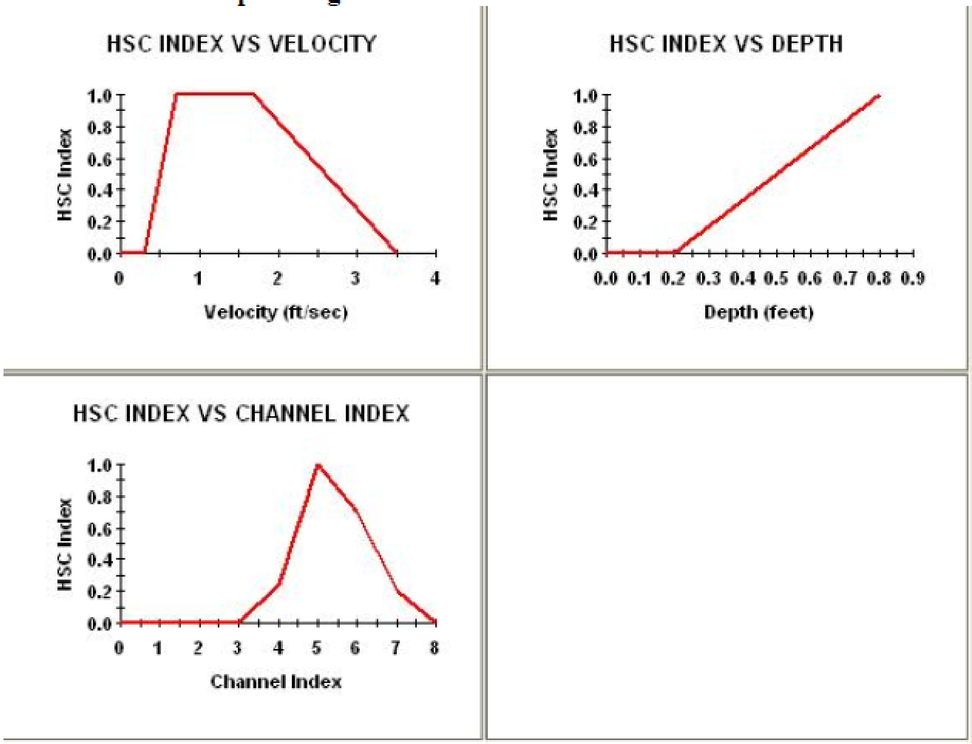
species criteria	lifestage	source	guild
Smallmouth Bass	All (spawning, fry, juvenile &adult)	Saluda	N/A
American Shad	spawning	Hightower, *et al.*, 2012	N/A
Brassy Jumprock	adult	Pee Dee River IFIM	deep ~~slow~~fast
Brassy Jumprock	juvenile	Pee Dee River IFIM	shallow ~~slow~~fast
Brassy Jumprock	spawning	Pee Dee River IFIM	shallow fast
Whitefin Shiner	adult	Pee Dee River IFIM	shallow slow; deep slow
Whitefin Shiner	juvenile	Pee Dee River IFIM	shallow slow
Whitefin Shiner	spawning	Pee Dee River IFIM	shallow fast
Robust Redhorse	adult	Pee Dee River IFIM	~~deep slow~~Stand alone species (Bud Freeman HSI)
Robust Redhorse	juvenile	Pee Dee River IFIM	Stand alone species ~~deep slow~~
Robust Redhorse	spawning	Pee Dee River IFIM	Stand alone species ~~shallow fast~~
Santee Chub	adult	Pee Dee River IFIM	shallow fast
Striped Bass	Adult	Pee Dee River IFIM	Deep slow, deep fast
Striped Bass	Spawning		N/A (Crance, Bulak)
Piedmont Darter	adult	Pee Dee River IFIM	shallow fast
Piedmont Darter	spawning	Pee Dee River IFIM	shallow fast
Snail Bullhead	Adult	Pee Dee River IFIM	deep slow
Snail Bullhead	Juvenile		shallow fast
Redbreast Sunfish	Adult	Saluda	N/A or deep slow?
Redbreast Sunfish	Spawning		Shallow slow?
Channel Catfish	adult	Pee Dee River IFIM	deep slow
Channel Catfish	juvenile	Pee Dee River IFIM	deep slow; deep fast

LITERATURE CITED

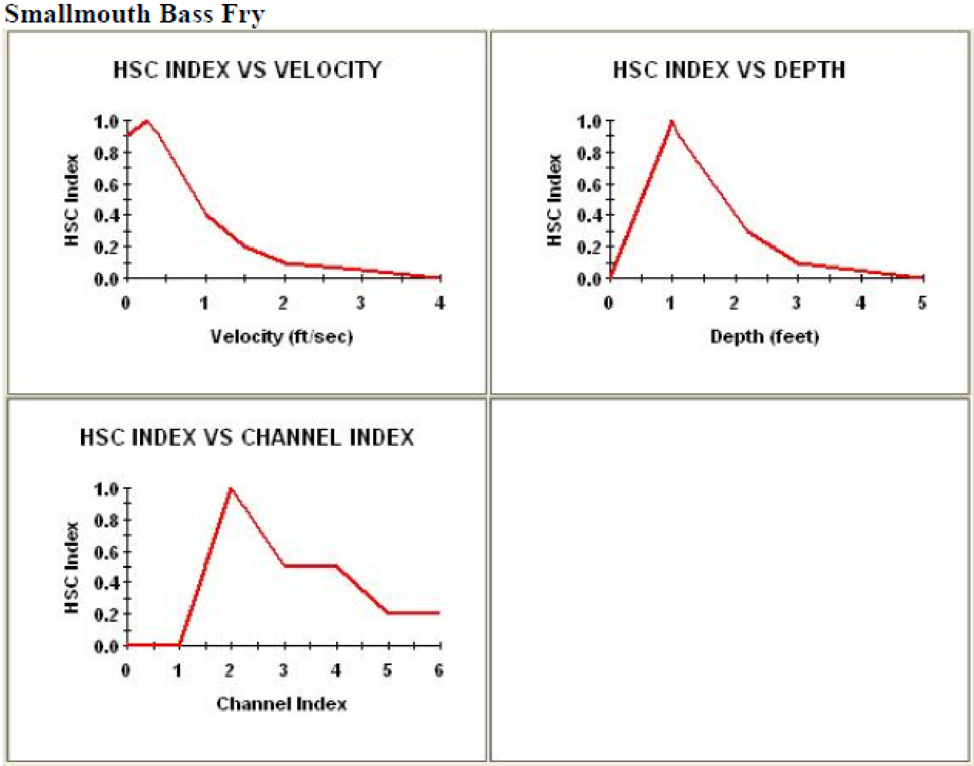
Hightower JE, Harris JE, Raabe JK, Brownell P, Drew CA. 2012. A Bayesian spawning habitat suitability model for American shad in southeastern United States rivers. Journal of Fish and Wildlife Management 3(2):184–198; e1944-687X. doi: 10.3996/082011-JFWM-047

Attachment A
Habitat Suitability Criteria

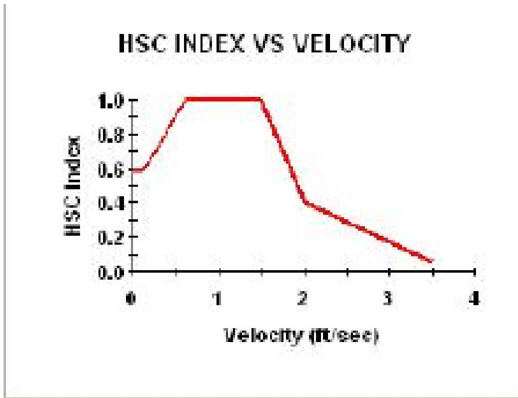
Smallmouth Bass Spawning

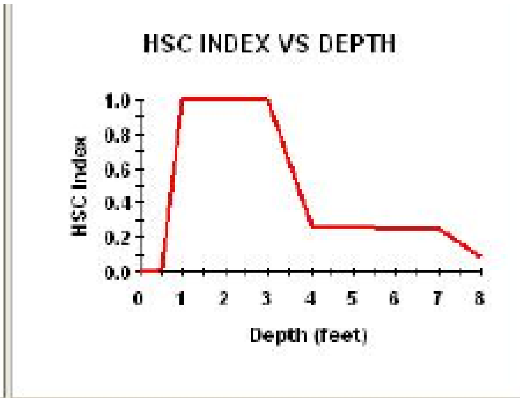


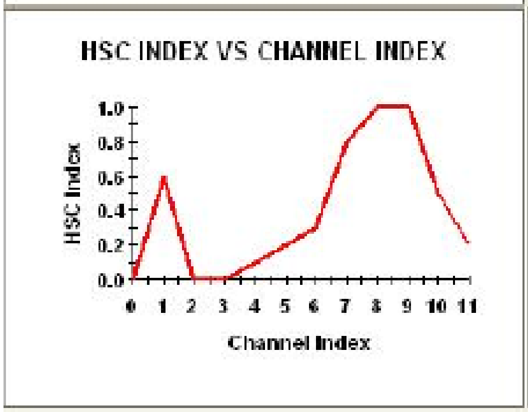
Smallmouth Bass Fry



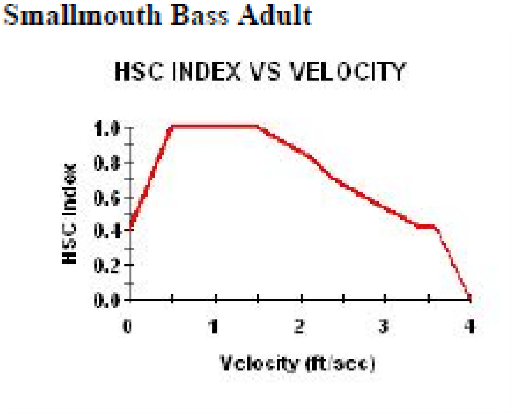
Smallmouth Bass Juvenile

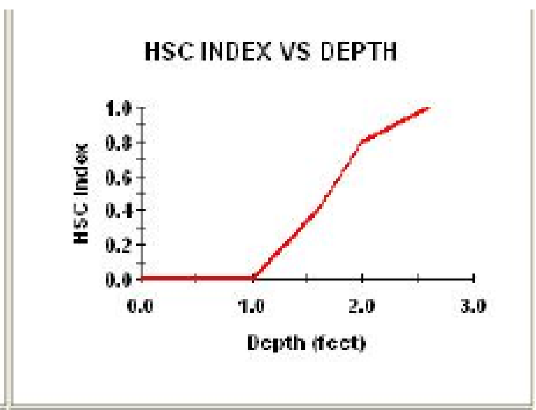


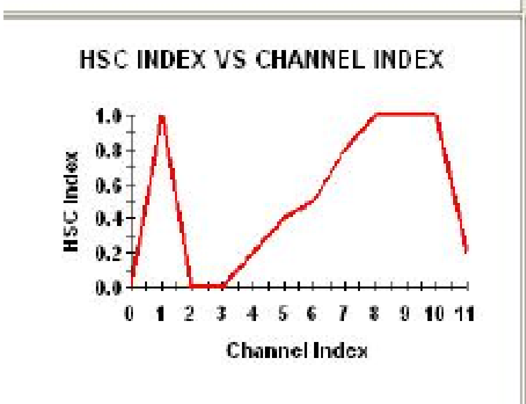




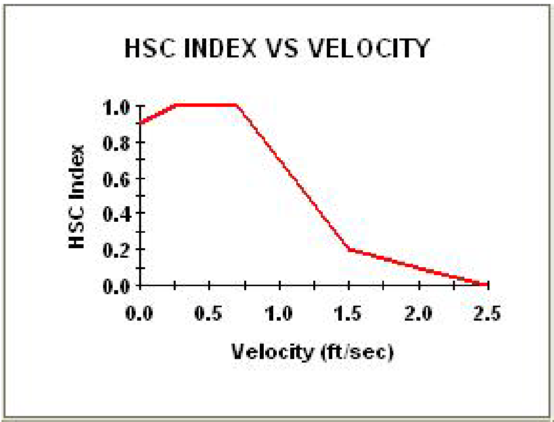
Smallmouth Bass Adult

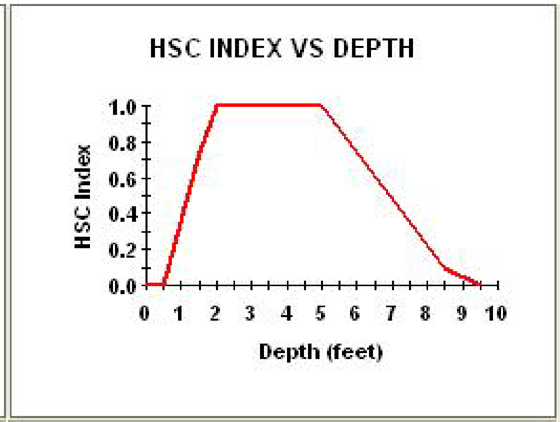


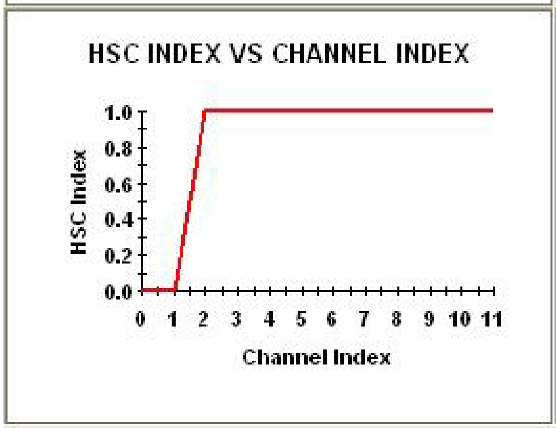




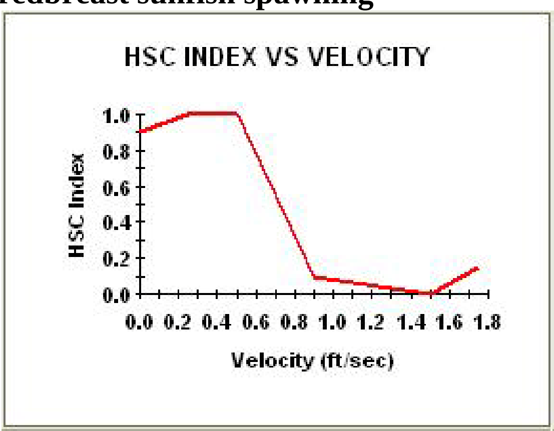
redbreast sunfish adult

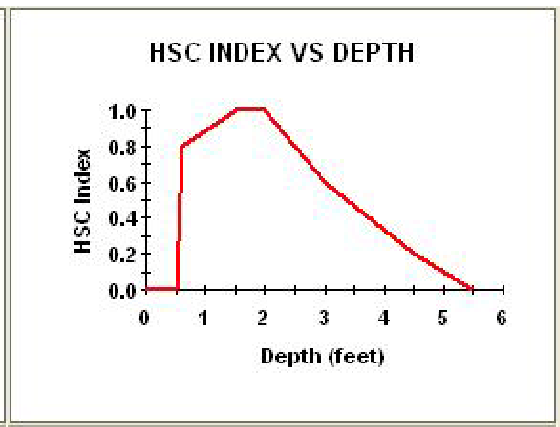


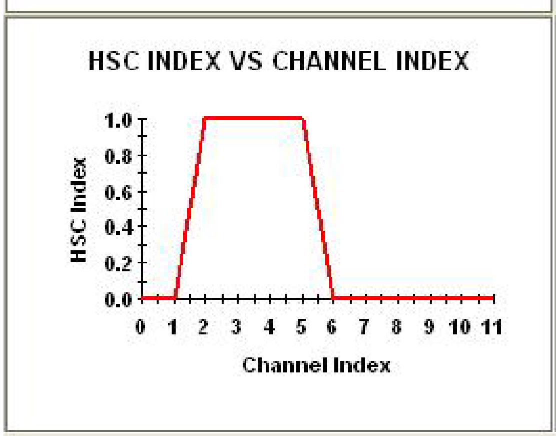




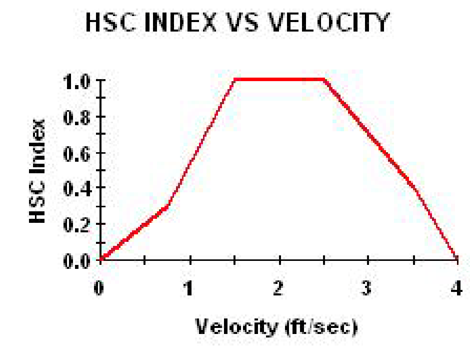
redbreast sunfish spawning

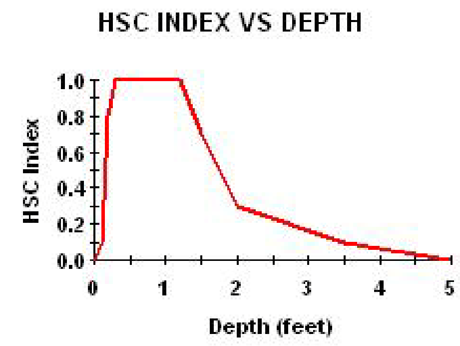


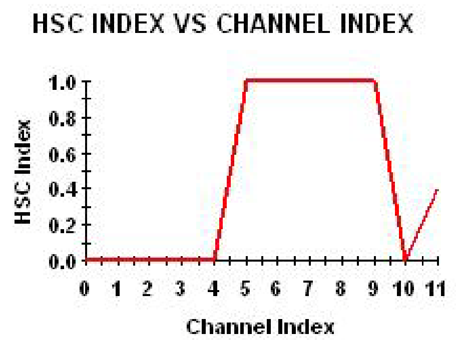




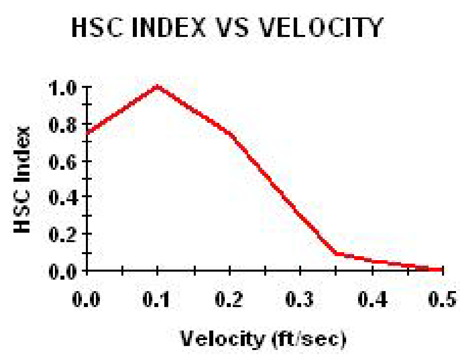
shallow-fast guild

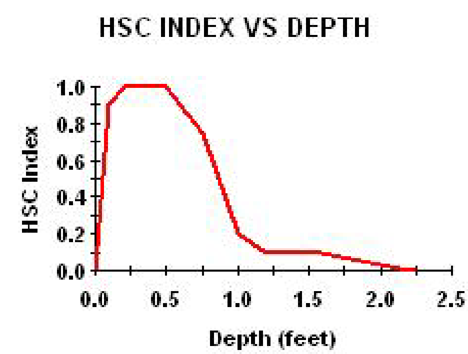


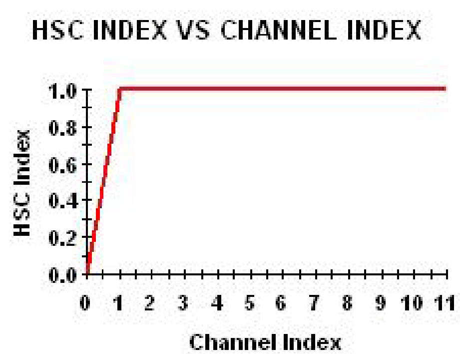




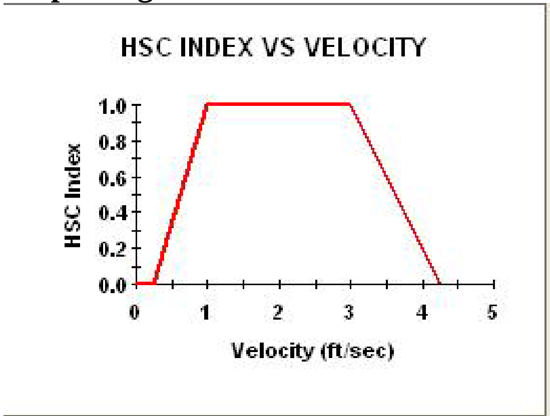
shallow-slow guild

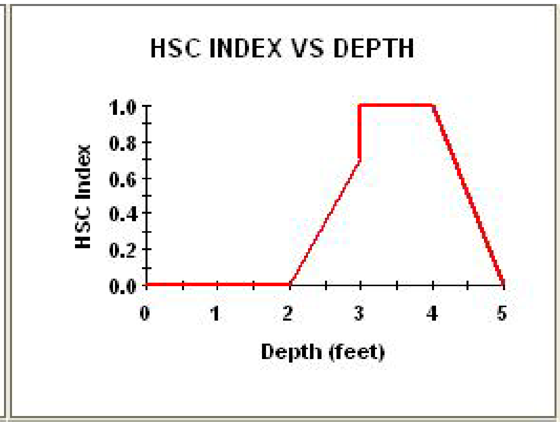


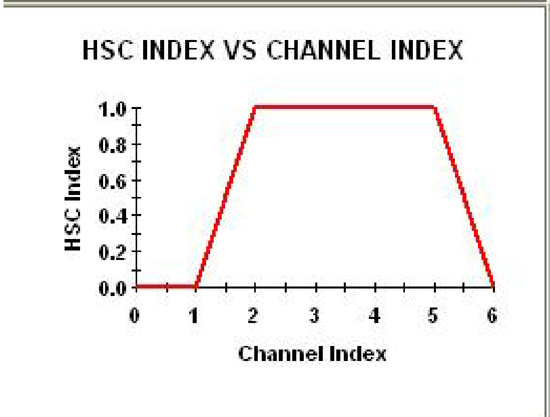




Deep-fast guild



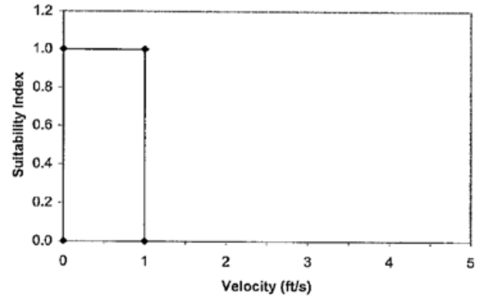




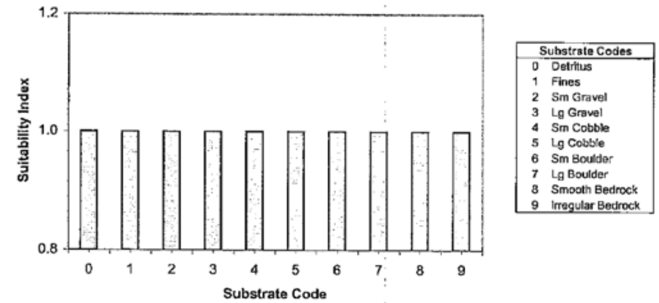
Kleinschmidt

Deep Slow Guild, No Cover

Generic guild habitat suitability



(Provided by P. Leonard in 10/11/03 memo)



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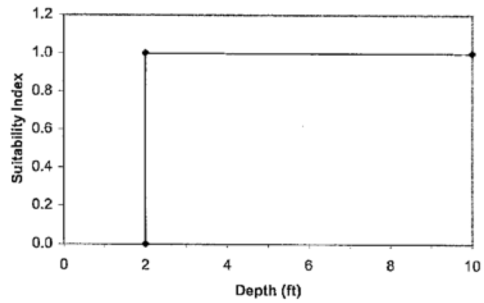

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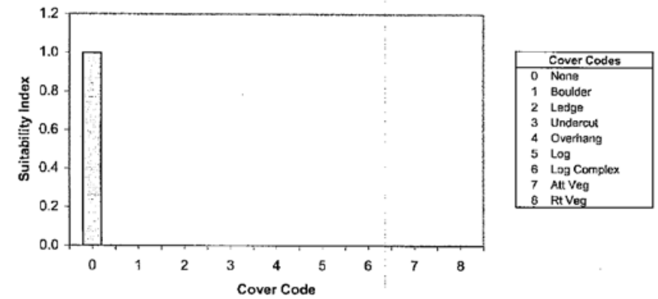
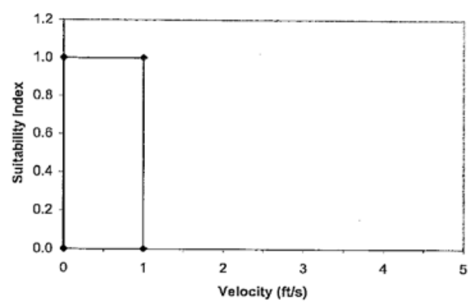


(Developed by Pee Dee Instream Flow Subgroup, June 2004)

Deep Slow Guild, Cover

Generic guild habitat suitability



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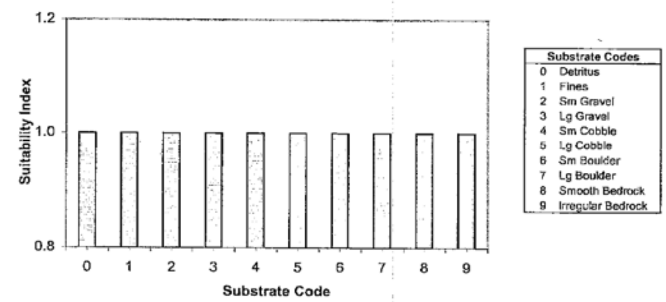

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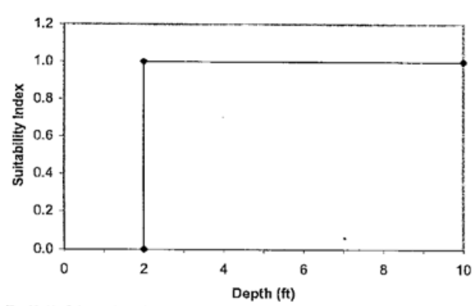
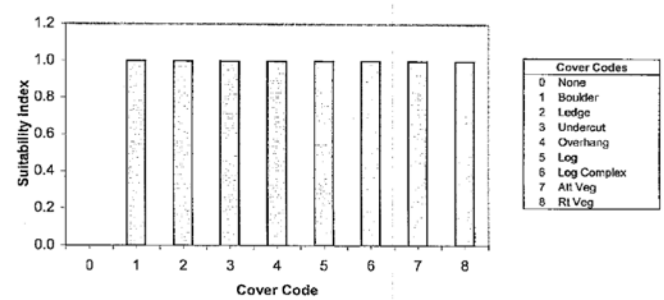


(Provided by P. Leonard in 10/11/03 memo)



(Developed by Pee Dee Instream Flow Subgroup, June 2004)

AMERICAN SHAD spawning (*Hightower, et al., 2012*).

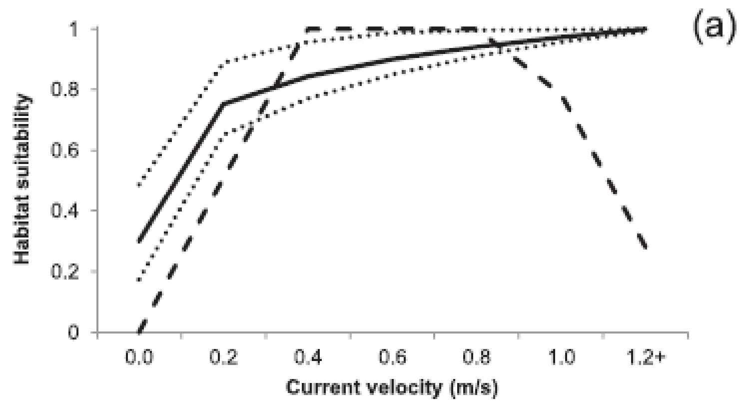


Figure 5. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for current velocity (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.2-m/s velocity bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

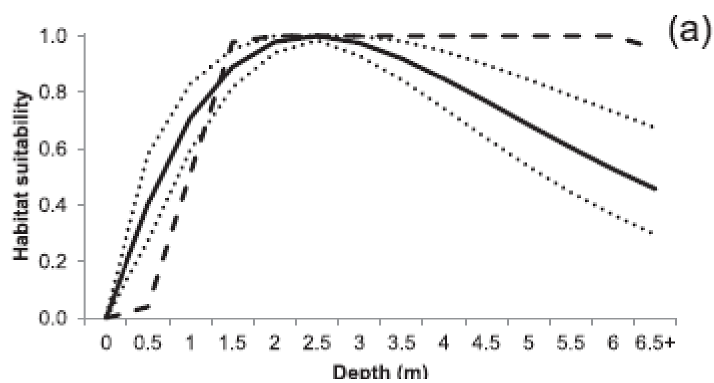


Figure 6. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for water depth in m (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.5-m depth bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

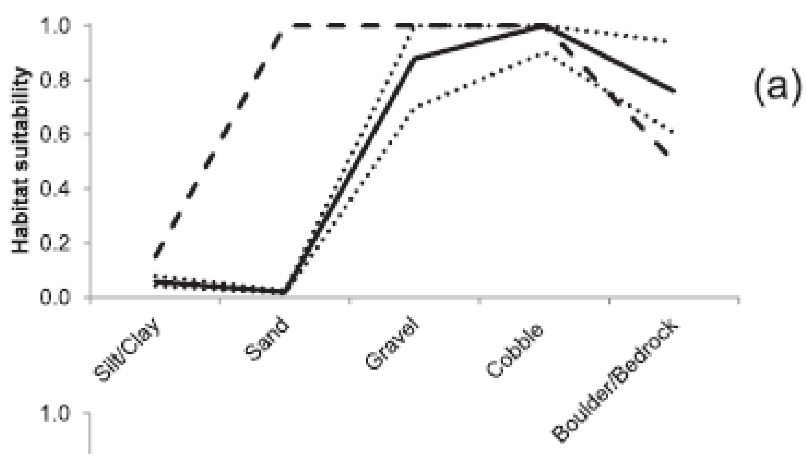


Figure 7. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for substrate (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b** and **c**) data on habitat use vs. availability, by substrate category. The dashed line shows the suitability curve developed by Stier and Crance (1985), using averages for combined categories (silt/clay, boulder/bedrock).

Mesohabitiat Classifications

Bettinger et al 2003

Habitat Type	Description
Riffle	Riffle Relatively shallow (<0.5m), swift flowing section of river where water surface is broken.
Glide	Relatively shallow (<1m); with visible flow but mostly laminar in nature; minimal observable turbulence; relatively featureless bottom
Run	Deep (>1m), swift flowing sections with turbulent flow; surface generally not broken
Pool	Deep (>1m) slow moving sections.
Shoals	Shoal area; which may contain a variety of habitat complexes.

Saluda Hydro IFIM Study

Habitat Type	Description
Riffle	Shallow, with moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel). Typically > 1% gradient.
Glide	Moderately shallow, well-defined non-turbulent laminar flow, transition from low to moderate velocity, lacking a definite ~~well-defined~~ thalweg, typically flat stream geometry, typically finer substrates, transitional from pool.
Run	Moderately deep ~~to deep~~, well-defined non-turbulent laminar flow, range from low to moderate velocity, well-defined thalweg, typically concave stream geometry, varying substrates, gently downstream slope (<1%).
Pool	Deep, low to no velocity, well-defined hydraulic control at outlet.
Rapid/Shoal	Shallow, with moderate to high velocity, turbulent, with chutes and eddies, high gradient, large substrates or bedrock. Typically >2% gradient.
Backwater	Varying depth, no or minimal velocity, off the primary channel flow ~~long backwatered reaches.~~

Catawba Wateree

Habitat Type	Description
Glide	Depending on the strength of the shoal and the bed profile directly upstream of the control, a glide or a pool will be created. A glide is generally defined by slower velocities and a relatively uniform bed profile, but a rough bed profile is not uncommon. Glides will either progress into a more concave bed profile just upstream of the shoal (creating a pool), or maintain their uniform hydraulic and bed features until direct contact with the shoal. Substrates can be large or small but, except at very high flows, do not create turbulence. Due to the slower velocities and increased depths, finer substrates will typically begin to settle in glides.
Run	Immediately downstream of the shoal, there is typically a transition area prior to the water entering the next pool or glide. This unit consists of relatively fast moving, turbulent water and a gradually descending bed profile. When mapping habitat in higher discharges (deeper flow), these areas can be visually identified by an upwelling of water just on the downstream edge of the shoal. This “roiling” effect is created by the sudden drop in water off of the shoal due to the lack of any backwater effect. Substrate composition varies from fine sediments to cobble and boulders. As the water begins to collect and back up further downstream, velocities slow, depths increase, and the transition into a glide or pool occurs.
Pool	If the bed profile upstream of the shoal is more concave or possesses significant undulations, a pool will be formed. Pools are visually represented by the slowest velocities of the four main habitat types and the most extreme depths. Steep banks and narrow channels relative to the rest of the reach can often be associated with pools. The stronger or more defined the downstream control (shoal), the more defined the pool. Substrate composition in pools generally consists of a layer (thick or thin) of finer substrates over boulder or bedrock.
Shoal	Shoals are relatively shallow, submerged ridges that occur with a consistent frequency down the longitudinal profile of the river. Shoals act as downstream controls to pools and glides and create the hydraulic conditions necessary to form runs immediately downstream. Substrate composition in shoals is typically bedrock, boulders, and coarse substrates. The “strength” of each hydraulic control dictates the magnitude to which it influences the upstream habitat types. Each shoal will create a unique situation upstream in which pools, glides or both may be identified.

AFS Aquatic Habitat Assessment Methods (Bain and Stevenson, 1999)

Habitat Type (macrohabitats)	**Description**
Glide	Nonturbulent, low-moderate velocity; gravel, cobble, sand substrate; slop 0-1%. Wide channel lacking a definite thalweg; usually at the transition between a pool and riffle; no major flow obstructions; lacks features associated with pools; moderately shallow (10-30 cm)
Run	Nonturbulent, swift velocities; gravel, cobble, boulder substrate; low slope. Occurs over a defined thalweg flat plane with a uniform channel form; no major flow obstructions; moderately shallow; deeper than riffles.
Pool	Formed from lateral construction of channel or sharp drop in water surface profile. Features: bend in channel, large-scale obstructions (e.g. boulder, log). Concave in shape; direction of flow varies widely; depth greater than riffle or runs.
Riffle	Moderate turbulence; little to no whitewater; high turbulence at points of channel construction. Moderate velocity (20-50 cm/s). Gravel, pebble, cobble substrates (totally or partially submerged). Slope <4%. Channel profile usually straight to convex.
Rapid	Considerable turbulence and whitewater. High velocity (>50 cm/s). Course, exposed, cobble, gravel substrate. Slope of 4-7%. Steps and pocket pools common; planar longitudinal profile.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Fisheries TWC Meeting

August 22, 2013

Final KDM 09-18-13

ATTENDEES:

Bill Marshall (SCDNR)
Milton Quattlebaum (SCANA)
Gerrit Jobsis (American Rivers)
Shane Boring (Kleinschmidt)
Dick Christie (SCDNR)
Kelly Miller (Kleinschmidt)
Byron Hamstead (USFWS)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Hal Beard (SCDNR)
Steve Summer (SCANA)
Alan Stuart (Kleinschmidt)
Pace Wilber (NOAA)
Tom McCoy (USFWS)
Chad Altman (SCDHEC)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting by reviewing the agenda and asking if everyone had a chance to review the Fisheries Report that was distributed prior to the meeting. Everyone had reviewed the report, so Alan opens the floor for comments. Ron Ahle with SCDNR was not able to attend the meeting, but sent in his edits and comments via email. Kelly will distribute these comments to the entire Fisheries TWC.

Dick reiterates Ron's point that information on the fish passage at Columbia Dam, including species composition, should be added to the report. He asks if Jason Bettinger has studied the downstream area also, and if so, says this information should be added to the report as well. Tom and Byron ask if the tributaries were studied, because they believe some fish species that should have been identified in the report were missing, such as the Carolina Darter. Shane says he will check on this and add information to the report as needed. Tom also mentions that the pie charts in the report are a bit confusing and the map on Page 2 is difficult to read. Shane says that he will try to rework this if possible. Shane tells the group that a paragraph will be added to the report that mentions target species and restoration efforts for these species.

The group discusses Ron's comment on white perch and how it relates to the report. Hal says the report states that a change of fish population in the lake was due to the presence of white perch, which Ron and Hal believe is unsubstantiated. Alan says this sentence can be removed from the report, since it was not the intent of the statement to claim that white perch have replaced other species.

Alan asks about the validity of Ron's statement that the smallmouth bass population in the river was supported by the hatchery. Hal says this statement is partially true, as the smallmouth bass population was supported by the hatchery, but that this was discontinued about two years ago. Hal says the fish have done well throughout the Broad River and are surviving on their own now.

Shane will also include a sentence in the report describing how the abundant fish community provides host fish for mussels.

Alan asks the group if, after the discussed edits have been made, this report adequately describes the fish community for the project. Everyone says yes. Alan says we will make the edits, give the group until September 6th to make any further comments, and then finalize the report.

The group then begins discussion on the proposed study plans. Alan asks the group if they see a need in a separate Robust Redhorse study, since the species will also be included in the IFIM study. Gerrit says he would like to see a separate study, to determine if and where spawning is occurring. Hal mentions that a lot of effort has been put into restoring the Robust Redhorse and that a study would be helpful to determine the results of this effort. Dick says they don’t have much information on the species yet and Milton says he will find out what information has been collected so far. He also says he will talk with the Robust Redhorse committee to find out what has been studied and what still needs to be studied. Alan asks if the group wants to just collect eggs by doing drift net sampling, or collect and document spawning females. Dick and Tom suggest the group talk with the Robust Redhorse committee and Ron Ahle to help determine the details of the study. Dick says he will call Scott Lamprecht and put him in touch with Shane to discuss the study. It is also mentioned that the mesohabitat study that will be conducted this fall will yield some information that might help in developing the Robust Redhorse study.

The group then focuses on the study plan for the American Shad. Alan asks if SCDNR is collecting juveniles to see if they are natural or from stocking efforts. Dick says we need to talk to Ron about this study, since a lot of the interest is coming from him. Shane will talk with Ron to develop a study plan for discussion at the next Fisheries TWC meeting. Dick says that if this study moves forward, funding might be made available through the Accord.

Alan moves the group toward discussing the eel abundance study. He asks the group what they would like to see in the study. Dick says he would like to see a study similar to the one conducted at Saluda. The group agrees to tweak the plan from Saluda for this study. Gerrit asks if this study needs to be coupled with a study on fish passage. Dick says there is definitely going to be some interest in eel passage at Parr. Dick asks if there is a location at the project where traps can be placed that operators will have easy access. Milton says he would have access to the traps. Dick says if a long term eel study were put into place, it would be ideal if operators could check the traps. Alan asks what the timing of the study should be. Tom says he will look it up and get back with everyone. Pace mentions that at Roanoke Rapids the eels peak during the spring and fall, with the spring peak being much larger than the fall peak. The group looks at Jason Bettinger’s presentation of his eel study from 2012. Based on his results, the groups notices that electrofishing should be included in the study, along with the eel ramps. Dick mentions that there isn’t much passage and that there had been discussion on stopping eel studies until the passage issue had been addressed. He says the studies associated with the Accord have been pushed out further until there is better passage for the eels. (Note: According to Al Crosby and Bill Post with SCDNR, 7,094 American eels have passed at St. Stephens as of August 21, 2013.)

The group then begins to discuss the Zone of Influence study, which Gerrit suggests be called the Reservoir Fluctuation Study. This study will just include Parr Reservoir, upstream of the dam. Alan says he thought that existing LIDAR data could be used to map out the acreages of affected areas. Gerrit says we need to have a bathymetry component to the study. Currently the group does not know of any bathymetry data on Parr Reservoir. Dick asks if we used LIDAR to do the study on Lake Murray and Alan answers yes. Dick then asks why the study doesn't include Lake Monticello also. He believes it needs to be included but that the sub-impoundment doesn't, since it doesn't fluctuate very much. Alan asks if there is any bathymetry data on Lake Monticello and Steve answers no. The group looks at a contour map of Lake Monticello and determines it has 10 foot contours, which may not be enough. Gerrit asks how fine the fluctuations should be measured. He believes the maximum increment should be one foot, but it could be finer. Bill M says if the purpose of the study is just to inventory the zone, one foot should be plenty. But if the purpose of the study is to determine the fluctuations affect on spawning, a finer increment may be needed. Alan says that from an operations standpoint, sometimes keeping the water level within a 6 inch band is not possible. Alan speaks with Jennifer Austin and determines that LIDAR data from Newberry and Fairfield counties does exist from 2008. Bill A says he would like to use this existing data to do this study. Gerrit mentions that this information can also be included with the recreation study, since one aspect of the recreation study was to examine the fluctuations and determine how they affected recreation.

Alan then turns the discussion to the entrainment and mortality study. Alan says that SCE&G plans to perform a desktop entrainment study at Parr. Pace asks what a desktop entrainment study is. Alan explains that Kleinschmidt has compiled a database of entrainment studies at FERC projects throughout the country. Projects that are similar to Parr are chosen to use as a basis for the desktop study. An entrainment rate is developed, broken up by seasonal components and sometimes species or families. An entrainment estimate is determined. Then turbine types are matched with projects where mortality studies have been completed. Mortality estimates are developed based on fish shape or family. Gerrit mentions that since this project has a pumpback component, this needs to be considered in the study. He says we need to discuss how to estimate American shad passage for the future, which may be something to examine post-license. Alan mentions that desktop entrainment and mortality studies have been done at Columbia and Lockhart, so the database for comparison to Parr is well developed. Alan asks if everyone agrees to a conventional desktop entrainment/mortality study for Parr Development. Everyone says yes.

For the study conducted at Fairfield, Alan says that mortality studies are examined, then adjusted for the lower efficiency of the pumpback. Alan explains that when the system is pumping, the mortality rates are higher, due to the lower efficiency of the units. A study plan for the Fairfield entrainment/mortality study will be created to include in the PAD, which will contain two phases. The first phase will be a white paper and the second phase will describe the actual development of the entrainment rates and mortality study. Pace asks if phase one and two can both be completed soon. Alan explains that there is information still being gathered that might be crucial to phase two that won't be available until later.

Gerrit expresses concern over the likelihood of fish being pumped into Lake Monticello versus travelling upriver. He says that a large effort has been made to create passage for fish and he doesn't want to see that effort go to waste. Fish may be likely to pass downstream only to be entrained at Fairfield. Alan says that after the entrainment/mortality study, the group will determine what can be done to mitigate any project effects. The group discusses whether Section 18 applies to

Fairfield. Alan says a section may be added to the study plan that discusses a mitigation or effectiveness evaluation to reduce entrainment of diadromous fish. Pace says that a mitigation alternatives study for resident and diadromous fish can be developed together and just tweaked for the different types of fish. It can be implemented if need be, or shelved for use in the future. Mitigation alternatives will be determined by the TWC and a statement about this will be added to the study plan.

At the end of the meeting, Tom shared information he received from Mark Cantrell regarding American eels. The optimum temperature for sampling eels is 15-18^{o}C, during the months of March and April.

Kleinschmidt and SCE&G will begin to develop the study plans discussed at the meeting and will distribute to the group for comments. The TWC will then meet again to discuss the study plans. Action items stemming from this meeting are included below.

ACTION ITEMS:

- Shane will incorporate edits to the Fisheries Report and send out for further comments and finalization. Kelly will distribute the final Fisheries report to the entire TWC.

- Kelly will distribute Ron's comments on the Fisheries Report to the entire Fisheries TWC.

- Shane will talk with Scott Lamprecht and Ron Ahle to discuss Robust Redhorse and American Shad and develop study plans.

- Tom will talk with Mark Cantrell and find out when the peak season for sampling American eels is and report back to the group. – Completed by end of meeting

- Milton will talk with the Robust Redhorse committee to find out what has been studied, the data collected and what still needs to be studied.

August 22, 2013

Fisheries Report:
Add section on species composition from Columbia Fish Passage.
Add Broad River Survey by Jason Bettinger – funded by Broad River Mitigation Program
Confusing the way pie charts were laid out
Page 2 map could not be viewed very clearly
Page 19 statement on documentation of some species – State vs federal listed
All comments should be received by September 6.

Robust Redhorse Spawning Study:
Draft after Robust Redhorse Committee Meeting on October 1 – 3, 2013 and possible mesohabitat survey the fall of 2013
Shane to talk with Scott Lamprecht regarding this issue

American shad Spawning Study:
Need more information
Shane to discuss with Ron regarding his interest

American Eel Abundance Study:
Look for elvers at dam
Look for areas of potential eel passage
Include Electrofishing in vicinity of dam as part of sampling methods
When is best time to sample for eels? Tom M
15 – 18 degree C – optimal temperature
March through April optimal time

Zone of Influence (Reservoir Fluctuation) Study:
Littoral habitat of Parr Reservoir and Monticello Reservoir
Existing LIDAR data – acreages of effected area
Bathymetry of reservoir down to elevation 256/257'
Look at Old USGS quad maps showing contour lines for Monticello Reservoir
Study not needed for sub-impoundment
Potential spawning habitat analysis – 1 foot increments tentatively for now
Potential tie with affects of fluctuation on recreation – study requested in recreation TWC
Quantify impact of fluctuation

Entrainment Mortality Study:
Parr Hydro Development
Conventional Desktop entrainment study – compiled various data from around the country and though literature search
Order of magnitude result
Resident species are evaluated

Fairfield Pumped Storage Development
Desktop numbers and mortality results
Threadfin shad & BBH

Turbine strikes
Maybe include a correction factor for less efficiency operation of pumpback vs conventional turbines
Two phase process:
First step – compile available data to determine next step – white paper
Second step – development entrainment rates and mortality study results
Develop mitigation alternatives for residence species
Include future options for diadromous species or cover this under Section 18

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Water Quality TWC Meeting

September 10, 2013

Final KDM 10-09-13

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Rusty Wenerick (SCDHEC)
Alison Jakupca (Kleinschmidt)
Henry Mealing (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Dan Dieter (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Ray Ammarell (SCE&G)
Fritz Rohde (NOAA) via conference call
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
John Knight (SCE&G)
Byron Hamstead (USFWS)
Tom McCoy (USFWS)
David Eargle (SCDHEC)
Kerry Castle (SCDNR)
Dick Christie (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alison opens the meeting with introductions and then leads the group in a discussion on the Baseline Water Quality Report. Byron asks if there are any monitoring sites further upstream than the SCDHEC B-047 monitoring site, which was included in the report. He explains he would like data from that area to compare against downstream data. Byron believes that current baseline data from this area is needed to use as a control. The next monitoring station is the USGS gage at Carlisle. Henry mentions that we can add more data into the report however we will not be able to find a monitoring site that is not impacted, since Neal Shoals is located above the Parr Fairfield Project. However, a site above the Project would represent conditions in the free-flowing part of the river before it becomes impounded. The group agrees that data from the Carlisle gage will be added to the report.

Byron also asks for more analysis to be completed on the existing data that is exhibited in the baseline report. He agrees to write a list of what he would like to see and submit that to Kelly to include in the report. Kelly will also work with Steve to determine if any more data has been collected by SCE&G. Kerry offers to send turbidity data collected by SCDNR to add in the report. Rusty adds that he would like to see any additional data collected above, within and below the Project regarding metals, since there is a historical Copper reading at a discontinued SCDHEC monitoring site located downstream of the Project. Steve says he will check to see what SCE&G metals data is available and will pass that along to Kelly. Rusty adds that there are also issues with phosphorus and pH at some of the SCDHEC stations at the Project. Rusty refers to the map he shared at the February 28th meeting, which was included as an appendix to the meeting notes. He says that the phosphorus is most likely coming from the watershed however he would like to see the phosphorus levels documented. Rusty added that SCDHEC is responsible for developing a TMDL to address nutrients in the watershed; however, in so far as the project may be able to adjust operations to mitigate the problem while still achieving the project purpose, SCDHEC would ask SCE&G to consider that. Steve says he will also search for phosphorus data collected at the Project by SCE&G. Rusty and Steve both agree to search for additional information on copper, phosphorus and pH in the upper portion of Lake Monticello and elsewhere. Rusty said that SCDHEC would submit written comments and would help with downloading any additional SCDHEC data. Dick mentions that SCE&G can address nonpoint source concerns in the future through shoreline management, even though this isn't included as part of the 401 water quality certification.

Ron says that the pH and temperature at Lake Monticello raised some red flags. He would like to see more information on the mixing zone permit from SCDHEC to be included in the report. The thermal study that was performed at Lake Monticello will be added as an addendum. Ron says it is important to see what is permitted at the V.C. Summer Nuclear Station to understand what isn't going to change regarding water quality at Lake Monticello.

The group then begins discussion of the Baseline Macro/Mussel Report. David mentions that he would like to see another upstream site, on the flowing part of the river, included in the report. Milton says he will talk with Dan Carnagey to see what other data is available. Byron asks if five samples are enough to be representative of an area. Milton explains that the transects are representative and that they are compared over time, not to each other.

David requested that a separate mussel study be performed in Lake Monticello. He said the specifics of the study can be determined by John Alderman. Shane and Milton are currently talking with Alderman to develop a study plan. David said that the study should examine a few important spots over a day or so to characterize the reservoir.

Milton then gives a presentation on his findings from a study of the substrate in the Fairfield tailrace. He found sand, rock and *Corbicula spp.* at the three spots he examined along three transects. Overall, he found a hard, scoured bottom. Ray shows the group pictures of the tailrace as the plant was being built. The information collected by Milton will be consolidated and included in the Baseline Macro/Mussel Report as an addendum.

The group then discusses the Water Quality in the West Area Study Plan. Ron says he would like to see one more monitoring station added on the tailrace side of dam to use as a control. Henry mentions that there is a USGS gage on that side of the dam that can be used for this purpose. Byron says he would also like to see a control monitoring station located further down Henderson Island on the east bank of the river. The group agrees that a fourth monitor will be located in the east channel near the bridge that crosses the mid-point of the island. Milton says that access should be fairly easy by boat or walking for all four proposed monitoring sites. Rusty mentions that this could be an opportunity to collect more data (such as water quality grab samples for nutrients or metals) and Byron agrees. Ron points out that eight months of monitoring may not be enough to accurately portray the water quality of that area. Henry says that we can monitor for one 8-month season, then evaluate whether further study is needed. Ron agrees and would like for a caveat to be added to the study plan explaining this. The group defines this statement, which is included below.

> "This study may be extended based on a review of the results from the initial eight month period as determined by the Water Quality TWC."

Ron also adds that the proposed data collection interval of 15 minutes can be scaled back to hourly collection intervals. The group also decides to shift the study season one month to extend from April to November.

The group discusses the comments submitted via email by Vivianne Vejdani regarding the need to collect turbidity and conductivity within this study, in addition to dissolved oxygen (DO) and temperature. The group agrees that a YSI meter will be used each month to collect DO, water temperature, and conductivity when data is downloaded from the HOBO meters In addition, pH will also be collected at that time, but with a separate meter. These discussed changes will be incorporated into the study plan and the final will be sent out to the TWC.

After lunch Bill A. gives a presentation on the sediment situation in Parr Reservoir, which indicated that the reservoir sediment levels are in "equilibrium". The presentation can be viewed at the Project website at www.parrfairfieldrelicense.com. Ron says that sediment seems to be passing through Parr Hydro. The reservoir does not appear to be "filling in," as it did at Neal Shoals. The topography maps show remnants of existing islands that have been in the reservoir prior to the original dam being built. Ron mentions that the area at the mouth of Cannon's Creek is very shallow and can be difficult to navigate. He says that this might be something that should be examined further in the process, through the Recreation TWC. Bill A. shows the group a presentation on the trash rake that is located immediately upstream of Parr Hydro. This depicts how the area immediately in front of the powerhouse is kept clear of debris and sediment. Bill M. says that the upper end of Parr Reservoir might still have sedimentation issues. Bill A. says that there is a sand mining operation located at the upper end of the reservoir, and also points out that Fairfield operations help to keep sediment stirred up and moving through the reservoir.

The group then discusses future meeting dates and agrees to hold the next Water Quality TWC meeting in January 2014 to discuss the updated and finalized Baseline Water Quality Report and Water Quality in the West Area Study Plan. Rusty reminds the group that it was agreed at the first meeting, held in February, that requests for additional water quality data would be deferred until after the final Baseline Water Quality Report was reviewed and discussed. Kelly will send out a Doodle Poll for this and other upcoming meeting dates. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Steve will find out what other SCE&G water quality data is available and will send this data to Kelly to add in the Water Quality Report.
- Rusty will search for additional copper, phosphorous and pH data for the upper portion of Monticello Reservoir
- Kerry will send the SCDNR turbidity data to Kelly to add in the Water Quality Report.
- Byron will submit a list of the edits and additions he wants for the Water Quality Report.

- Kelly will make additions and edits to the Water Quality Report and resubmit to the TWC for review. These changes will include at least the following: metals downstream (including copper), USGS gauge at Carlisle data, phosphorous, pH, new nuclear SCDHEC mixing zone permit parameters.

- Shane Boring will begin developing a Mussel Study Plan for Monticello Reservoir.

- Kelly will make edits to the Water Quality in West Area Study Plan and resubmit to the TWC for review.

- Milton will talk with Dan Carnagey regarding other available macro data on Broad River upstream of the Parr Project to be included in the macro report.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Lake and Land Management and Recreation RCG Meeting

October 16, 2013

Final KDM 11-13-13

ATTENDEES:

Tommy Boozer (SCE&G)
Dick Christie (SCDNR)
Bill Stangler (Congaree Riverkeeper)
Randy Mahan (SCE&G)
Alison Jakupca (Kleinschmidt)
Kelly Miller (Kleinschmidt)
E. J. Jones (SCPRT)
Joseph Wojcicki (By-PAS)
Bill Marshall (SCDNR)
Beth Trump (SCE&G)
Bill Argentieri (SCE&G)
Scott Collins (SCE&G)
Steve Summer (SCANA)
Vivianne Vejdani (SCDNR)
Henry Mealing (Kleinschmidt)
David Haddon (SCE&G)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alison opened the meeting by reviewing the agenda and the mission statement of the Lake and Land Management and Recreation RCG. She then directed the group in a discussion on the Recreation Use and Needs Study (RUNS) plan. David mentioned that the surveys included in the study plan seem to be extensive. He doesn't believe that many people will be willing to spend that much time answering questions. Alison said that we can go through the interview questions and remove any questions that the group decides are extraneous. Alison also mentioned that an incentive will be used to keep people interested, such as a floating key chain.

As the group reviewed the study plan, Tommy mentioned that the Scenic Overlook is only partially owned by SCE&G. He said he will call the county to see if they have any information on their portion of the overlook that can be included in the final recreation report. Dick also mentioned SCDNR will contribute data on the waterfowl areas that are located within the Project Boundary. Sam Stokes (Broad River waterfowl area) and Brett Moule (Enoree River waterfowl area) are the contacts for this information.

Alison discussed the study season for the RUNS. The study is scheduled so that it will cover the early crappie season, the Canada goose season, and the turkey season at Lake Monticello and the migratory waterfowl seasons at Parr Reservoir. However the exact study dates will not be set until 2015, since hunting and fishing season dates can change slightly each year. Henry asked if we want to study the Canada goose season on Parr Reservoir as well. Dick said he will investigate and let the group know what he finds out. After lunch Dick confirmed that the Canada geese season should also be studied on Parr Reservoir so that both the Parr and Monticello studies are consistent.

Henry mentioned that the data Tommy will collect for the Form 80 Reports will also be included in the recreation report. The recreation site inventory for the report will be completed in 2015. The group agreed to the list of sites that were designated for on-site interviews and traffic counters as a means of data collection.

Bill M. asked if we want to quantify the number of users on the Broad River below the Parr Shoals Dam. If so, he mentioned that the Palmetto Trail would be a good place to do this. The option of using a traffic counter was suggested however the counters may collect false numbers because of residences in the area. Bill M. said he will find out if there are any use estimates available for the Palmetto Trail. Bill S. suggested using a traffic counter at the site on the west side of the river instead.

The group discussed the sample days that are included in the study. Alison will develop a draft schedule that will list the sample days and will send this out to the RCG for approval. Special event days, such as fishing tournaments, will not be determined until 2015, so the table will remain a draft until exact dates for the special events are set.

The group then agreed to adjust the waterfowl focus groups to only include 10-12 representatives. The smaller groups will allow for greater productivity at the meetings.

The group then moved on to discuss the Recreational Flows Study Plan. Bill S. asked how far down the study area reaches. This will be specified more clearly in the plan. Henry mentioned that a map will be developed for this plan, and also for the RUNS plan. Bill S. asked that the public access areas be shown on these maps. Maps will be developed, sent to the RCG for approval, and included in the final study plans.

Henry asked the group if there is a list of people that need to be included in the focus group for this study. Alison asked Bill S. if he and others could help develop that list. Bill S. said that the Chestnut Hill Plantation HOA and Stuart Greeter, a former Congaree Riverkeeper, could offer some information regarding this. He also suggested asking local outfitters, the Palmetto Paddlers, and Charlene Coleman for a list of names and organizations. Dick also mentioned that there may be some local river guides that would be good to include in the focus group, and that Hal Beard and Ron Ahle may be able to help identify these people.

Bill M. asked about the timeframe for when we want these flows, and mentioned that this is not included in the study plan. Henry said that we need to have the IFIM study completed before we complete the Recreational Flows Study. Dick mentioned that we also need to complete the Navigational Flows Study first, to develop a baseline for the Recreational Flows Study. The group decided that phase one, which includes the focus group meeting, should occur in late 2014. After the IFIM study, phase two and a second meeting of the focus group will occur in the fall of 2015 or spring of 2016. A final report will be issued by June 2016.

The group then discussed the Navigational Flows Study Plan. Bill S. said that the study area described in the plan does not include additional areas that were discussed at previous meetings. The group will look at the IFIM study transects to determine what additional study sites need to be examined. The areas of the river that are known to be the most difficult to navigate downstream of Parr Shoals Dam need to be studied, to ensure that navigation is possible in these areas.

After lunch, the group discussed the Shoreline Management Plan (SMP) for Lake Monticello. Alison reviewed the comment submitted by Bill M. regarding residential land use. Tommy said that there is no land to sell at Lake Monticello and there is no intention of selling any land. The majority of the land around the lake is classified as recreation. Section 3.2 of the Monticello SMP will discuss why there are no residential classifications at Lake Monticello.

Alison then began to review the Monticello and Parr SMPs from the beginning. She mentioned that any extraneous information will be removed from the SMPs for inclusion in the PAD. Specifics can be added back in later. The group removed and edited the land classifications included in the SMPs. The group also noted that examples of acceptable shoreline stabilization and rip-rap will be included in the permitting handbook, which is separate from the SMPs and does not require FERC approval. Also examples of private and common dock layouts and information on clearances in coves will be included in the permitting handbook.

The five documents discussed during this meeting are included at the end of these notes, with all edits shown in track changes. Revised and finalized copies of the documents will be emailed to the RCG. Bill A. told the group that he would like to begin developing text for the SMPs in 2014. A straw man will be sent out for RCG review no later than 2015, along with a straw man of the permitting handbook. The group agreed to this timeline.

Action items stemming from this meeting are detailed below.

ACTION ITEMS:

- Bill M. will find out if the Palmetto Trail collects use estimates for inclusion in the RUNS.

- Alison will develop a schedule that details the sample days for the RUNS and distribute to the RCG for review.

- Kleinschmidt will develop a map for inclusion in the RUNS Plan and a map for inclusion in the Recreational Flows Study Plan. These will be distributed to the RCG for review and included in the final study plans.

- SCE&G and Kleinschmidt will use the information provided by the RCG to begin reaching out to various people and organizations to help develop a list of participants for the RUNS and Recreational Flows Study focus groups.

DRAFT
RECREATION USE AND NEEDS STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2013

DRAFT
RECREATION USE AND NEEDS
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

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September 2013

RECREATION USE AND NEEDS STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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RECREATION USE AND NEEDS STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates to continuously pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations.

The Fairfield Pumped Storage Development is located directly off of the Broad River and forms the 6,800-acre upper reservoir, Monticello Reservoir, with four earthen dams. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

2.0 PURPOSE OF THE STUDY

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new

Comment [b1]: Include map of Project area and study plan location.

operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

As a part of this process, SCE&G is proposing to perform an assessment of existing and future recreational use, opportunities, and needs for the Project. The assessment is designed to provide information pertinent to the current and future availability and adequacy of SCE&G owned and managed recreation sites and specific informal recreation areas at Monticello Reservoir and the Parr Reservoir. The overall study plan objective is to identify current and potential recreational use, opportunities, and needs at the Project by addressing the following goals and objectives:

Goal 1: *Characterize the existing recreational use of SCE&G's recreation sites on Monticello Reservoir and Parr Reservoir. This will be accomplished by meeting the following objectives:*

i. Identify recreation points, inventory the services and facilities offered at each, and assess the general condition of each site (including American with Disabilities Act [ADA] compliance).
ii. Identify the patterns of use at each site (type, volume, and daily patterns of use).

Goal 2: *Characterize existing use of waterfowl areas (Broad River Waterfowl Area, Enoree River Waterfowl area) and SCE&G recreation lands by hunters during designated hunting seasons. This will be accomplished by meeting the following objectives:*

i. Identify the patterns of use within the Project boundary (type, volume, and daily/seasonal patterns of use).

Goal 3: *Identify future recreational needs relating to public recreation sites on Monticello Reservoir and Parr Reservoir. This will be accomplished by meeting the following objectives:*

i. Identify existing user needs and preferences, including perceptions of crowding at recreation sites.
ii. Estimate future recreational use of existing recreation sites.
iii. Identify future needs for new recreation sites and facilities.

3.0 STUDY AREA

SCE&G designated recreation sites and informal recreation areas on Monticello Reservoir and Parr Reservoir that will be included in this assessment include the following:

TABLE 1 RECREATION SITES TO BE ASSESSED

MONTICELLO RESERVOIR RECREATION SITES & INFORMAL AREAS	PARR RESERVOIR RECREATION SITES & INFORMAL AREAS
1. Scenic Overlook (SCE&G-maintained portion)	1. Cannon's Creek Boat Ramp
2. Hwy 215 Boat Ramp	2. Heller's Creek Boat Ramp
3. Hwy 99 Boat Ramp	3. Broad River ~~Creek~~ Waterfowl Area (vehicle counter only)
4. Recreation Lake Access Area	4. Hwy 34 Boat Ramp
5. Informal fishing area, east side of Hwy 99	5. Enoree River Waterfowl Area (vehicle counter only)
	6. Enoree River Bridge Informal Access Area (vehicle counter only)

4.0 STUDY SEASON

Study seasons will vary by study area based upon current knowledge of use patterns. Study seasons should capture specific seasonal activities, including hunting during legal seasons and on-water recreational use during the peak season (typically defined as Memorial Day to Labor Day). As hunting season dates vary annually based upon SCDNR board decisions, only approximate date ranges for specific targeted mail-in survey activities are provided within this study plan. Exact dates for waterfowl survey activities will be determined ~~in~~ when study season dates are published, anticipated being mid-summer 2014. Study season specifics are further described below.

4.1 MONTICELLO RESERVOIR

Primary interview activities will occur from April 1 through Labor Day, 2015. Additional interviews will be conducted from February 1 through March 31, 2016 in order to capture recreational activity on the Reservoir during early crappie season. Specific targeted survey activities with mail-in surveys, as described in Section 5.5, will occur during the Canada Geese hunting season (approximately September 1 through September 30, depending on yearly SCDNR approved seasons).

4.2 Parr Reservoir

Primary interview activities, as described in Section 5.0, will occur from April 1 through Labor Day, 2015, to encompass turkey hunting season, as well as the peak recreation season. Specific targeted survey activities with mail-in surveys, as described in Section 5.5, will occur during Migratory Waterfowl Seasons (approximately ~~mid~~ September 2015 through January 2016, depending on yearly SCDNR approved seasons).

Comment [b2]: Add Canada Geese wording to Parr Reservoir also.

5.0 DATA COLLECTION METHODS

A variety of data collection techniques will be used to obtain the information necessary to meet the study objectives. Table 2 identifies the information needed to address each objective and the data collection methods to be used. Both primary and secondary data will be utilized. Primary data will entail site inventories, user counts, and use surveys (exit interviews). Secondary data will include U.S. Bureau of Census data, the South Carolina Statewide Comprehensive Outdoor Recreation Plan (SCORP), SC Recreation Participation & Preference Study, and other relevant, readily available literature. Additional input will be solicited from the Lake & Land Management and Recreation Resource Conservation Group (RCG), Recreation TWC, and target "focus groups" of especially knowledgeable individuals, offering knowledge of the recreation resources and needs of the lake and river.

TABLE 2 RECREATION USE AND NEEDS STUDY PLAN OBJECTIVES AND EFFORTS

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 1: Characterize existing recreational use of recreation sites on Monticello Reservoir and the Parr Reservoir		
Identify formal recreation sites, inventory the services and facilities offered at each, and assess the general condition and ADA compliance of each site	• Physical inventory of all boat ramps, grills, shelters, restrooms, parking capacity, etc., at each site • General assessment of site condition to include maintenance, basic rehabilitation needs, etc. • Visitors' assessment of site conditions • Identification of activities that occur at each site • ADA compliance assessment	• Recreation Site Inventory • Survey of Recreation Site Users
Identify the patterns of use at each site (type, volume, and daily patterns of use)	• Utilize vehicle counts as an estimation of people • Estimate of # people/vehicle • Estimate of # vehicles/site • Parking capacity	• Traffic Counter Data • Surveyor Counts of Vehicles at Recreation Sites • Survey of Recreation Site Users - # of people per vehicle and length of visit • Recreation Site Inventory - # of parking spaces • County data from Scenic Overlook

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 2: Characterize existing use of waterfowl areas (Broad River Waterfowl Area, Enoree River Waterfowl area) and SCE&G recreation lands by hunters during designated hunting seasons.		
Identify the patterns of use within the Project boundary (type, volume, and daily/seasonal patterns of use).	• Estimation of # hunters/site or waterfowl area	• Counts of Vehicles at Recreation Sites/waterfowl areas • Mail-in questionnaire specific to hunting use at the Project • SCDNR waterfowl use data • SCDNR hunting permit data

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 3: Identify future recreational needs relating to public recreation sites on Monticello Reservoir and Parr Reservoir		
Identify existing user needs and preferences, including perceptions of crowding at recreation sites	• User preferences and opinions of needs and crowding at sites • Condition assessment	• Survey of Recreation Site Users • Recreation Site Inventory
Estimate future recreational use of existing recreation sites	• Current inventory and use data from Goals 1 and 2 • Population projections for the project area • Recreational use trends	• Results of Goals 1 and 2 • U.S. Bureau of Census Data • SC Division of Research & Statistics (Budget and Control Board) • SCORP, SC Recreation Participation & Preference Study, or other readily available literature
Identify future needs for new recreation sites and facilities	• Population projections • Recreation use trends • "focus group" (stakeholders) knowledge of recreation resources and needs	• SC Div. of Research & Statistics • SCORP, SC Recreation Participation & Preference Study, or other literature • Recreation TWC and Lake and Land Management & Recreation RCG

The capacity, availability, and overall condition of existing recreation sites will be assessed through review of existing information and an on-site inventory (Section 5.1). Recreational use of SCE&G's public recreation sites (Table 2) during the appropriate recreation season (as described in 4.0) will be estimated using a combination of data including traffic count, survey data, spot counts, and additional collection methods as described in Section 5.2, 5.3, 5.4, and 5.5. Methods for estimating recreational use are described in Section 6.0.

5.1 RECREATION SITE INVENTORY

Data on the types of amenities, activities supported, and the parking capacity of recreation sites at the Project, and the land area each site encompasses will be obtained from two sources. First, existing information regarding recreation sites such as FERC Form 80's and existing GIS data layers will be referenced. Second, a site visit will be made to collect data on the type, number, and size of facilities (restrooms, parking areas, boat ramps, picnic shelters and tables, etc.) located at each site. The general condition of recreation facilities and a qualitative assessment of each site's compliance with the ADA will also be recorded. A copy of the inventory form is provided in Appendix A.

Comment [b3]: Change all references of ADA to "Barrier Free"

Upon completion of the inventory, all data will be uploaded into a database; anticipated to be a GIS database. The database will be structured so that it can be used in a variety of formats (brochure, maps, web pages, etc.) and can be updated as recreation sites are modified, added, or changed in any way.

5.2 TRAFFIC COUNTS

Traffic counters will be installed to record the number of vehicles that enter and exit the public recreation areas. Traffic count data will be collected for an entire year in order to capture the various hunting seasons. On Monticello Reservoir, traffic counters will be installed at the lake access point of the Scenic Overlook, the Hwy 215 Boat Ramp, the Hwy 99 Boat Ramp, Recreation Lake Access Area, and the Hwy 99 informal fishing area. At Parr Reservoir, traffic counters will be installed at Cannon's Creek Boat Ramp, Heller's Creek Boat Ramp, Broad River Waterfowl Area, Hwy 34 Boat Ramp, Enoree River Waterfowl Area, and the Enoree River Bridge informal area.

5.3 PUBLIC RECREATION AREA VISITOR EXIT INTERVIEWS

The preferences and perceptions of people using SCE&G's recreation sites and informal areas are important inputs in management decisions regarding the adequacy and availability of existing recreation sites. Information from recreation site users will be obtained via an onsite survey from April 1 through Labor Day, 2015, and from February 1 through March 31, 2016, on Monticello Reservoir and from April 1 through Labor Day, 2015, for Parr Reservoir.

Exit surveys will be administered to collect user characteristics (origin, gender, age, group size, etc.), the type of land-based and water-based recreation activities individuals are participating in, length of stay, perceptions of crowdedness, and conditions of recreation sites at the Project. Visitor demographic information will also be collected. Surveys will be conducted at the following locations:

Monticello Reservoir

- Scenic Overlook
- Hwy 215 Boat Ramp
- Hwy 99 Boat Ramp
- Recreation Lake Access Area
- Hwy 99 informal Fishing Area

Parr Reservoir

- Cannon's Creek Boat Ramp
- Heller's Creek Boat Ramp
- Hwy 34 Bridge

The data collected will be used to provide a general pattern of recreation use and assist in the development of recreation use estimates at access sites. The data will also provide recreation user inputs on "crowdedness" and potential facility needs. The survey will be pre-tested in the field prior to implementation and revisions will be incorporated, as necessary. If any significant revisions to the survey or study protocol are deemed necessary subsequent to field pre-testing, the TWC will be notified.

Two survey versions will be implemented – one for Monticello Reservoir and one for Parr Reservoir. The two survey versions will be very similar to each other and will contain similar questions. Draft questionnaires are provided in Appendix B.

Stratified random sampling will be used to develop a sampling plan in order to complete at least 30 days of interviewing at each recreation site. Sampling days will be made up of weekends, weekdays and holidays; however, weekends and holidays will be sampled at a greater rate than weekdays, to account for the heavier use that typically occurs during those periods. In preparing the sampling plan, the TWC will be consulted on the potential for including special event days with the holidays.

Comment [b4]: Clarify better which days are being surveyed. Identify all holidays will be surveyed.

Comment [b5]: Add to this study plan a list of the proposed days that will be surveyed.

All survey clerks will be trained thoroughly as a means of quality control. Survey clerks will be provided with detailed information on the study schedule, appropriate materials to aid in data collection, and direction on appropriate interviewing techniques and attire. Interviewers will also be provided with an incentive for survey respondents to complete the survey.

5.4 SPOT COUNTS

Spot counts will be conducted at the public recreation sites identified in Section 5.3 once per interview period, concurrent with exit interviews. Specifically, spot counts will document the number of visitors and/or vehicles present at that visit and help to characterize site use. Information recorded during spot counts will include: date, time, and weather; amount of vehicle and vehicle/trailer parking capacity in use; number and type of activities observed at the site; and state license plate data. Spot count data will be used in parallel with traffic counter data.

5.5 ADDITIONAL USER DATA COLLECTION EFFORTS

Waterfowl hunting typically occurs during the fall and winter months. Waterfowl hunters represent a unique group of users whose preferences and perceptions may differ from those using recreation sites during the summer months. The preferences and perceptions of waterfowl hunters will be identified through use of a panel of waterfowl hunters.

Kleinschmidt will work with the Recreation TWC to identify waterfowl organizations whose hunters use the Project. A panel will be assembled from willing participants of the respective organizations. Should not enough participants be available from the organizations, additional individual hunters may be sought out to serve on the panel. ~~Up to 20~~A small group of hunters will be invited to participate in a group meeting, similar to a focus group, to identify the opportunities and needs of waterfowl hunters using Project access areas. The information collected will be similar to that of the access site survey. Kleinschmidt will recruit the hunters, develop a meeting format and materials, and will conduct the meeting. It is anticipated that the meeting will occur during the waterfowl hunting season.

Additionally, mail-in surveys similar to the access site survey will be distributed at the Broad River and Enoree River Waterfowl Areas during waterfowl hunting season. The study seasons for Monticello Reservoir and Parr Reservoir, as discussed in Section 4.0, will capture the turkey hunting season through exit interview activities.

Representation of those utilizing the Project during local fishing tournaments are anticipated to be represented during access site exit interviews, as registration, check-in and weigh-in typically occurs at access areas.

6.0 ANALYSIS

The following sections provide a description of the approach for estimating existing and future recreational use, recreation site capacity and use density percentages, and recreation needs.

6.1 CURRENT RECREATION USE ESTIMATES

The reported estimates of recreation will be presented in "recreation days". The FERC defines a recreation day as one visit by a person to a development for purposes of recreation during any 24-hour period. The weekday, weekend, and holiday average recreation days will be calculated for each Monticello Reservoir and Parr Reservoir recreation site utilizing the traffic counters and recreation site survey data. The average number of people at each site within the morning and afternoon periods will be estimated within each day type and converted to a daily estimate. Daily estimates for each day type will be expanded to represent the study period and summed for a total estimate for each recreation site.

6.2 FUTURE RECREATION USE ESTIMATES

Estimated projections of future recreation use at Monticello Reservoir and Parr Reservoir will be developed using the average annual increase in population growth over the past 10 years, as reported by the Census Bureau or the State Division of Research and Statistics, for Newberry, Fairfield and Richland counties[1]. The estimates will be augmented with discussion of trends reported in the SCORP (2014) and the SC Recreation Participation & Preference Study (2005). Estimated projections will be provided in 5 year intervals for the anticipated term of the license up to 50 years into the future (through year 2070).

While it is acknowledged that future changes in the supply of recreation resources, either in their quantity, accessibility, and/or quality may influence future demand and use, the demand analysis undertaken for this study does not attempt to predict what these future changes might consist of or how they might specifically affect levels of use at Project facilities. Therefore, the demand analysis results should be viewed as a general guide of potential future recreation pressure developed for planning purposes only.

[1] Although Richland County is not within the FERC Project boundary, it is believed that a significant number of those who recreate at the Project reside within Richland County.

6.3 RECREATION SITE CAPACITY

For purposes of this study, the carrying capacity for a recreation site is defined as the number of vehicles and boat trailers that can be parked at a recreation site at one time, based on the number of available parking spaces associated with each site. For paved parking areas, this will be achieved by counting the number of designated parking spaces available at the recreation site. For gravel parking areas, the number of available parking spaces for each recreation site will be estimated by measuring the area (sq ft) available for parking and estimating the number of vehicles that could be parked at the location, if optimal space were utilized. These estimates will be based on parking capacity standards for vehicle length, width, and available turn around space.

6.4 RECREATION SITE USE DENSITY

The use density of recreation sites will be estimated by comparing the average observed number of vehicles at the sites on sampled weekday, weekend, and holiday days with the available parking capacity for each recreation site. The average observed number of vehicles divided by the parking capacity will provide an estimated use density for each site.

6.5 RECREATION NEEDS ASSESSMENT

The need for recreation and site development or modification of existing recreation resources will be assessed based on the inventory, condition, capacity, and exit interview survey results. The needs assessment will focus on the existing condition and user opinions of recreation sites, ADA compliance, and the ability of sites to meet current and anticipated future recreation demand pressures. Consideration will also be given to site opportunities and constraints, as well as support facilities such as signage and maintenance. The need for new recreational sites, facilities, and shoreline will be determined through assessment of the information collected and the input of stakeholders on the Recreation TWC and Lake & Land Management RCG.

7.0 SCHEDULE

The proposed schedule for completion of the Recreation Use and Needs Study is as follows:

TASK	DATE
Mobilization for field work (includes field clerk hiring, training, etc.)	March 2015
Survey development and pre-testing	March 2015
Installation of Traffic Counters	March 31, 2015
Interview survey collection (Monticello Reservoir)	April 1-September 7 (Labor Day, 2015); and February 1 - March 31, 2016[2]
Interview survey collection (Parr Reservoir)	April 1 -September 7 (Labor Day, 2015)
Waterfowl survey activities	Throughout 2015 and early 2016 during appropriate seasons.
Early data entry, cleaning, and processing	Early October 2015
Determine if additional data collection is needed	December 2015[3]
Conduct analyses	April - July 2016
Submit draft report	July 2016
Finalize report	July/August 2016

8.0 REFERENCES

South Carolina Department of Parks, Recreation and Tourism, Recreation, Planning and Engineering Office. 2008. South Carolina Statewide Comprehensive Outdoor Recreation Plan.

University of South Carolina. 2005. South Carolina Recreation Participation & Preference Study. Prepared for the South Carolina Department of Parks, Recreation and Tourism. (Online) [URL]: http://www.scprt.com/files/RPE/2005%20Rec%20Study.pdf

[2] The recreation season has been extended into 2016 on Monticello Reservoir in order to capture use data during the early crappie season, from February 1 through March 31, 2016.

[3] If additional data collection is required, data collection methods, results and analyses, developed and assessed in cooperation with the Recreation RCG, will be provided in an addendum to the report.

APPENDIX A

SITE INVENTORY FORM

SOUTH CAROLINA ELECTRIC & GAS COMPANY

RECREATION ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SCE&G Public Site Inventory Form

Inspected by: ________ Date: _______

Site Name: ___________________________

Site Address: ____

City: _____________________ State: _SC_ Zip Code: ___________

Facility Type:

_____ Primitive Camp _____ Picnic Area ____ Day Use

_____ Overlook Site _____ Informal Site ____ Launch Ramp

Road Access:

_____ Paved access.......................................______ # of lanes

_____ Unpaved access..................................______ # of lanes – (Circular entrance/exit)

Operations:

_____ Manned _____ Seasonal (From_____To_____)

_____ Unmanned _____ Year Round

_____ Fee ($) ....(Site_____; Parking;_____)

Site Amenities:

# Type	# Type
_____ Picnic Tables	_____ Potable Water
_____ Grills	_____ Boat Fuel
_____ Firepit/ring	_____ Trash Cans
_____ Boat Pump Out	_____ Docks
_____ Trails (specify use_____________: Miles_____)	_____ Playground
_____ Shelter	_____ Showers
_____ Designated Swim Area	_____ Concession
_____ Store	_____Marina (# of slips_____)
_____ Dumping Station	

Parking Lots:

Type	Estimated # Paved	Estimated # Gravel	
ADA Spaces	_____	_____	_____ Spaces delineated?
Regular Spaces	_____	_____	_____ Curbs?
Vehicle & trailer spaces	_____	_____	

Sanitation Facilities:

	Flush	(ADA?)	Portable	(ADA?)	Showers	(ADA?)
Unisex	_____	(_____)	_____	(_____)	_____	(_____)
Women	_____	(_____)	_____	(_____)	_____	(_____)
Men	_____	(_____)	_____	(_____)	_____	(_____)

Campground/Campsite:

	RV sites	Cabins	Tent sites	Primitive sites
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
ADA compliant	______	______	______	______

Boat Launch Facilities:

_____ Hard surface _____ Unimproved (informal) _____ # of Lanes

_____ Gravel _____ Carry In _____ Boat Prep Area?

Courtesy/Fishing Docks:

Courtesy/Fishing	Dimensions	ADA Compliant
______________	______________________	______________________________
______________	______________________	______________________________
______________	______________________	______________________________
______________	______________________	______________________________
______________	______________________	______________________________

Notes:

____

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Picture Number From _____ To ____

APPENDIX B

RECREATION SITE QUESTIONNAIRES

Monticello Reservoir Public Access Site Questionnaire

Clerk:_______________	**Site:** _______________	**Date:** ______________	**Time:** __________ **am/pm**	
Weather: ☐ **Sunny**	☐ **Partly Cloudy**	☐ **Cloudy**	☐ **Light Rain**	☐ **Heavy Rain**

RESPONDENT GENDER: ☐ **Male** ☐ **Female** **RESPONDENT REFUSED INTERVIEW:** ☐
NUMBER OF PEOPLE IN VEHICLE: **RESPONDENT DOES NOT SPEAK ENGLISH:** ☐
VEHICLE HAS A BOAT TRAILER: ☐ **RESPONDENT IS NOT 18 YEARS OR OLDER:** ☐
RESPONDENT HAS BEEN INTERVIEWED AT THIS SITE PREVIOUSLY: ☐

THE FIRST FEW QUESTIONS ASK ABOUT YOUR EXPERIENCE HERE TODAY

1. Including yourself, how many people are in your party today? *(Fill in blank.)*

   _____ people in party

2. What time did you arrive ***at Monticello Reservoir*** today? *(Fill in blank.)*

   __________ am / pm

3. What is the primary recreation activity that you participated in today ***at Monticello Reservoir***? *(Please read the list to respondents. Check only one main activity in the first column.)*

What other activities did you participate in today ***at Monticello Reservoir***? *(Check all that apply in the second column.)*

Check only one main activity	*Check all other activities*	*Types of Activities*
		FISHING:
☐	☐	***boat fishing***
☐	☐	***pier/dock fishing***
☐	☐	***bank fishing***
		BOATING:
☐	☐	***motor boating***
☐	☐	***pontoon/party boating***
☐	☐	***sailing***
☐	☐	***canoeing/kayaking***
☐	☐	***windsurfing***
☐	☐	***paddleboarding***
		OTHER:
☐	☐	***bicycling***
☐	☐	***tent or vehicle camping***
☐	☐	***horseback riding***
☐	☐	***walking/hiking/backpacking***
☐	☐	***sightseeing***
☐	☐	***hunting***
☐	☐	***nature study/wildlife viewing/photography***
☐	☐	***swimming***
☐	☐	***picnicking***
☐	☐	***sunbathing***
☐	☐	***other:***________________________________

Check only <u>one</u> main activity	*Check all other activities*	*Types of Activities*
	☐	***None***

4. Did you spend any time ***on the water on Monticello Reservoir*** today? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 6.)*

5A. Did you recreate on any of the ***islands on Monticello Reservoir*** today?

☐ YES
☐ NO *(If no, skip to Question 6.)*

5B. ~~Here is a map of the islands on Monticello Reservoir. Can you show me which island(s) that you went to? (*Check all that apply.*)~~

~~☐ Island 1~~ ~~☐ Island 5~~
~~☐ Island 2~~ ~~☐ Island 6~~
~~☐ Island 3~~ ~~☐ Island 7~~
~~☐ Island 4~~

Formatted: Tab stops: Not at 1.5"

5C. What activities did you participate in ***while on the island(s)***? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

~~☐ boat fishing~~	☐ bank fishing	☐ hunting
☐ camping	☐ walking/hiking	☐ sightseeing
☐ nature study/wildlife viewing/photography	☐ swimming	☐ picnicking
☐ sunbathing		
☐ other (please specify: ____)		

6. On a scale from 1 to 5, with 1 being light, 3 being moderate, and 5 being heavy, how would you rate the crowdedness ***at this recreation site*** today? *(Circle one number.)*

Light ***Moderate*** ***Heavy***

1 2 3 4 5

7A. On a scale from 1 to 5, with 1 being poor and 5 being excellent, how would you rate the overall condition ***of this recreation site*** today? *(Circle one number.)*

Poor ***Excellent***

1 2 3 4 5

7B. Why did you choose to come to ***this recreation site*** today? (*Fill in the blank.)*

____

____

____

____

7C. Are there any additional facilities needed ***at this recreation site***? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 8.)*

7D. What do you recommend? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

☐ access road	☐ bank fishing area	☐ boat dock
☐ boat launch	☐ camping area	☐ fish cleaning station
☐ fishing pier/dock	☐ lighting	☐ parking lot
☐ picnic tables/shelter	☐ restrooms	☐ signs & information
☐ swimming area	☐ trails	☐ trash cans
☐ RV camping	☐ tent camping	☐ bilingual signs & information
☐ other (please specify: ____)		

7E. Are there any other improvements that you would recommend for this site?

☐ YES
☐ NO *(If no, skip to Question 8.)*

7F. What improvements do you recommend? *(Fill in the blank.)*

____
____
____
____

8. What was your primary reason for choosing to recreate ***at Monticello Reservoir*** today verses another lake or area? *(Fill in blank.)*

____
____
____

9. What ***other lakes*** do you recreate at? *(Fill in blank.)*

____
____
____
____

I HAVE JUST A FEW MORE QUESTIONS

10. Do you own a permanent or seasonal lakefront residence ***on Monticello Reservoir***? What is your zip code? *(Check one box and fill in the blank for zip code.)*

- ☐ YES – Permanent Home→ ZIP CODE: ____________
- ☐ YES – Seasonal Home → ZIP CODE: ____________
- ☐ NO - Non-lakefront resident → ZIP CODE: ____________

11. In what year were you born? *(Fill in blank.)*

___________ YEAR

12. Do you have any additional comments about the recreation facilities at ***Monticello Reservoir***? (*Please fill in blank and be as specific as possible.*)

____
____
____
____
____
____

THANK YOU FOR YOUR HELP! WE APPRECIATE YOUR TIME TODAY!

Parr Reservoir/Broad River Public Access Site Questionnaire

Clerk:_______________ **Site:** _______________ **Date:** ______________ **Time:** __________ **am/pm**

Weather: **☐ Sunny** **☐ Partly Cloudy** **☐ Cloudy** **☐ Light Rain** **☐ Heavy Rain**

RESPONDENT GENDER: ☐ Male ☐ Female **RESPONDENT REFUSED INTERVIEW: ☐**
NUMBER OF PEOPLE IN VEHICLE: **RESPONDENT DOES NOT SPEAK ENGLISH: ☐**
VEHICLE HAS A BOAT TRAILER: ☐ **RESPONDENT IS NOT 18 YEARS OR OLDER: ☐**
RESPONDENT HAS BEEN INTERVIEWED AT THIS SITE PREVIOUSLY: ☐

THE FIRST FEW QUESTIONS ASK ABOUT YOUR EXPERIENCE HERE TODAY

1. Including yourself, how many people are in your party today? *(Fill in blank.)*

   _____ people in party

2. What time did you arrive ***at Parr Reservoir*** today? *(Fill in blank.)*

   __________ am / pm

3. What is the primary recreation activity that you participated in today ***at Parr Reservoir***? *(Please read the list to respondents. Check only one main activity in the first column.)*

   What other activities did you participate in today ***at Parr Reservoir***? *(Check all that apply in the second column.)*

Check only one main activity	*Check all other activities*	*Types of Activities*
		FISHING:
☐	☐	***boat fishing***
☐	☐	***pier/dock fishing***
☐	☐	***bank fishing***
		BOATING:
☐	☐	***motor boating***
☐	☐	***canoeing/kayaking***
		OTHER:
☐	☐	***tent or vehicle camping***
☐	☐	***horseback riding***
☐	☐	***walking/hiking/backpacking***
☐	☐	***Sightseeing***
☐	☐	***Hunting***
☐	☐	***nature study/wildlife viewing/photography***
☐	☐	***Swimming***
☐	☐	***Picnicking***
☐	☐	***Sunbathing***
☐	☐	***other:***___________________________________ _
	☐	***None***

4. On a scale from 1 to 5, with 1 being light, 3 being moderate, and 5 being heavy, how would you rate the crowdedness ***at this recreation site*** today? *(Circle one number.)*

Light		***Moderate***		***Heavy***
1	2	3	4	5

5A. On a scale from 1 to 5, with 1 being poor and 5 being excellent, how would you rate the overall condition ***of this recreation site*** today? *(Circle one number.)*

Poor				***Excellent***
1	2	3	4	5

5B. Why did you choose to come to ***this recreation site*** today? (*Fill in the blank.)*

____

____

____

____

5C. Are there any additional facilities needed ***at this recreation site***? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 6.)*

5D. What do you recommend? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

☐ access road	☐ bank fishing area	☐ boat dock
☐ boat launch	☐ camping area	☐ fish cleaning station
☐ fishing pier/dock	☐ lighting	☐ parking lot
☐ picnic tables/shelter	☐ restrooms	☐ signs & information
☐ swimming area	☐ trails	☐ trash cans
☐ RV camping	☐ tent camping	☐ bilingual signs & information
☐ other (please specify: ______________________________________)		

5E. Are there any other improvements that you would recommend for this site?

☐ YES
☐ NO *(If no, skip to Question 6.)*

5F. What improvements do you recommend? *(Fill in the blank.)*

____

____

____

____

I HAVE JUST A FEW MORE QUESTIONS

6. Do you own a permanent or seasonal residence ***on the Broad River***? What is your zip code? *(Check one box and fill in the blank for zip code.)*

- ☐ YES – Permanent Home→ ZIP CODE: ____________
- ☐ YES – Seasonal Home → ZIP CODE: ____________
- ☐ NO - Non-lakefront resident → ZIP CODE: ____________

7. In what year were you born? *(Fill in blank.)*

___________ YEAR

8. Do you have any additional comments about the recreation facilities on ***Parr Reservoir***? (*Please fill in blank and be as specific as possible.*)

____

____

____

____

____

____

THANK YOU FOR YOUR HELP! WE APPRECIATE YOUR TIME TODAY!

DRAFT

DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT (FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2013

DRAFT
DOWNSTREAM RECREATIONAL FLOW ASSESSMENT
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

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September 2013

DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Parr Hydro Development, in particular, forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally continuously operates to pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations at the Fairfield Pumped Storage Development.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

Accordingly, SCE&G organized a Recreation TWC (Appendix A), comprised of interested stakeholders who will collaborate with SCE&G to identify and make recommendations related to recreational needs and opportunities in the Project area. The TWC has requested that a study be designed and implemented that would assess flows downstream of the Parr Shoals Dam (Parr Dam) that provide quality recreational experiences and identify preferred flows for recreational activities, primarily as they relate to wade-angling, canoeing and kayaking.

2.0 PURPOSE OF THE STUDY

To fulfill the needs identified by the TWC, this study will serve to assess potential and identify preferred recreational flows downstream of the Parr Dam primarily as they relate to wade-angling, canoeing and kayaking. This study encompasses the following goals and objectives:

Goal 1: *Characterize currently available recreational opportunities on the Broad River, downstream of the Parr Dam, as they relate to wade-angling, canoeing and kayaking. This will be accomplished by meeting the following objectives:*

i. Utilize the information collected during focus group activities to identify the current patterns of non-motorized boating use on the Broad River, below the Parr Dam, by location and volume, and the quality of those activities.
ii. Estimate preferred flows and seasonal distribution associated with reasonable and safe recreational use of the Broad River, below Parr Dam, for target activities.

Goal 2: *Evaluate potential issues related to portage around Parr Dam. This will be accomplished by meeting the following objectives:*

i. Identify the need among paddlers for portage opportunities around Parr Dam through focus group discussions.

3.0 STUDY AREA

The Project boundary, as defined by FERC, does not encompass the Broad River below the Parr Dam. However, operation of the Parr Development affects and could serve to enhance recreational opportunities below Parr Dam. As noted, SCE&G currently operates the Parr Dam in a modified run-of-river capacity.

Comment [b1]: Add map of boundary of sturdy area and location of current public access points

For this study, the geographic scope will begin at the base of the Parr Dam and encompass limited downstream areas of the Broad River. Focus group discussions will be directed toward recreational wading and boating flow opportunities as they relate to representative hydraulic conditions (i.e. runs, pools, and rapids) in identified reaches of the Broad River. Should Phase 2 be implemented, as discussed below, the specific areas of any on-water evaluations/verifications will be chosen with regards to access and in consultation with the TWC/focus group.

4.0 METHODOLOGY

Information gathered for this study will be used to examine the suitability of the Broad River, downstream of the Parr Dam, for different recreational activities under various flow ranges. The study may involve a one or two-phase approach, depending upon the outcome of Phase 1, to meet the goals of the study through the objectives identified above. Phase 1 will involve convening a panel of experienced anglers, paddlers, NGOs and agency staff familiar with the study reaches to assess the feasibility and potential quality of particular flow ranges for specified on-water activities. Pertinent existing information will also be reviewed as it relates to this effort. Phase 2 will involve an on-site evaluation with members of the TWC and/or focus group convened during Phase 1, if the information gleaned during Phase 1 activities does not serve to meet study goals.

In addition to these efforts, the planned Project Recreation Use and Needs Study will provide information regarding recreational opportunities, patterns and levels of use on the Broad River, primarily above the Parr Dam. This data may be utilized in association with the data gathered from Phase 1 and, potentially, Phase 2 efforts.

4.1 PHASE 1 - FOCUS GROUP AND EXISTING INFORMATION REVIEW

A panel of knowledgeable and experienced parties will be formed to collect and disseminate information regarding recreation opportunities and potential flow effects on recreation on the Broad River downstream of the Parr Dam. The panel will include local paddlers/outfitters, anglers, canoe/kayak clubs, and members of the TWC. A focus group discussion will be conducted to identify and document characteristics of the Broad River within the Study Area with respect to the nature, seasonal distribution, and quality of target on-water activities and preferred river flows.

Existing information about the Broad River channel, hydrology, and flow data for the Broad River in the vicinity of the Project, will be compiled and reviewed to determine if there is any information or data pertinent to this effort. Literature searches will be conducted via the web, libraries, and SCE&G and agency and NGO collections.

4.2 PHASE 2 - SITE RECONNAISSANCE

Contingent upon discussions with the TWC and panel members under Phase 1, a site reconnaissance may be necessary to augment existing information and for the field verification of preferred recreational flows. Critical areas for evaluation will be pre-determined in consultation with the TWC. Information gained from mesohabitat studies may also aid in the identification of instream hydraulic alterations and may provide useful information for selecting on-water evaluation areas. The TWC and panel will observe and assess the quality of target recreational activities at the pre-determined locations and at the preferred flow ranges determined as part of the Phase 1 analysis.

5.0 DELIVERABLES

A draft and final report will be prepared for this effort. The draft report will be reviewed internally by the Recreation TWC and the Lake and Land Management and Recreation Resource Conservation Group (RCG). Comments and edits from the TWC will be incorporated into a Final Report for the relicensing effort. The report will include an executive summary, an introduction, objectives, methods and the resulting recommendations for recreational flows.

6.0 SCHEDULE

The proposed schedule for completion of the Downstream Recreational Flow Assessment is as follows:

TASK	DATE
Focus Group Meeting 1 and Literature Review	~~April - June 2015~~September – October 2014
Focus Group Meeting 2	September 2015
Phase 2 Panel Reconnaissance	~~July - September~~October - November 2015
Submit Draft Report	~~October - November 2015~~2016
TWC Review	~~December 2015 - January~~ 2016
Submit Final Report	~~February - March~~ 2016

7.0 REFERENCES

South Carolina Department of Parks, Recreation and Tourism, Recreation, Planning and Engineering Office. 2008. South Carolina Statewide Comprehensive Outdoor Recreation Plan.

University of South Carolina. 2005. South Carolina Recreation Participation & Preference Study. Prepared for the South Carolina Department of Parks, Recreation and Tourism. (Online) [URL]: http://www.scprt.com/files/RPE/2005%20Rec%20Study.pdf

Whitaker, Doug, Bo Shelby, and John Gangemi. 2005. Flows and Recreation: A Guide to Studies for River Professionals. October 2005.

DRAFT
DOWNSTREAM NAVIGATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2013

DRAFT
DOWNSTREAM NAVIGATIONAL FLOW ASSESSMENT
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
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SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently engaged in a relicensing process which involves cooperation and collaboration among SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The Recreation TWC has requested that flows downstream of the Parr Shoals Dam (Parr Dam) be assessed during planned Instream Flow Incremental Methodology (IFIM) studies to determine if downstream flows currently facilitate one-way navigation at an identified point of constriction in the Broad River, downstream of the Project. Although the primary purpose of the IFIM study is to develop an understanding of key habitat-flow relationships for aquatic species in the Broad River, the IFIM study also provides an appropriate means of determining consistency with navigational goals under various flow scenarios.

2.0 STUDY OBJECTIVE

The objective of the navigational analysis is to assess the flow levels within the Broad River, at identified points of constriction, needed to facilitate one-way navigation. The criteria for one-way navigation can be defined as a "minimum depth of one foot across a channel 10 feet wide or across 10 percent of the total stream width, whichever is greater. Minimum depth does not need to occur across a continuous 10 percent of the stream width, but each point of passage must be at least 10 feet wide."(SCWRC, 1988)

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

The navigational analyses will evaluate flows within the Broad River at points of navigational constriction downstream of the Parr Dam. Recreation TWC participants initially have identified one point of potential constriction at the shoal located roughly 2.4 miles upstream of Haltiwanger Island or Bookman Island (Figure 1). This area is included within the study area for the IFIM and Mesohabitat studies. Other specific areas of constriction may be reviewed and assessed during IFIM study efforts.

The navigational analyses will be conducted during the summer of 2015 concurrent with IFIM study efforts.

4.0 METHODOLOGY

IFIM study transects will include representative locations at points of navigational constriction, as discussed in 3.0, to allow the characterization of hydraulics (wetted depth and width) during a range of flows. The "navigational" transect locations will be field blazed with flagging, recorded via GPS, or other appropriate means. The study sites will be mapped sufficiently to quantify the areas represented by the transects. Consistent with IFIM survey protocol, transect headpin and tailpin ends will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. A measuring tape accurate to 0.1-foot will be secured at each transect to enable repeat field measurements, if necessary. Stream bed and water elevations tied to a local datum will be surveyed to the nearest 0.1-foot using standard optical surveying instrumentation and methods. If USGS gage data is not available, a staff gage may be placed at the study site to confirm stable flow during measurements. Survey activities are anticipated to take place at a

Comment [b1]: Revise map to include Book man Island in addition to Haltiwanger Island and IFIM Study Site 7.

Comment [b2]: Revise wording to determine for most restrictive spot as determined by mesohabitat field survey later this year. .

flow of 400 cfs. A water level logger will also be placed at the transect locations to gather water surface elevation data under various flow events. Water surface elevations will be used to develop stage-discharge relationships for the site and the stage-discharge relationships will be assessed on whether one-way navigation is achieved.

Information obtained during survey activities will be included within the draft IFIM report that will be submitted to the study team for review and comment. The report will document the methods and results as encountered in the field. Supporting data will be presented in graphic and tabular form and appendices will include cross-sectional survey data and reference photographs of study sites.

The methodology for this analysis may be revised or supplemented based on consultation with the Instream Flow TWC and other interested stakeholders, or if field efforts so dictate.

5.0 SCHEDULE AND REPORTING

Data will be gathered during the IFIM study, anticipated to occur in 2015. A final report summarizing IFIM study findings, including an analysis of impediments to one-way navigation under various flow conditions, will be issued subsequent to the completion of field work.

6.0 USE OF STUDY RESULTS

Study findings will be used as an information resource during discussion of downstream flow issues with the Instream Flows TWC, and other relicensing stakeholders.

7.0 LIST OF ATTACHMENTS

Figure 1: Potential Point of Navigational Constriction

8.0 REFERENCES

South Carolina Water Resources Commission (SCWRC). 1988. Instream Flow Study Phase II: Determination of Minimum Flow Standards to Protect Instream Uses in Priority Stream Segments: A Report to the South Carolina General Assembly. Available Online. [URL]: http://scwaterlaw.sc.gov/Instream%20Flow%20Study%20ph2.pdf. Accessed August 2013.

FIGURE 1 POTENTIAL POINT OF NAVIGATIONAL CONSTRICTION

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SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

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EXECUTIVE SUMMARY

[*Summarize the purpose of the SMP, goals and objectives of the SMP, brief description of project purpose and project history and operations, a brief description of shoreline classifications, brief description of the types of permitted uses]*

1.0 INTRODUCTION

[General Project Details and History of the Shoreline Management Plan. Include an updated Map of the Project]

2.0 PURPOSE AND SCOPE OF THE SHORELINE MANAGEMENT PLAN

[Discuss the purpose of the SMP and balance that it assists in providing between developmental, recreational and environmental issues]

3.0 HISTORY OF THE SHORELINE MANAGEMENT PLAN

[Include discussion on the history of the Project and a discussion of the history of development surrounding the Project. Also discuss FERC approval of the current SMP.]

3.1 CURRENT SMP DOCUMENT AND SHORELINE CLASSIFICATIONS

3.2 PROJECT BOUNDARY

3.3 ACREAGE OF PROJECT LANDS

4.0 SHORELINE MANAGEMENT PLAN GOALS AND OBJECTIVES

[Discuss specific goals related to the relicensing process, and consultation that has taken place]

4.1 CONSULTATION

4.1.1 RECREATION/LAKE AND LAND MANAGEMENT RESOURCE CONSERVATION GROUP

4.1.2 LAKE AND LAND MANAGEMENT TECHNICAL WORKING COMMITTEE

4.1.3 MEETING SCHEDULE

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5.1 Geology and Soils

5.2 Water Quality

5.3 Aquatic Resources

5.4 Terrestrial Resources

5.5 Cultural Resources

5.6 Land Use and Aesthetics

5.7 Recreation Facilities and Use

6.0 LAND USE CLASSIFICATIONS

[Identify and define the various land use classifications]

6.1 FOREST MANAGEMENT

6.2 PUBLIC RECREATION

6.3 NATURAL AREAS

6.4 PROJECT OPERATIONS

6.5 WILDLIFE CONSERVATION AREA

6.6 DOCK EXCLUSION AREA

6.7 DOCK APPROVAL AREA

6.8 ISLANDS

7.0 LAND USE PRESCRIPTIONS

[*Discuss the land management prescriptions, as administered through the permitting handbook, and the guiding principles regarding the management of SCE&G-owned lands within each classification*]

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9.3.3 WATER WITHDRAWALS

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12.2 RECOMMENDED LAND OWNER SHORELINE MANAGEMENT PRACTICES

12.2.1 MINIMIZING NON-POINT SOURCE POLLUTION

12.2.2 VEGETATION MANAGEMENT

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Comment [b2]: Sections 6 and 7 - Reorder as appropriate

Comment [b3]: Revise or remove pages and appendices that follow.

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MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Rare, Threatened and Endangered Species TWC Meeting

October 22, 2013

Final KDM 11-13-13

ATTENDEES:

Bill Argentieri (SCE&G)
David Eargle (SCDHEC)
Steve Summer (SCANA)
Shane Boring (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Gerrit Jobsis (American Rivers)
Vivianne Vejdani (SCDNR)
Henry Mealing (Kleinschmidt)
Milton Quattlebaum (SCANA)
Alison Jakupca (Kleinschmidt)
Randy Mahan (SCANA)
Bill Stangler (Congaree Riverkeeper)
Byron Hamstead (USFWS)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting by reviewing the agenda. The group then began to discuss the RT&E Literature Based Study Plan. The group reviewed the USFWS list of RT&E species for Newberry and Fairfield counties. Henry told the group that we plan to begin the research for this study in 2014, and if any other species are added to the list in 2015, they will be included in the final report. The group agreed to this timeline. Byron brought maps to show the locations of the active bald eagle nests near the Project. Steve said that SCE&G also keeps track of the nests. The two groups agreed to work together to make sure that all of this information is shared. Byron agreed to send the Bald Eagle nesting location information to Kelly electronically.

The group then discussed Tom McCoy's comment regarding the Carolina darter. Byron explained that there was a historical record of the species occurring in the Project Area, and that the Project Area provides the correct habitat for this species. However, it is unknown if the record is pre-impoundment. While this species is not currently federally listed (it is a federal species of concern and a state threatened species). Shane will do some research on this species to determine its status in the Project Area. Shane reminded the group that any species the agencies want to be included in the study will be added to the list.

Vivianne commented that since this is a desktop study, she isn't sure if the objectives listed in the study plan can be met, including the identification of appropriate habitat for specific species and the verification of the presence or absence of specific species in the study area. She also suggested that the other RT&E studies that will be conducted are referenced in the literature-based study. The study plan was edited to reflect Vivianne's comments.

Byron mentioned that the Newberry burrowing crayfish, a federal at-risk species, needs to be included in the RT&E literature based study plan. Shane said he would make sure this species is captured in the study.

Bill S. asked why the study area specified in the RT&E Literature Based Study Plan only extends a ½ mile below the Parr Shoals Dam. The group agreed that the study needs to extend down to, and include, Frost Shoals. All study plans will be adjusted to be consistent with this geographic scope.

The group then discussed the Rocky Shoals Spider Lily (RSSL) Study Plan and the comments submitted by the USFWS. The USFWS questioned whether the GPS locations of the RSSL should be public knowledge. The group agreed that many locations are already public knowledge and this hasn't been a problem in the past.

Wording is added to Section 7 of the study plan to explain that information collected during the studies will be used in the development of potential PM&E measures. This wording will be added to all of the study plans.

Gerrit requested that elevation information for the RSSL be documented during the study. Bill S. added that the big concern for the species is how long the plants are completely inundated. Too long of an inundation period and they may die, but not long enough leaves the plants susceptible to predation. The group agreed that elevations of some lily populations will be collected during the IFIM study. The RSSL location data will be compared to the proposed IFIM transects, and the IFIM transects could be slightly shifted so that IFIM study data could apply directly to populations of RSSL. The IFIM study plan and the RSSL study plan will be edited to reflect this.

The group then discussed the Spiny Crayfish Study Plan. The USFWS provided comments on the study plan including the concern of how the crayfish will be correctly identified. Alison explained that only the Form I males will be collected in the field, and then sent to Arnie Eversole, or another qualified astacologist for further identification.

USFWS was also concerned about how frequently the traps will be monitored. Alison explained that the traps will be checked weekly, unless cannibalism or predation seems to be an issue. The traps will then be checked more frequently. The USFWS suggested changing the bait to canned cat food, and everyone agreed that this is an appropriate and effective bait. The study plan was edited to reflect this change. David then asked if the timing of the study is most appropriate for catching crayfish. Alison will contact Arnie Eversole to confirm that this is the correct time for the study, and that the traps are being checked at the appropriate frequency.

The group discussed the proposed monitoring sites for the crayfish study. Byron would like to see the traps set near woody debris, at a variety of depths in the river. Bill S. says that no monitoring location is currently set for downstream of the Parr Shoals Dam, and that maybe another site should be added in that area. The group decided that the best option would be to include general areas for monitoring in the study plan and then go on a reconnaissance trip to determine exact locations closer to the time the study will be conducted. USFWS, SCE&G and Kleinschmidt will work together to determine the best locations for the traps, with consideration to habitat, likely hood of success, and accessibility. Byron also suggested the possibility of having more than one trap at each monitoring location. This was also included in the study plan edits and will be determined during the reconnaissance trip.

Byron also suggested collecting water quality data at the sampling stations. Henry said that a YSI meter can be taken when the traps are checked and temperature, dissolved oxygen and conductivity will be recorded.

After lunch, the group discussed the Monticello Mussel Study Plan. The USFWS requested that water quality data be collected at the sampling sites. Shane spoke with John Alderman prior to the meeting and asked his opinion on this. John said he didn't think it was necessary, since it just provides a snapshot of the water quality in a specific location. However the group decided that when the study is performed, water quality data, including temperature, dissolved oxygen and conductivity, will be collected using a YSI meter at some of the sampling sites. USFWS was also interested in learning the qualifications of the malacologist that will be performing the study, to ensure that he or she has the correct permits to handle RT&E species in the event one is discovered. Shane said that John Alderman or a similarly qualified group will likely be leading the study, and all are qualified and permitted to handle any sensitive species. David asked if the Carolina heelsplitter needs to be specifically mentioned in the study plan. Shane told David that all mussels found will be identified, and if the Carolina heelsplitter is found in Monticello Reservoir that it will be documented.

Henry told the group that if anyone is interested in participating in a particular study, to let SCE&G or Kleinschmidt know. They are welcome to participate in the field studies if we can accommodate them.

The four study plans discussed during this meeting are included at the end of these notes, with all edits shown in track changes. Revised and finalized copies of the documents will be emailed to the TWC. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Byron will email the Bald Eagle nesting information to Kelly.
- Shane will research the Carolina darter to determine if the species is located in the Project Area.
- Bill S. will send Kelly the Davenport study and reference for the Rocky Shoals Spider Lily.
- Alison will talk to Arnie Eversole verifying the correct time and frequency to sample crayfish.
- Kleinschmidt will update the geographic scope of all study plans to extend downstream of Parr Shoals Dam to include Frost Shoals. The study plans will also be updated to mention that all information collected during the studies will be considered in the development of potential PM&E measures.

- Kleinschmidt will revise the RSSL and IFIM Study Plans to include documenting elevation of the RSSL populations.

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

DRAFT
RARE, THREATENED AND ENDANGERED SPECIES
STUDY PLAN

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

September 2013

PARR HYDROELECTRIC PROJECT
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DRAFT RARE, THREATENED AND ENDANGERED SPECIES **STUDY PLAN**

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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(FERC NO. 1894)

DRAFT RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Fairfield Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as the licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGOs), and interested individuals. Collaboration and cooperation of stakeholders is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs), including members from among the interested stakeholders, with the objective of achieving consensus regarding the identification and proper treatment of these resource issues in the context of a new license.

In preparation for relicensing, SCE&G formed a Rare, Threatened and Endangered Species Technical Working Committee ("RT&E TWC" or "TWC"), which is comprised of interested stakeholders who are working with SCE&G to identify potential issues, make biological study recommendations, and provide technical and experience-based input related to rare, threatened and endangered (RT&E) species potentially residing in the Project area. SCE&G is planning to conduct a literature-based study to compile existing information on federally and state listed RT&E species in the immediate project area. SCE&G will use this information in developing their license application for Federal Energy Regulatory Commission (FERC).

2.0 STUDY OBJECTIVES

Comment [b1]: Add a section listing the RT&E studies that we are doing, such as spiny crayfish, RSSL, etc.

The objective of this study is to ~~accurately~~ characterize the present status of RT&E species at the Parr Fairfield Hydroelectric Project by providing information regarding the availability of RT&E habitat and ~~by verifying the presence or absence~~characterize the known status of RT&E species within the Project boundary and Project vicinity. The presence or absence of selected species will be verified through targeted field studies.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

Comment [b2]: Make the geographic scope consistent throughout all of the study plans.

This study will focus on all areas within the FERC Project boundary, including Parr and Monticello reservoirs and the immediate vicinity of the Project in Fairfield and Newberry counties. As this study is a desktop exercise, no field reconnaissance will be implemented. RT&E species that are deemed as potentially occurring within the Project Area and from Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island~~vicinity will be noted through this study,~~ along with the known presences of available RT&E habitat will be evaluated. The study is scheduled to commence in 2015.

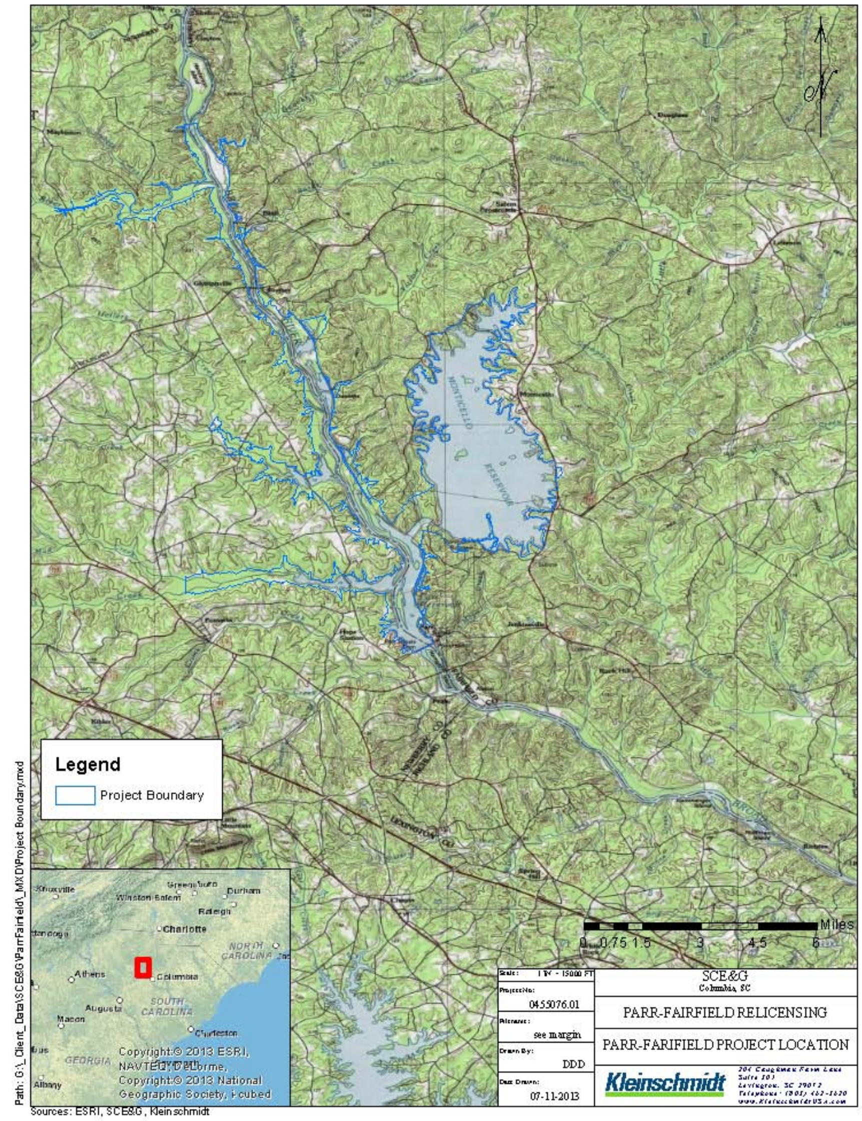

FIGURE 1 PARR-FAIRFIELD PROJECT LOCATION MAP

4.0 COLLECTION METHODS AND ANALYSIS

In order to appropriately characterize the present status of RT&E species in the Project vicinity, information will be collected from various sources, including the South Carolina Department of Natural Resources (SCDNR) and the U.S. Fish and Wildlife Service (USFWS) RT&E databases.

As an initial step, a list of RT&E species documented as occurring in the counties surrounding the Project and downstream (Newberry, ~~and~~ Fairfield and Richland) will be compiled based on the USFWS and SCDNR county level listings. Additional key species may be added at the request of TWC members, if agreed to be appropriate. The federal, state and global status of each of these species will be summarized, along with counties of occurrence. As a second step, known ranges of these species, along with occurrence data from the SCDNR Natural Heritage Program and other survey data, will then be used to eliminate species occurring in the counties but not in the Broad River Basin. Habitat requirements of each of the remaining species will then be summarized and compared to available habitat within the Project boundary and include an area ~~just~~ downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island~~for approximately ½ mile~~. This analysis will yield a list of species that potentially occur within the Broad River Basin, and that have suitable habitat within the Project Boundary and ~~just~~ downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island~~for approximately ½ mile~~.

5.0 SCHEDULE

Research and data collection efforts will begin ~~in~~ no later than the spring of 2015. A final report summarizing the study findings including the compiled spreadsheets will be issued within 120 days of the completion of data collection. Study methodology and timing may be adjusted based on consultation with resource agencies and interested stakeholders.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, USFWS, RT&E TWC and other relicensing stakeholders.

DRAFT
ROCKY SHOALS SPIDER LILY
(HYMENOCALLIS CORONARIA)
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

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October 2013

DRAFT
ROCKY SHOALS SPIDER LILY
(Hymenocallis coronaria)
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC No. 1894)

Prepared for:

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October 2013

DRAFT ROCKY SHOALS SPIDER LILY
***(HYMENOCALLIS CORONARIA)* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DRAFT ROCKY SHOALS SPIDER LILY
***(HYMENOCALLIS CORONARIA)* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project (FERC No. 1894) ("Parr Fairfield Project" or "Project"), owned and operated by the South Carolina Electric & Gas Company ("SCE&G" or "Licensee"), is seeking a new license from the Federal Energy Regulatory Commission ("FERC"), as their current license is set to expire on June 30, 2020. The Parr Fairfield Project consists of two developments, including the Parr Hydro Development and the Fairfield Pumped Storage Development, located in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license. A Rare, Threatened & Endangered Species TWC ("RT&E TWC" or "TWC") was formed to address potential RT&E related issues associated with the Project. It is comprised of stakeholders including the U.S. Fish and Wildlife Service ("USFWS"), the National Marine Fisheries Service ("NMFS"), the South Carolina Department of Health and Environmental Control ("SCDHEC") and the South Carolina Department of Natural Resources ("SCDNR"), among others. During issues scoping, the TWC identified a South Carolina state species of concern, the Rocky Shoals Spider Lily (*Hymenocallis coronaria*) as occurring in the Broad River, downstream of the Parr Shoals Dam (Parr Dam). TWC members requested a survey to document the presence of this species in reaches downstream of the Project Area.

2.0 RELEVANT LIFE HISTORY INFORMATION

The Rocky Shoals Spider Lily (*Hymenocallis coronaria*), a recognized species of concern for South Carolina, is an aquatic, perennial flowering plant easily identified by its large white flowers. The plant develops from a bulb and grows to be approximately 3 feet tall. *H. coronaria* requires a specialized habitat of swift, shallow flowing water over rocks and direct sunlight (Davenport, 2007). The Broad River downstream of the Parr Dam contains shoal areas which provide the necessary habitat for this species. During winter months, plant bulbs and seeds stay buried in the rocky riverbed until May, when leaves begin to emerge above the water surface. During this time, flower stalks begin to develop and the short blooming season occurs from mid-May through June (Davenport, 2007).

3.0 STUDY OBJECTIVES

The objective of this study is to assess the status of *H. coronaria* within the area of Project influence by identifying and documenting all populations in the portion of the Broad River from Parr Dam extending to and including Frost Shoals, near Boatwright Island~~to Boatwright Island, including Frost Shoals~~.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

As the life history information indicates, *H. coronaria* populations may occur at various shoals along the Broad River downstream of the Parr Dam. For this reason, the survey area will include the stretch of the Broad River downstream of the Parr Dam extending to and including Frost Shoals, near Boatwright Island. The survey reach is depicted in yellow in Figure 1.

The study will occur during the flowering season over two to three days in May or June, depending on flows and weather.

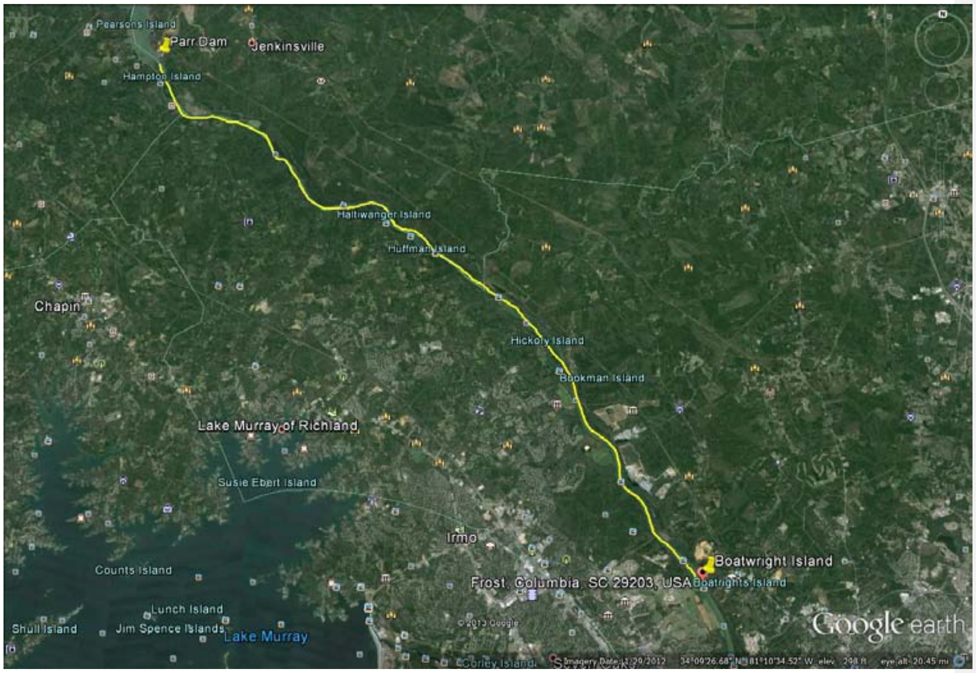

FIGURE 1 ROCKY SHOALS SPIDER LILY SURVEY REACH

5.0 COLLECTION METHODS AND ANALYSIS

The survey will take place during the flowering season of the *H. coronaria*, which occurs from late spring to early summer. A survey crew(s) will deploy in kayaks or canoes at the base of the Parr Dam and paddle downstream, observing the area for populations of *H. coronaria*. The main stem river channel, side channel areas and island complexes will be thoroughly surveyed. The crew(s) will paddle approximately halfway down the survey reach on Day 1. The group will then reconvene at the take-out location from Day 1 on Day 2 and paddle the remainder of the study area. When populations are sighted, the crew will document the exact location of the plants using GPS. The basal area of plants or clumps of plants will be measured and recorded. Elevation data for documented plants or clumps of plants will be obtained either during this survey or during the IFIM Survey. ~~The number of individual plants within each population will also be estimated and recorded.~~

6.0 SCHEDULE

It is anticipated that data collection will occur in the spring of 2015. Due to the variability in flows and meteorlogic conditions, the exact survey dates will be determined at a later date and announced two weeks in advance to the TWC members. If 2015 has extensive high flow conditions that would not allow for an effective assessment, the study will be postponed until the spring of 2016.

Within 90 days of the close of field work, a final report summarizing the study findings will be issued. Study methodology, duration and timing may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Comment [b1]: Add reference to potential PM&E measures to all study plans

Study results will be used as an information resource during the discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, SCDHEC, USFWS, RT&E TWC, and other relicensing stakeholders.

8.0 REFERENCES

Davenport, L. J. (2007). “Cahaba Lily.” *The Encyclopedia of Alabama*. [Online] URL: http://www.encyclopediaofalabama.org/face/Article.jsp?id=h-967. Accessed August 7, 2013.

DRAFT
BROAD RIVER SPINY CRAYFISH
CAMBARUS SPICATUS
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

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September 2013

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BROAD RIVER SPINY CRAYFISH
CAMBARUS SPICATUS
STUDY PLAN

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DRAFT BROAD RIVER SPINY CRAYFISH
***CAMBARUS SPICATUS* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DRAFT BROAD RIVER SPINY CRAYFISH
***CAMBARUS SPICATUS* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894)(Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

During issues scoping, the TWC identified the potential need for a crayfish survey dependent upon discussions with U.S. Fish and Wildlife Service ("USFWS"). Based upon communications with the USFWS on June 6, 2013, the Broad River Spiny Crayfish (*Cambarus spicatus*), a South Carolina species of special concern, may be located within the Project area. As such, crayfish surveys were recommended to document the presence of this species within the Project area and downstream of the Parr Shoals Dam.

2.0 RELEVANT LIFE HISTORY INFORMATION

As noted, the Broad River Spiny Crayfish (*Cambarus spicatus*) is a species of concern in South Carolina. Eversole (1990) identified *C. spicatus* as having a distribution limited to lotic environments in the Broad River drainage basin. *C. spicatus* collections in the vicinity of the Project occurred within the Little River, a tributary to the Broad River, in Fairfield County. Although *C. spicatus* collections are limited, individuals were primarily associated with leaf litter and other organic debris located along the banks of streams. Preferred substrates have been found to be comprised primarily of sand and tend to be unstable in nature with a lack of rooted aquatic vegetation. Current information indicates that *C. spicatus* reproduces during the summer months (Eversole, 1990). *C. spicatus* was described by Hobbs (1956) as gray-green with cream, pink, purple and brown highlights. The chelae (the "claw" or "pincer") are green with orange tips and a double row of tubercles. Individuals range from about 60 mm (2.4 inches) to 78 mm (3.1 inches) in length.

3.0 STUDY OBJECTIVES

The objective of this survey is to assess the status of *C. spicatus* in the portion of the Broad River located within the Project boundary and an accessible area downstream of the Parr Shoals Dam.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

Based upon the life history information identified above, sampling sites will be located along the margins of the Broad River and associated tributaries, in areas of leaf litter/detritus, if possible. At least ~~Three~~ three sampling ~~sites~~ areas are proposed to be included as a part of this survey. ~~These~~ General locations are listed in Table 1 and in Figure 1, below. These locations are approximate and actual sampling sites will be determined ~~in the field~~in consultation with USFWS prior to start of survey.

TABLE 1 BROAD RIVER CRAYFISH SAMPLING LOCATIONS

	SAMPLING ~~LOCATIONS~~AREAS
1.	~~Cannon's Creek Boat Ramp~~Main Reservoir
2.	~~Heller's Creek Boat Ramp~~Broad River Downstream of Parr Shoals Dam
3.	Hwy 34 Boat Ramp

The study season will extend from August 1 through October 1, 2015.

Comment [b1]: Verify this time frame is correct.

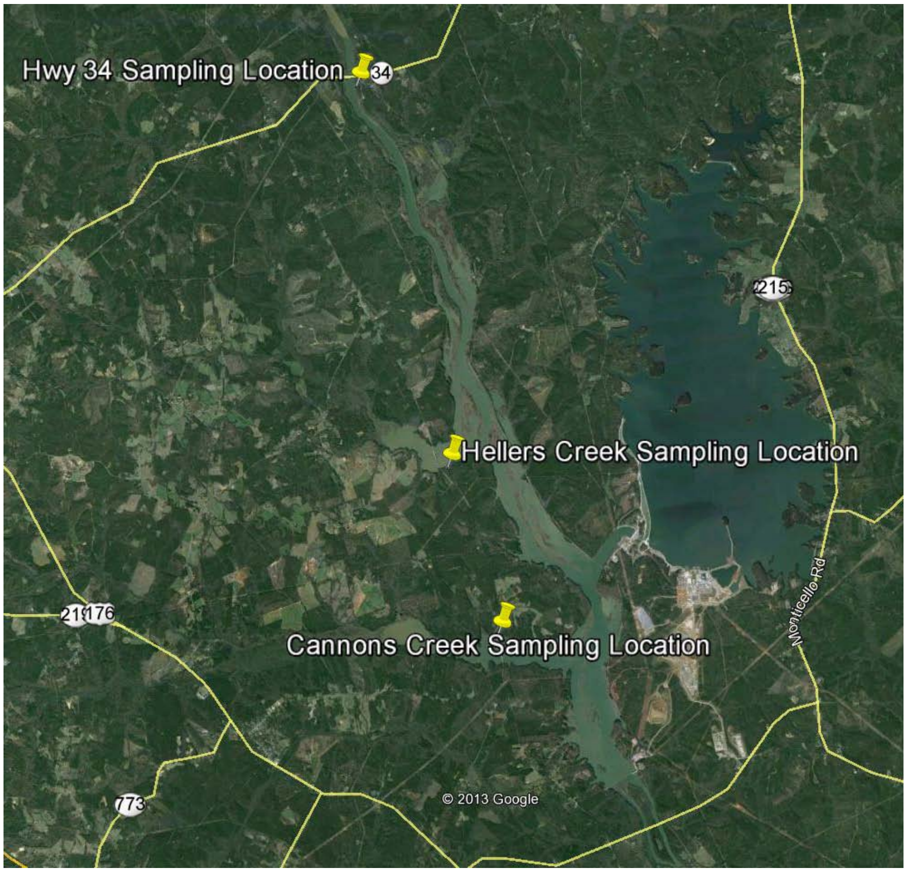

FIGURE 1 CRAYFISH SAMPLING LOCATIONS

Comment [b2]: Change / expand map move pins to proposed areas.

5.0 COLLECTION METHODS AND ANALYSIS

Passive trap methods will be utilized for this study. Traps will consist of double-entry, galvanized wire mesh minnow traps with 1" opercula. Traps will be baited with ~~herring~~ canned fish and will be re-baited at weekly intervals, or as needed. A one-pound weight will be placed in the traps to ensure that they remain submerged. Traps will be deployed along ~~river margins~~shoreline, in areas of detritus and/or leaf litter, if possible. The number of traps per area will be determined during sample location reconnaissance. Traps will also be placed in locations where water depth is sufficient to ensure that they remain inundated ~~over the full range of~~

~~reservoir fluctuations~~. They will also be positioned such that they are not readily noticeable in an effort to decrease disturbance and vandalism. In the event of vandalism or theft, the trap will be replaced as soon as possible.

The traps will be checked on a weekly basis. Data recorded for each collection event will include: location (including site description and GPS coordinates), date, name of water body, basic water quality parameters (temperature, DO and conductivity), trap retrieval and deployment times~~;~~, the total number of crayfish collected~~;~~, the number of males and females. For the purposes of identification, only Form I males will be collected from the sample; other individuals will be released. Collected materials will be fixed in 5% neutral formalin, washed in tap water and preserved in 70% ethyl alcohol. Samples will be transported to a qualified astacologist for species identification.

6.0 SCHEDULE

Site location reconnaissance will be conducted in consultation with USFWS prior to start of survey. Crayfish traps will be deployed at the ~~three~~ sampling locations on or around August 1, 2015 and will be allowed to sample for approximately eight weeks. The traps will be checked weekly during this sampling period.

Comment [b3]: Verify actual date for this activity.

A final report summarizing the study findings will be issued within 120 days of completion of field work. Study methodology, timing and duration may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, RT&E TWC, and other relicensing stakeholders.

8.0 REFERENCES

Eversole, Arnold G. 1990. Status Report on *Cambarus (Puncticambarus) spicatus* Hobbs, *Distocambarus (Fitzcambarus) youngineri* Hobbs, and *Procambarus (Pennides) echinatus* Hobbs. Completion Report. 21 pp.

Hobbs, H. H., Jr. 1956a. A new crayfish of the genus Procambarus from South Carolina (Decapoda:Astacidae). J. Wash. Acad. Sci. 46(1):117-121.

NatureServe. 2013. *Cambarus spicatus* Hobbs, Broad River Spiney Crayfish. (Available Online)[URL]: http://www.natureserve.org/

Price, Jennifer. Undated. Broad River Spiny Crayfish *Cambarus spicatus*. 2pp.

DRAFT

Lake Monticello Freshwater Mussel Reconnaissance Survey Study Plan

Parr Hydroelectric Project (FERC No. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

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October 2013

DRAFT

LAKE MONTICELLO FRESHWATER MUSSEL RECONNAISSANCE SURVEY

STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
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October 2013

LAKE MONTICELLO FRESHWATER MUSSEL RECONNAISSANCE SURVEY

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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LAKE MONTICELLO FRESHWATER MUSSEL RECONNAISSANCE SURVEY

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr-Fairfield Hydro Project (FERC No. 1894) (Project) is a 525 megawatt (MW) licensed hydroelectric facility owned and operated by South Carolina Electric & Gas (SCE&G). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates to continuously pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations.

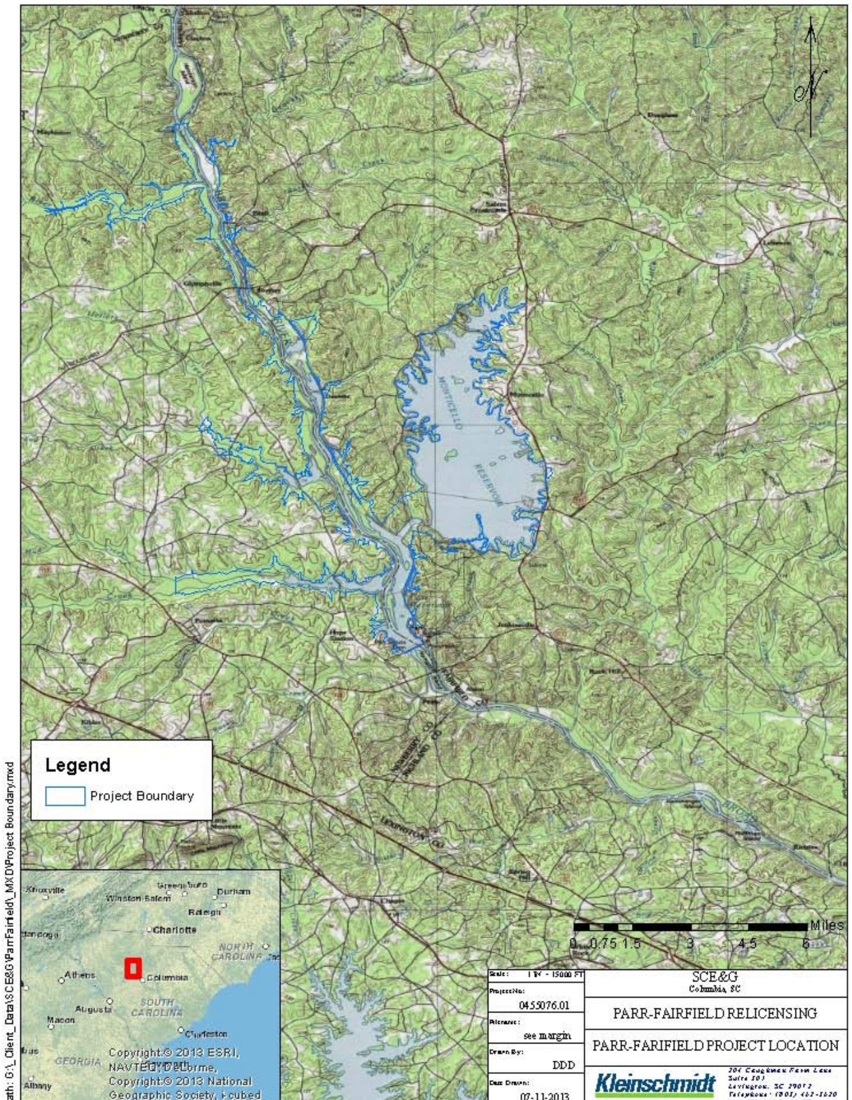
The Fairfield Pumped Storage Development is located directly off of the Broad River and forms the 6,800-acre upper reservoir, Monticello Reservoir, with four earthen dams. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. Their collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working

Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

During early meetings aimed at scoping appropriate relicensing studies, the Rare, Threatened and Endangered Species (RT&E) TWC requested information describing the status of freshwater mussels in Parr and Monticello reservoirs, as well as in the downstream reach of the Broad River influenced by Project operations. A subsequent TWC review of existing mussel data for the Project vicinity determined that recent surveys conducted by the South Carolina Department of Natural Resources (SCDNR) (Price, 2010) and Alderman Environmental Services (Alderman and Alderman, 2012) were adequate for characterizing the mussel fauna of Parr Reservoir and the downstream reach of the Broad. The TWC further determined that no such data were available for Monticello Reservoir; thus a qualitative survey would be needed. This Study Plan was prepared pursuant to that determination.

FIGURE 1 PROJECT LOCATION MAP



Sources: ESRI, SCE&G, Kleinschmidt

2.0 STUDY OBJECTIVE

The study objective will be to determine whether native freshwater mussels are present within the pool of Monticello Reservoir, and if so, gather qualitative data describing the diversity, spatial distribution and relative abundance of the mussel fauna inhabiting the lake.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

The reconnaissance survey described herein will focus on selected habitats within the Monticello Reservoir pool that are likely to support populations of native freshwater mussels. Surveys will be conducted in 2015, likely during the summer to early fall months when water clarity and temperatures are sufficiently high to support wading and other in-water survey methods.

4.0 METHODOLOGY

Freshwater mussel surveys in Monticello will utilize qualitative methods that allow for rapid coverage of larger survey areas and have proven more robust at determining diversity of surveyed areas (Miller and Payne, 1993). Qualitative surveys will involve timed visual and/or tactile inspections of suitable habitat for presence of live freshwater mussels and/or shell material and will be conducted by a qualified malacologist with expertise in Broad River fauna. Although the number and specific location of qualitative survey points will likely be refined in the field based on professional judgment of the lead malacologist, it is expected that a minimum of 30 representative sites will be distributed throughout the reservoir[1]. Particular attention will be placed upon the examination of potential Savannah lilliput (*Toxolasma pullus*) (federal at-risk species and State species of concern) habitat within backwater areas of the reservoir.

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Exact methods for conducting visual and tactile searches will vary depending on water depth. However, it should be noted that water levels on Monticello Reservoir typically fluctuate up to 4.5 ft daily as a result of pumping operations, and as such, mussel surveys will focus primarily on those areas below the 4.5 ft depth contour where mussels are likely to become established. Depending upon water depths, wading, batiscope, snorkeling, or SCUBA will be used to conduct timed surveys at each of the selected sites:

[1] It is estimated that each site will require an average of 30 man-minutes to conduct a reconnaissance level survey.

- Wading – Where water is relatively shallow, clear, and flat (no disturbances by wind), a biologist walks over an area to conduct a visual~~ly~~ and/or tactile survey ~~an area~~ for live mussels and shells. This method is typically focused upon examinations of exposed near-shore habitats.
- Batiscope or snorkeling – In clear to slightly turbid waters up to 2 meters deep, or in waters with wind-disturbed surfaces, a batiscope or snorkeling will be used to conduct a visual and/or tactile~~visually~~ survey ~~an area~~ for live mussels and shells.
- SCUBA – In survey areas of Monticello Reservoir with depths from 1 to 8+ meters, a biologist will traverse the lake bottom using SCUBA to conduct a visual and/or tactile survey for mussel species that prefer deeper waters and may not be detected at near-shore sites.

Live and fresh dead mussels collected during the survey will be identified to species, enumerated and returned to their habitat, although some shell material and/or live specimens may be preserved and returned to the laboratory for taxonomic confirmation. All sampling stations, as well as any significant mussel beds found during sampling, will be documented using a Global Positioning System (GPS) receiver. Mussel habitat surveyed at each sample location, as well the species collected during the survey, will also be photo documented. Basic water quality parameters (temperature, DO and conductivity) will be collected near the substrate at representative sample areas.

5.0 REPORTING

A report will be prepared for TWC review and comment. The report will document methods and results as encountered in the field including:

- A species list documenting the diversity of mussel fauna of Monticello Reservoir.
- GIS maps depicting spatial distribution of mussel populations.
- Tabular summaries comparing Catch per Unit Effort and relative abundance of species encountered.
- Summarize water quality data.

6.0 SCHEDULE AND REQUIRED CONDITIONS

As previously noted, it is expected that field surveys will be conducted during the summer or fall of 2015. It is expected that this effort will require 2-3 days of field work to complete. A final report summarizing the study findings will be issued subsequent to the completion of field work. The methodology for this survey may be revised or supplemented based on consultation with the RT&E TWC and other interested stakeholders.

7.0 USE OF STUDY RESULTS

Study findings will be used as an information resource during discussion of RT&E species issues and developing potential Protection, Mitigation and Enhancement measures with the TWC, and other relicensing stakeholders.

8.0 REFERENCES

Alderman, J.M. and J.D. Alderman. 2012. Freshwater Mussel Surveys within The Broad River, East of Hampton Island. Prepared by Alderman Environmental Services, Inc. for SCANA Services, Inc. October 29, 2012. 48 pp.

Miller, A.C. and B.S. Payne. 1993. Qualitative versus quantitative sampling to evaluate population and community characteristics at a large-river mussel bed. American Midland Naturalist 130:133-145.

Price, J. 2010. Fish Passage on the Broad River: an assessment of the benefits to freshwater mussels. Completion Report to the Broad River Mitigation Fund. University of SC and South Carolina Department of Natural Resources. 59 pp.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Fisheries TWC Meeting

December 19, 2013

Final KDM 1-24-14

ATTENDEES:

Bill Marshall (SCDNR)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Shane Boring (Kleinschmidt)
Dick Christie (SCDNR)
Kelly Miller (Kleinschmidt)
Byron Hamstead (USFWS)
Sam Stokes (SCDNR)
Bill Argentieri (SCE&G)
Ron Ahle (SCDNR)
Randy Mahan (SCANA)
Henry Mealing (Kleinschmidt)
Fritz Rohde (NOAA)
Dan Dieter (Kleinschmidt)
Scott Lamprecht (SCDNR)

These notes serve as a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting with introductions and then briefly discussed the agenda with the group.

Fisheries Baseline Report
Shane then reviewed the edits made to the Fisheries Baseline Report. He mentioned that there was only a small amount of fisheries information available for the Recreation Lake and asked that if anyone had more information to send it to him and he would include it in the report. Additional data will be accepted until August 2014 for inclusion in the PAD. Shane also told the group that an addendum was added to the report, summarizing the American Eel and American Shad data collected by SCDNR as part of the Santee River Basin Accord (Accord). SCDNR reviewed the summary before it was finalized and added to the Fisheries Baseline Report.

Robust Redhorse Spawning Areas
The group then discussed the potential Robust Redhorse spawning areas that were identified during the Mesohabitat Assessment. Shane said the search for spawning sites wasn't quantitative however the group had published habitat requirements (Freeman and Freeman 2002) in mind during the survey and identified a few potential sites as they moved downriver. Shane showed the group a few pictures of the two areas that were identified as potential spawning areas for Robust Redhorse. This information is included at the end of these notes. Scott noted that he believed these to also be the two sites where he had tracked his limited number of telemetered fish. Shane noted that Scott and Milton are planning to go out on the river again to search for more potential spawning sites. The group agreed that the best way to document all of this information is for Shane to develop a memo that will be added as an appendix to the IFIM Report, as well as be included in the PAD.

Reservoir Fluctuations

Next the group focused on the fluctuations of Parr and Monticello Reservoirs, and discussed what would be the best way to study these fluctuations and determine possible effects. At an earlier meeting, the group discussed the possibility of using existing LiDAR data to measure the fluctuation zone of each reservoir. Dan analyzed the existing LiDAR data and determined it was unreliable for analyzing the fluctuation zone for a variety of reasons. Since the LiDAR data collected was for land and not water, it was full of errors, most notably related to data not being available for the full range of reservoir fluctuations. Also, Monticello Reservoir was at full pool when the LiDAR was collected, so no shoreline was visible below 425 ft msl. Dan's PowerPoint presentation which summarizes his findings is included at the end of these notes.

Bill A. then presented information on the fluctuations of the two reservoirs, collected by SCE&G and USGS. For both reservoirs, the greatest amount of fluctuation occurs in August and the least amount occurs in February. The average fluctuation for Parr Reservoir over the course of a year is approximately 4.69 ft and the average fluctuation for Monticello Reservoir is approximately 2.46 ft. Henry explained to the group that since reservoir fluctuation occurs every day, fish are not likely to use the habitat that is subject to the daily fluctuations. Ron added that fish don't have to spawn every year, such as during dry years when spawning habitats may not be available. Ron also mentioned that flow control and pool management were potential mitigation options. Henry asked the group to brainstorm other ways that the spawning areas could be enhanced besides flow control. Installation of spawning benches, bamboo bundles, and artificial reefs below the fluctuation zone in Monticello Reservoir can all create artificial spawning habitat for various fish species. Because of the flowing nature of Parr Reservoir, it may be more difficult to permanently install some of these natural or artificial habitats. The group discussed the need to go on site at Parr Reservoir and document the fluctuation effects. Information can be collected at a few select sites, including taking pictures during a drawdown and gathering slope and distance of exposed littoral zones. Milton suggested installing some enhancement measures in areas such as Cannon's Creek, where they are less likely to be washed away. Scott said that in his experience, the best enhancements are of natural materials, such as cedar trees. If cedar trees are submerged when they are still green with the root wads attached, they are very effective and last for a long time. Scott also said that gravel beds are effective at attracting Centrarchids, although it is unknown as to whether they actually use these areas for spawning. Scott also suggested building a small dyke to create a littoral impoundment within Parr Reservoir which would retain water between fluctuations. This would be another way to create spawning habitat. Henry said that all of these ideas can be evaluated in the future as PM&E measures. In the meantime, the group agreed to go out to representative locations within the two reservoirs and document the exposed areas during fluctuations to create a baseline. Steve also suggested that the group could consider the total surface area of Parr Reservoir before and after the 9 ft crest gates were built. This area accounts for 9 of the 10 feet of fluctuation zone in Parr Reservoir. SCE&G and Kleinschmidt will develop a study plan to include existing information on the fluctuations with Parr and Monticello Reservoirs, an action plan for gathering more information at select sites within the reservoirs, and possible options for PM&E measures.

Waterfowl Study

Shane then discussed the changes that were made to the Waterfowl Study Plan. At the request of SCDNR, three additional monitoring dates per study year were added to the existing six monitoring dates per study year, for a total of 18 monitoring dates, or nine per year. Everyone agreed to these changes, so this study plan will be finalized for inclusion in the PAD.

American Eel Abundance Study

The group then discussed the American Eel Study Plan. There was initial concern over the frequency in which the American eel trap was to be checked. Traps were originally to be checked weekly, but after further discussion, the study plan was amended to specify that traps would be checked every Monday, Wednesday, and Friday during the study period. Henry then explained that SCE&G and Kleinschmidt are investigating the use of a "wireless camera" to aid in monitoring. This way, traps could be remotely monitored on a daily basis. Since technology is constantly changing, the group agreed to amend the study plan explaining that the eel trap would be monitored remotely via on-site camera or on-site every Monday, Wednesday and Friday. Fritz expressed concern that one trap may not be enough to thoroughly monitor the area for eels, and showed the group images of traps from an American eel study that was performed at Roanoke Rapids in North Carolina. Henry reminded the group that previous eel studies at the Columbia Dam, located downstream of Parr Shoals Dam, collected less than 10 eels over several years of study. Based on that information the group decided that one trap should be satisfactory for the study. Henry added that electrofishing efforts would also be utilized to ensure the study area is thoroughly examined for American eels. Fritz agreed that one trap would be fine, as long as it is properly placed. Kleinschmidt will edit the study plan to reflect the changes discussed and Bill A. will submit the final plan to the Accord members for approval.

Entrainment/Impingement Study

The group discussed the draft Entrainment/Impingement Study Plan. Prior to the meeting, Byron submitted comments and questions regarding this study plan, which were addressed as the group worked through the document. Henry explained to the group how a desktop entrainment study is prepared and some history on how these desktop studies began in the 1990's. He explained that factors such as bar rack spacing, entrainment velocities, location of intakes, reservoir stratification, species composition, and turbine size and type are all considered, among others, during a desktop study. There was some general discussion regarding collecting hydroacoustic information as part of the study. Dick explained that hydroacoustic data was collected at the Keowee-Toxaway Project, and data collected showed that operational changes at one of the units resulted in a reduction in entrainment. Field work was performed at that Project because fish populations were a concern however this is not the case at the Parr/Fairfield Project. There was general consensus that a desktop Entrainment/Impingement Study was an acceptable method to address this issue. The group discussed the need for hold points to occur during the study. The group will meet to discuss the progress of the study after each of the following parts of the study is complete: Step 1 - Develop an entrainment and turbine mortality database that can be applied to the Parr and Monticello developments; Step 3 - Characterize the species composition of potential fish entrainment; Step 5 - Estimate the total annual entrainment for the Project based on normal operation; and Step 7 - Estimate impingement mortality for fish elimination from entrainment estimates. A draft report will then be issued. Bill M. asked if any information was available on fish distribution in the forebay area. Very little is currently available, so the group agreed to have Milton conduct some additional electrofishing surveys in the forebay in Monticello Reservoir and the tailrace canal in Parr Reservoir when he collects fish for the VC Summer Nuclear Plan studies in the spring and fall of 2014 and 2015. This information will also be used in the Entrainment study. Kleinschmidt will revise the study plan to reflect the changes discussed and send out a revised draft to the TWC for approval. The study plan will then be finalized and included in the PAD.

Diadromous Fish Passage
The group then talked about the need for a Diadromous Fish Passage Alternatives Evaluation, an issue that was originally raised by Gerrit Jobsis and Karla Reece at one of the initial RCG meetings. Byron noted in an email prior to the meeting that the USFWS thought that this issue would be addressed as part of the Accord. Bill A. explained for the group that the Accord has identified triggers for a fish passage alternatives analysis. Henry said that information on the Accord, along with information on the Santee-Cooper Basin Diadromous Fish Passage Restoration Plan, will be included in the PAD however moving forward with a fish passage alternatives plan is premature at this point. Fritz noted that there has been internal discussion within the NOAA Protected Resources Group about becoming more involved in the Parr/Fairfield Relicensing and the Accord. The group agreed that this is an appropriate way to handle the issue at this point and in the meantime, SCE&G and Kleinschmidt will reach out to Gerrit and Karla to discuss any further concerns they may have.

After discussion of the fish passage issue, Henry closed the meeting. Action items identified during the meeting are included below.

ACTION ITEMS:

- Ron will send his photos of the two sites identified for Robust Redhorse spawning to Kelly.
- SCE&G will develop graphs depicting the fluctuations during wet versus dry years at Parr and Monticello Reservoir.
- SCE&G will find information on the reservoir surface areas before and after the crest gates were built, to be included in the Fluctuation Study Plan.
- Kleinschmidt will develop a Fluctuation Study Plan and submit to the TWC for review.
- Kleinschmidt will finalize the Waterfowl Study Plan and distribute to the TWC.
- Kleinschmidt will amend and finalize the American Eel Study Plan as discussed at the meeting and distribute to the TWC. Bill A. will submit this study plan to the Accord members for approval.
- Kleinschmidt will revise the Entrainment/Impingement Study Plan and resubmit the draft to the TWC for review.

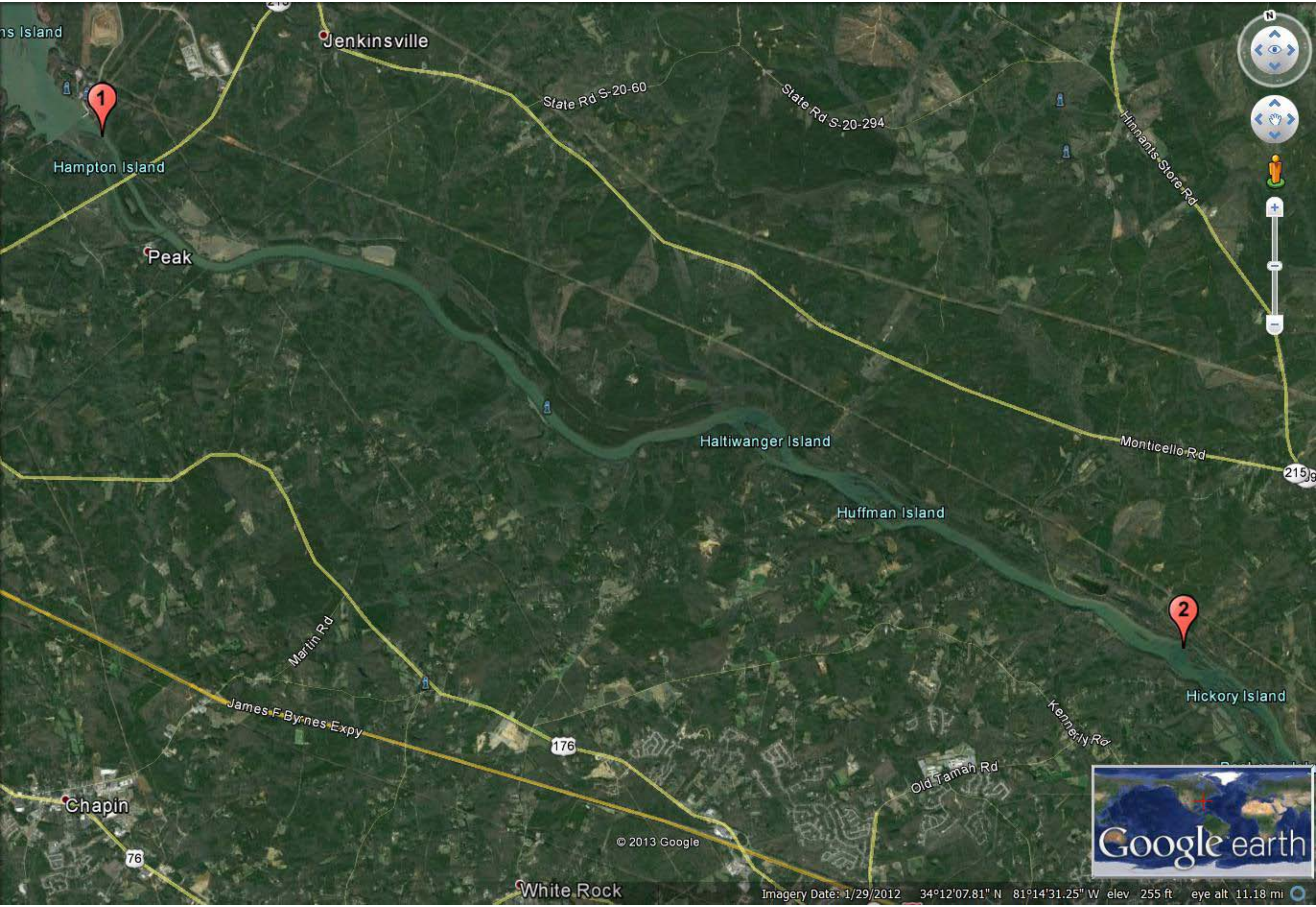
Potential Robust Redhorse Sites

Robust Redhorse Spawning Habitat (Freeman and Freeman, 2001)

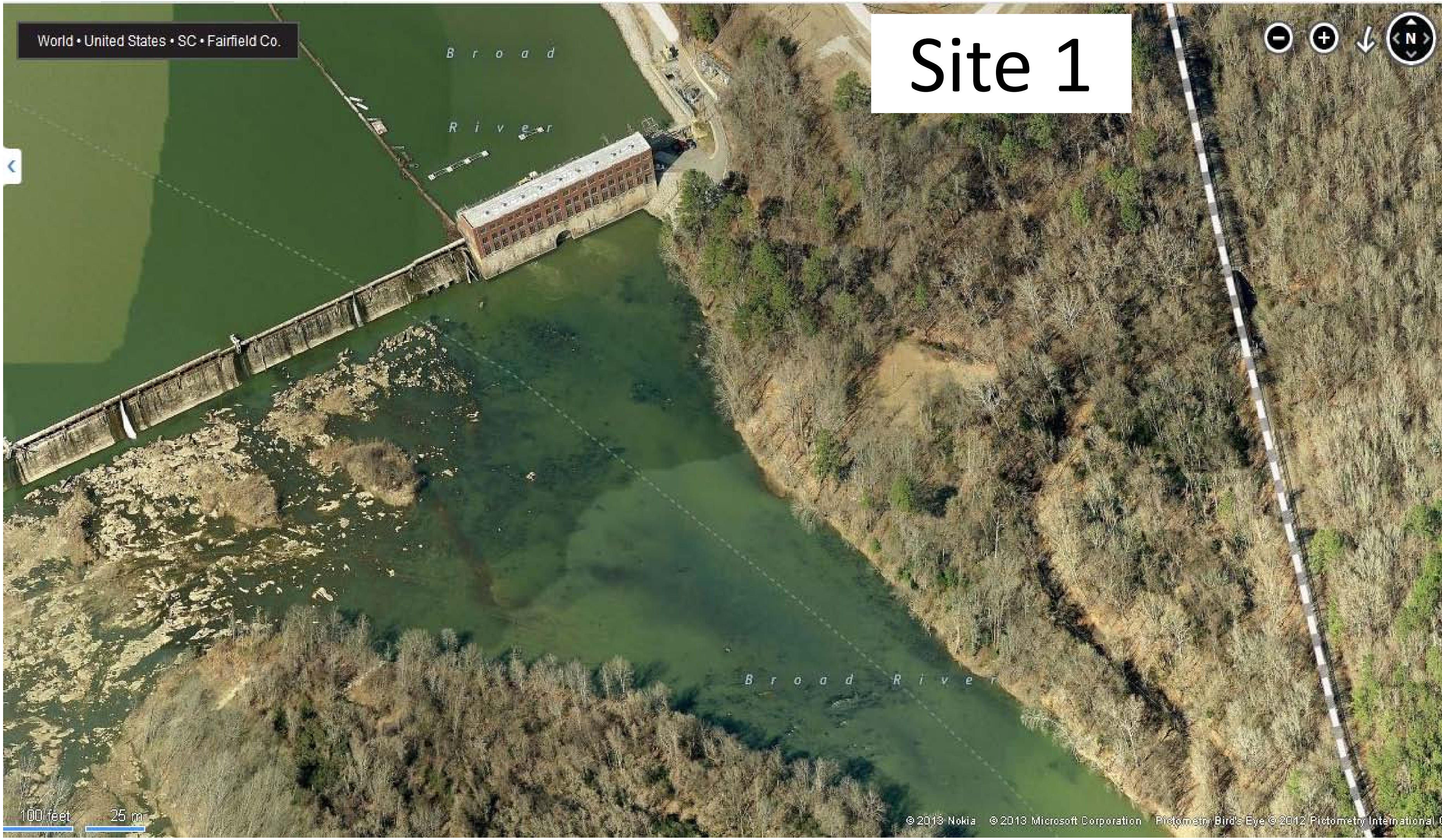
- Mid-channel gravel bars
- Dominated by medium - coarse gravel, 12-50 mm (0.5 – 2.0 in)
- < 30 % sand and minimal fine particles
- “small enough to be moved and allow egg deposition….yet large enough to provide interstitial space for eggs and larvae”

Robust Redhorse Spawning Habitat (Freeman and Freeman, 2001)

- Suitable water depth: 0.29 - 1.1 m (1 – 3.6 ft)
- Suitable average water column velocity: 0.26 - 0.67 m/s (0.85 – 2.20 ft/s)
- Interstitial flow thought to be very important, hence spawning in “heads of gravel-bottom riffle” (glides)



ns Island
Jenkinsville
State Rd S-20-60
State Rd S-20-294
Hinnants Store Rd
1
Hampton Island
Peak
Haltiwanger Island
Monticello Rd
215
Huffman Island
2
Hickory Island
Martin Rd
James F Byrnes Expy
176
Kennerly Rd
Old Tamah Rd
Chapin
76
© 2013 Google
White Rock
Imagery Date: 1/29/2012 34°12'07.81" N 81°14'31.25" W elev 255 ft eye alt 11.18 mi
Google earth

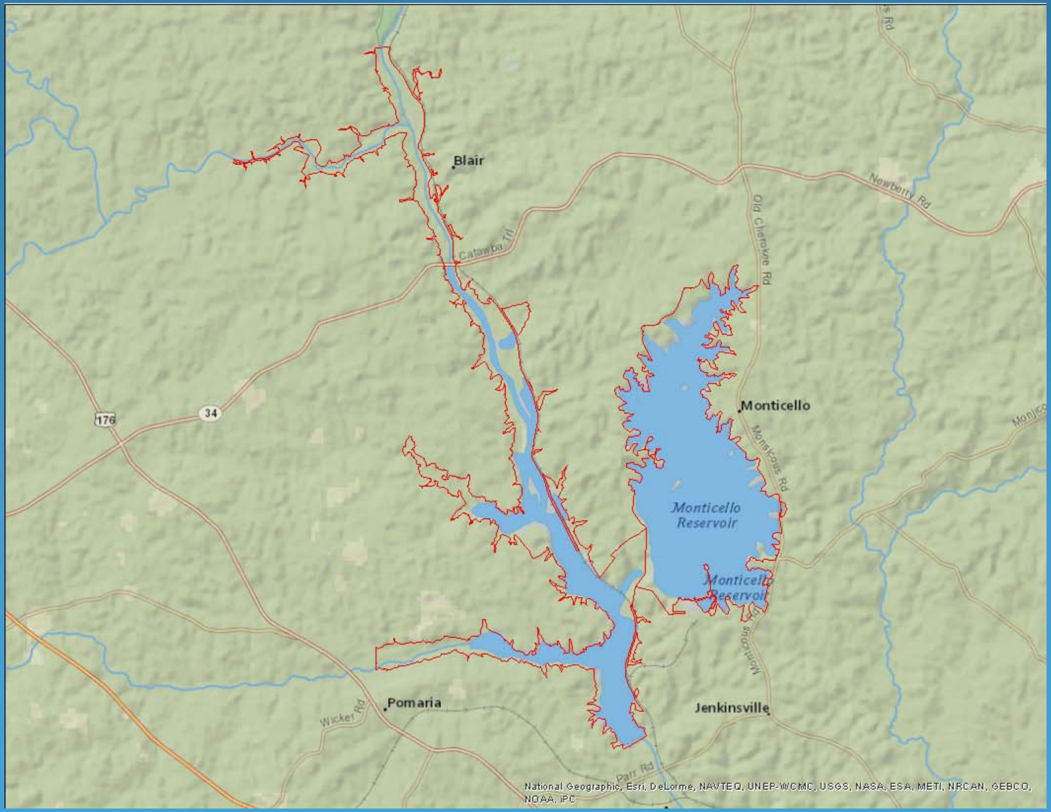

Site 1
World • United States • SC • Fairfield Co.
B r o a d
R i v e r
B r o a d R i v e r
100 feet
25 m
© 2013 Nokia © 2013 Microsoft Corporation Pictometry Bird's Eye © 2012 Pictometry International Co


World • United States • SC • Richland Co. • North Area
Site 2
Broad River
25 feet
10 m
© 2013 Microsoft Corporation Pictometry Bird's Eye © 2012 Pictometry International Corp


10/24/2013


10/24/2013

Reservoir Fluctuation at Parr and Monticello Reservoirs



Introduction

- Minimum reservoir pools create some dynamic riparian areas
- Public LiDAR data was studied to determine the surface area exposure resulting from reservoir fluctuation within the project boundary

Background

- Parr Reservoir water surface elevations resulting from the Fairfield Pump Storage System
  - Maximum pool elevation 266 ft
  - Minimum pool elevation 256 ft

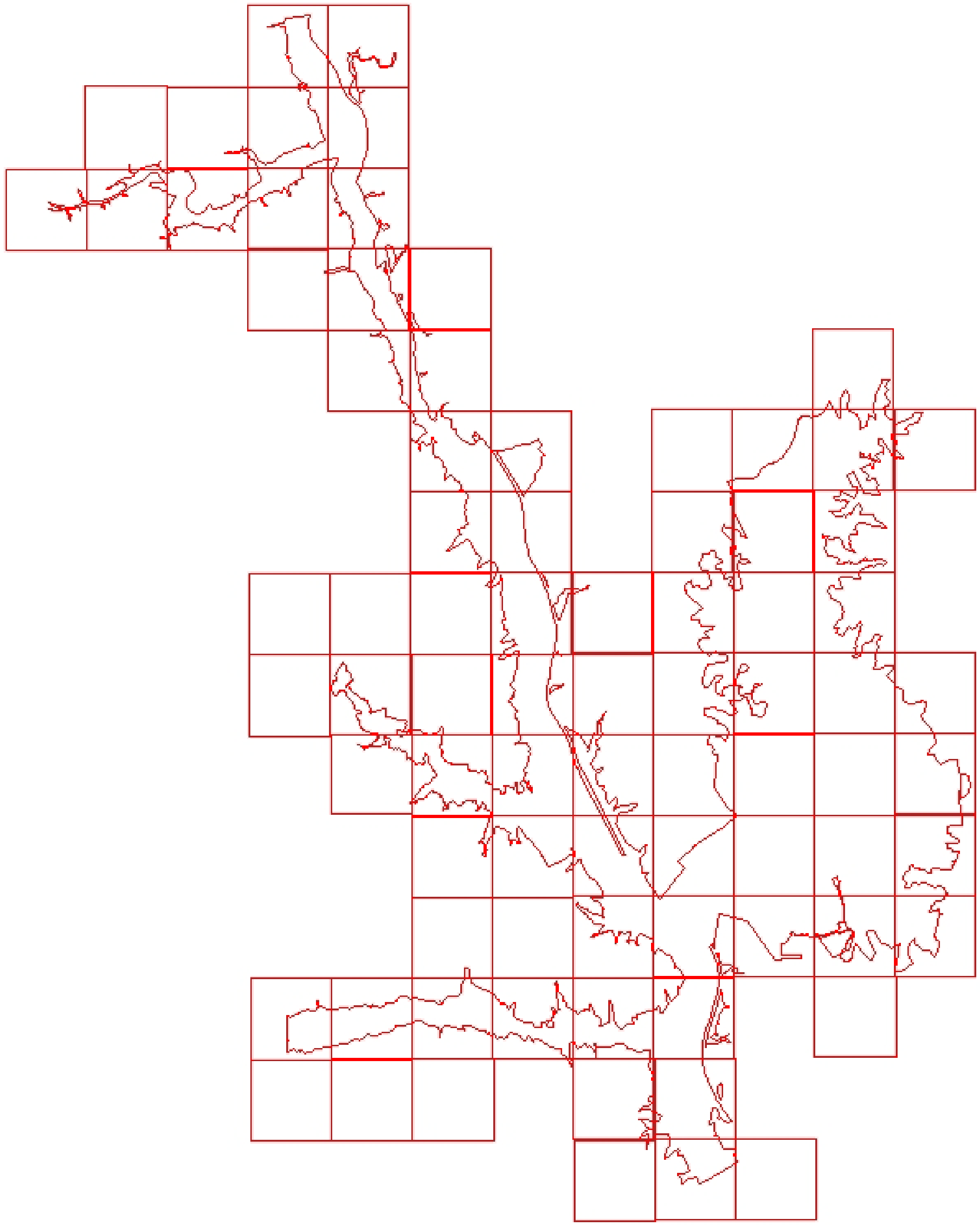
- Surface Area of Parr Reservoir – 4,400 acres
- Surface Area of Monticello Reservoir – 6,800 acres
- Total Surface Area of Both Reservoirs – 11,200 acres

Methods

- LiDAR point cloud data (.las) collected and verified for USGS by contractor Dewberry and subcontractor Fugro EarthData

- Collected from January, 15 2008 to February 10, 2008

- <2% error in dataset



Methods (cont'd)

- Las Dataset created in ArcMap 10.1 with project boundary as a surface constraint

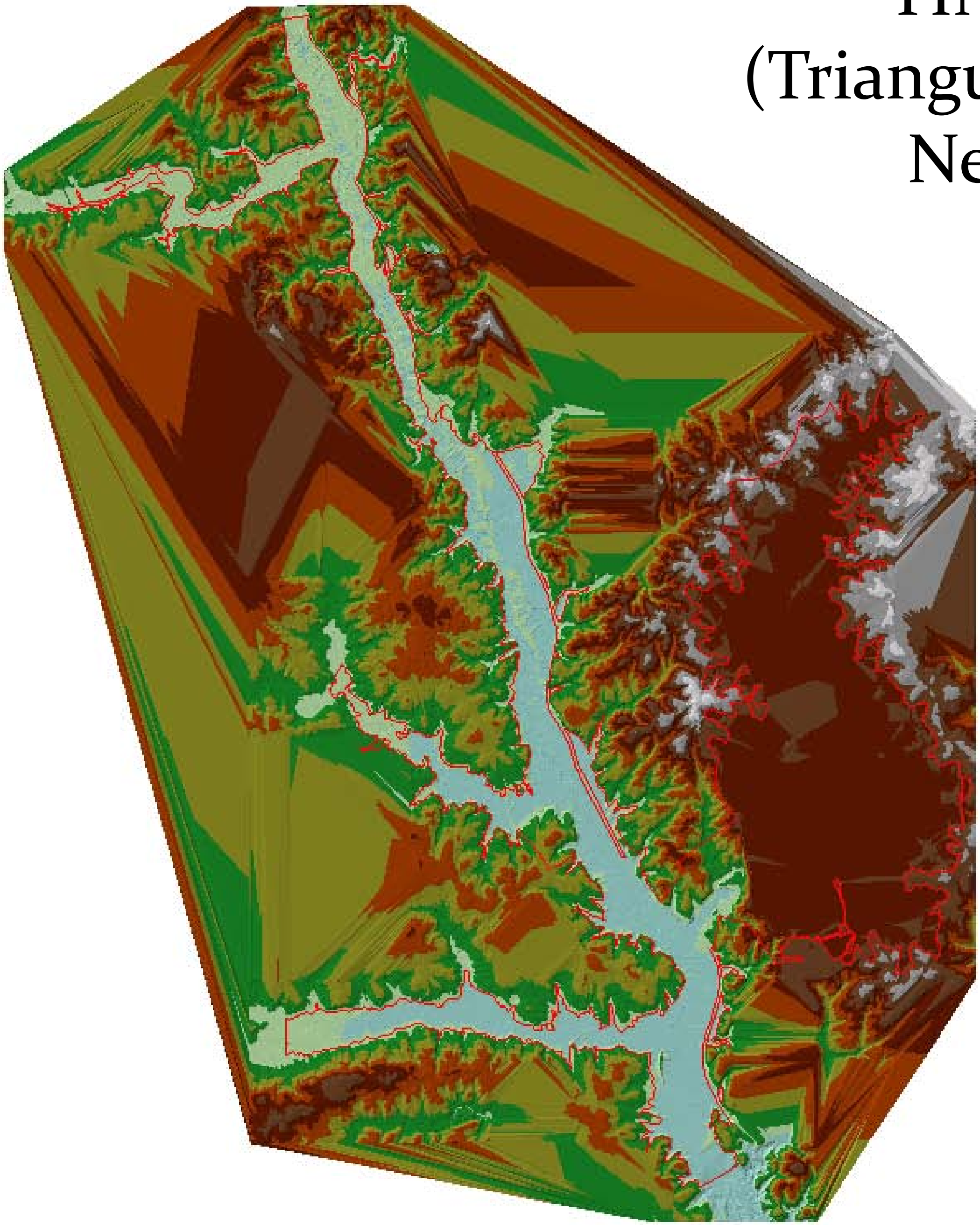
- Data conversion from Las to TIN
  - Surface Volume Functional tool to calculate surface area

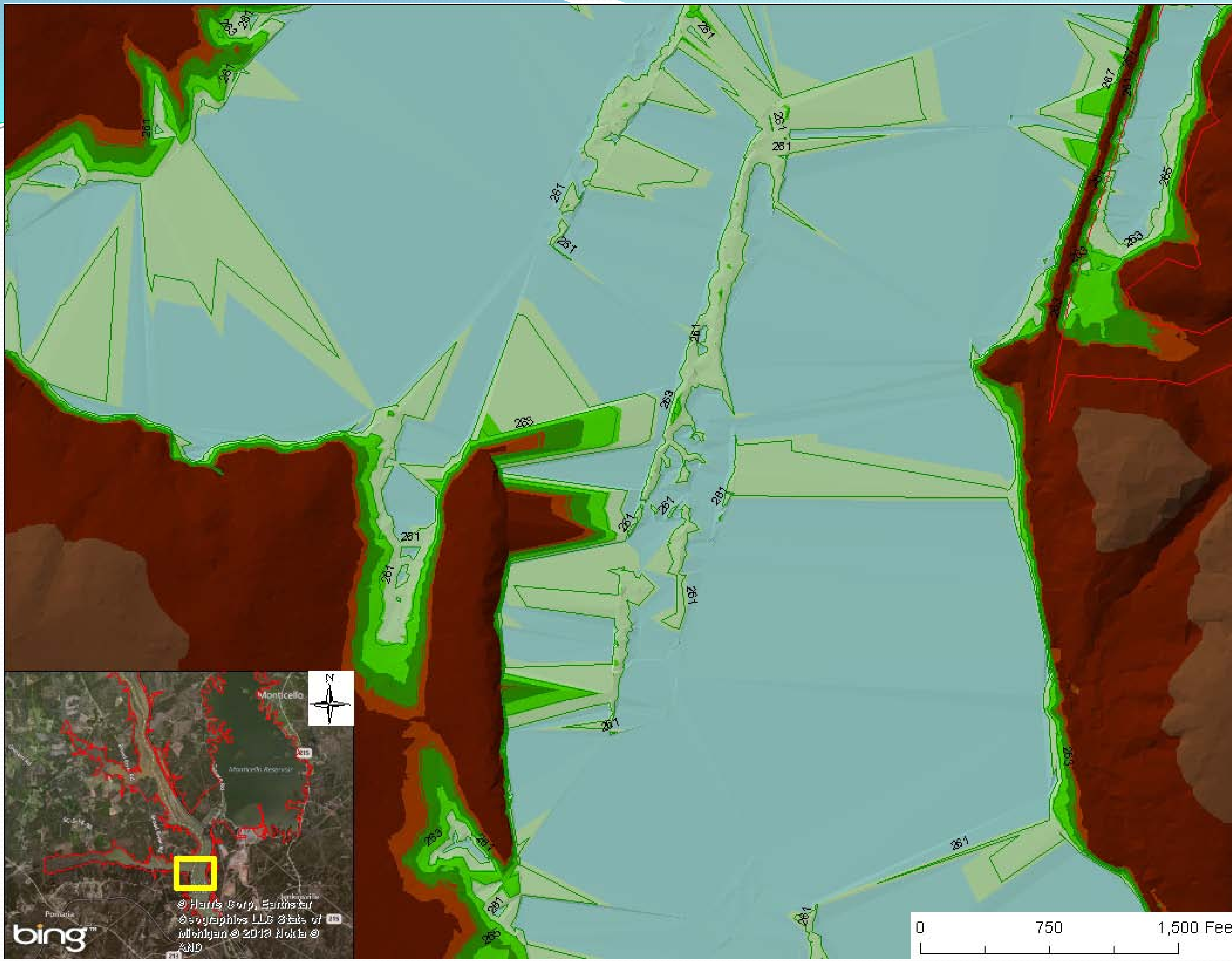
- TIN to Contours
  - Contours illustrate 2ft topographical elevations

Methods (cont'd)

- Areas of exposure were measured in 2ft increments of total acreage within the project boundary at Parr Reservoir
  - 267-265
  - 265-263
  - 263-261
  - 261-259
  - 267-259 (total)

TIN Model (Triangular Irregular Network)




281
283
285
Monticello
Monticello Reservoir
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© Harris Corp, Earthstar Geographics LLC State of Michigan © 2013 Nokia © AND
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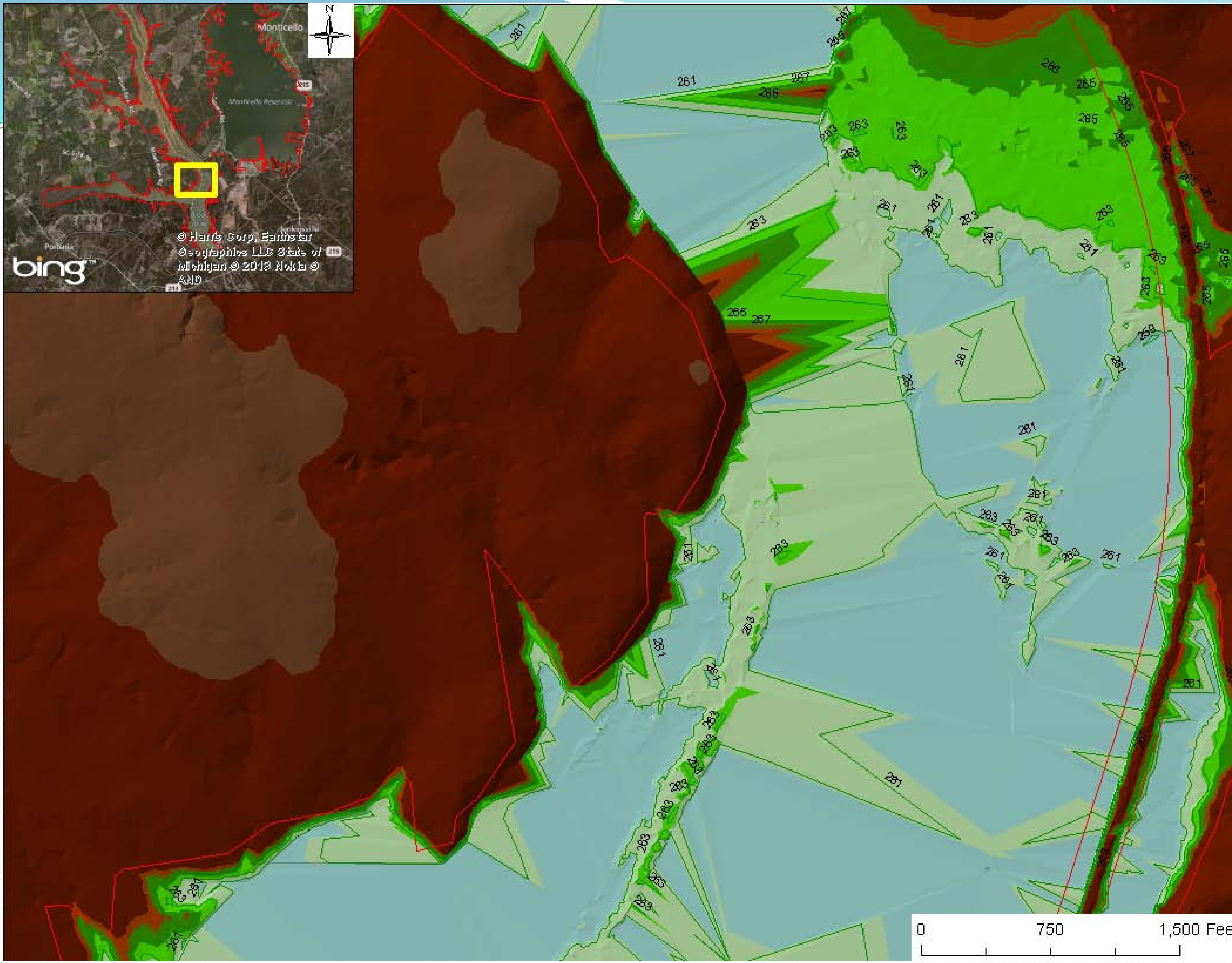

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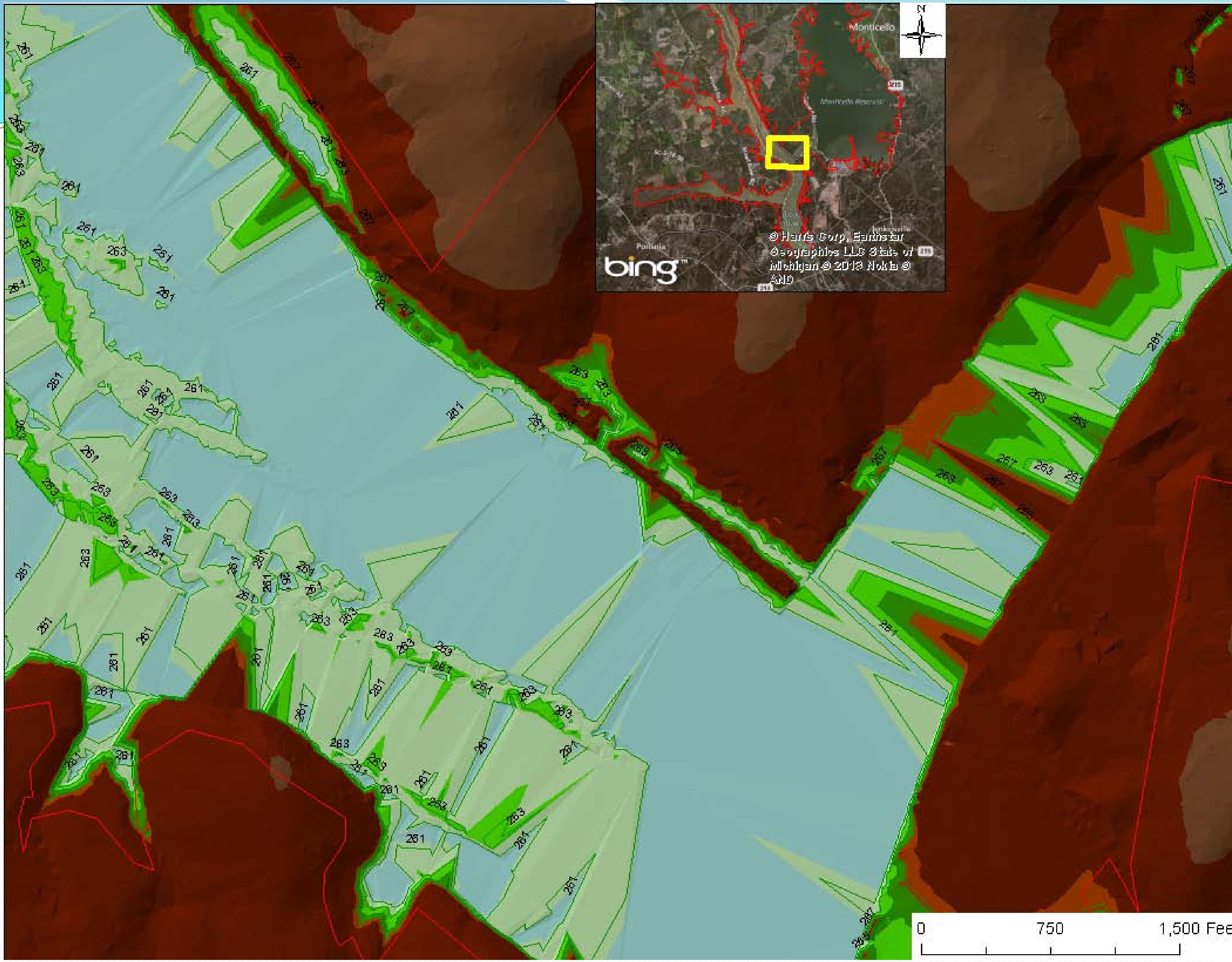

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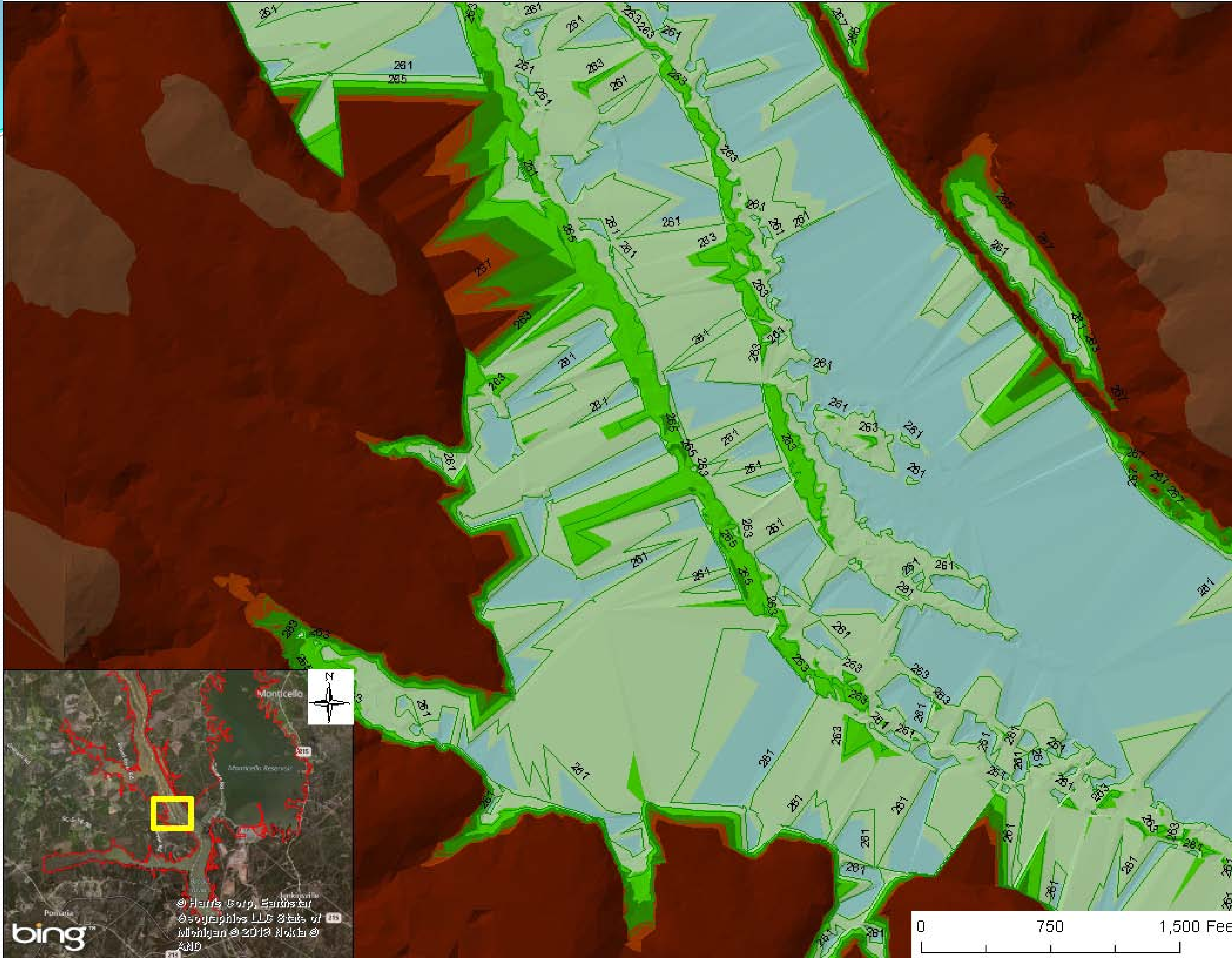
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Broad River
Broad River
261
263
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269
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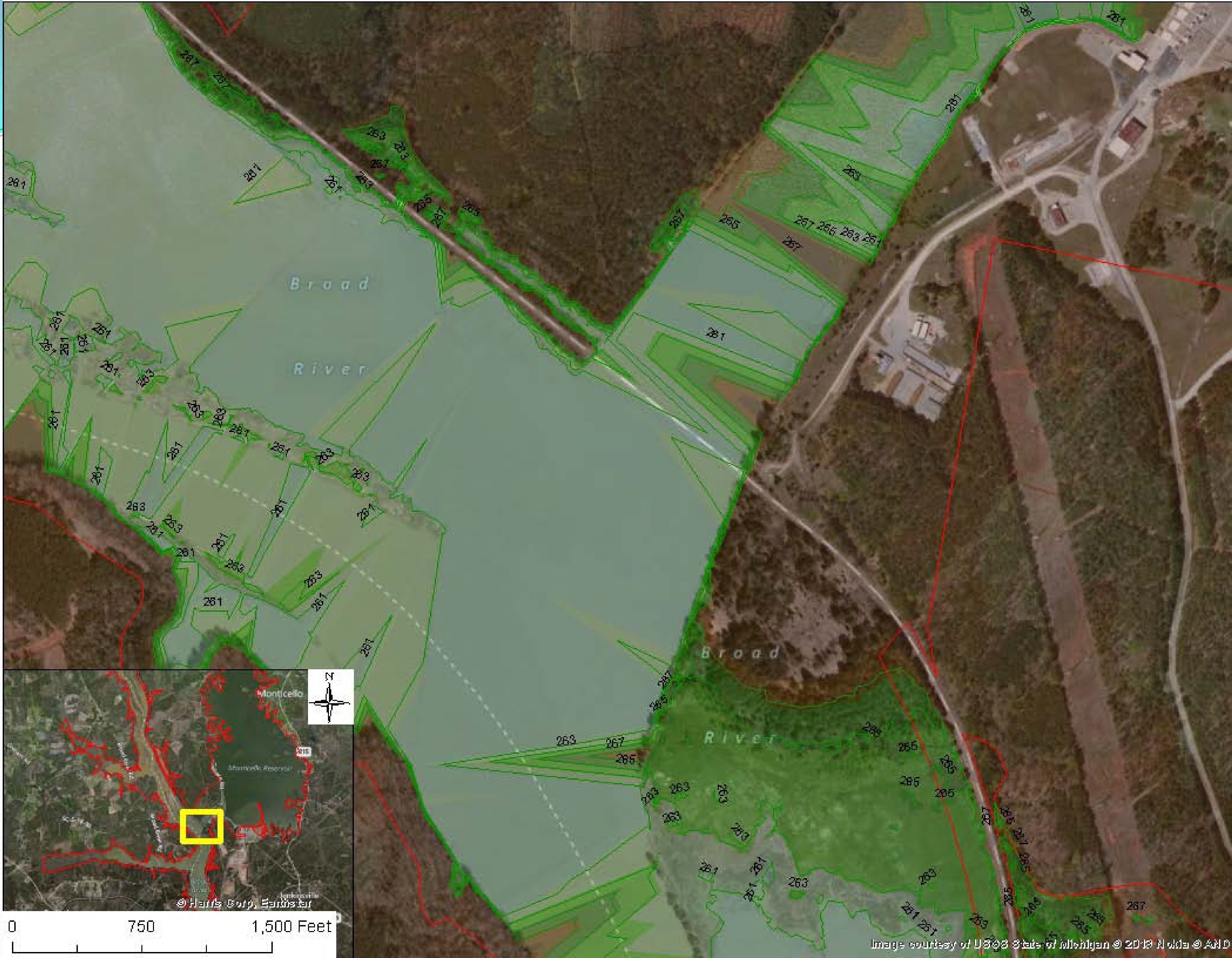

Broad River
Broad River
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George Buck Rd
Monticello
Monticello Reservoir
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© Harris Corp, Earthstar
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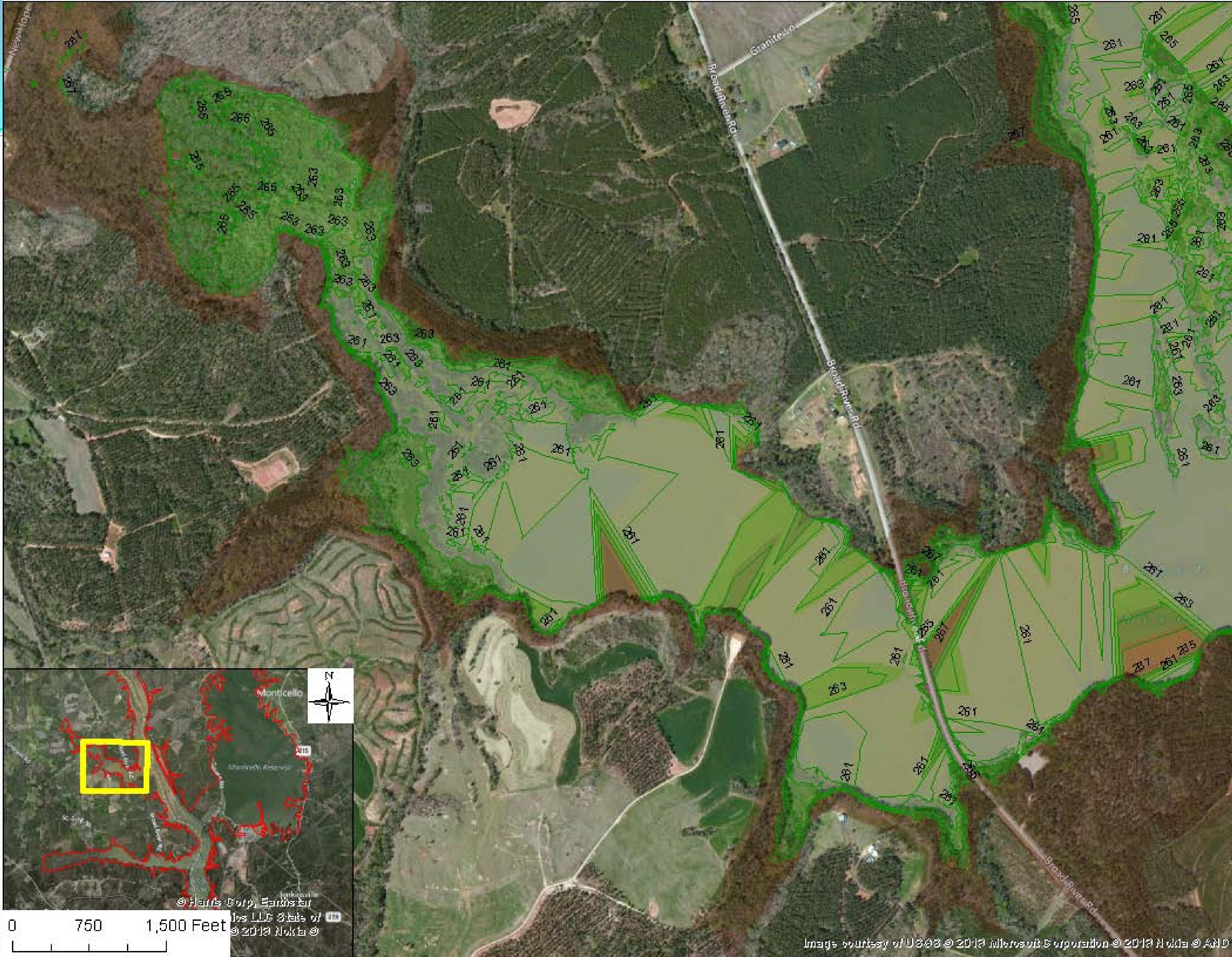
Image courtesy of USGS State of Michigan © 2013 Nokia © AND



Granite Ln
Broad River Rd
Monticello
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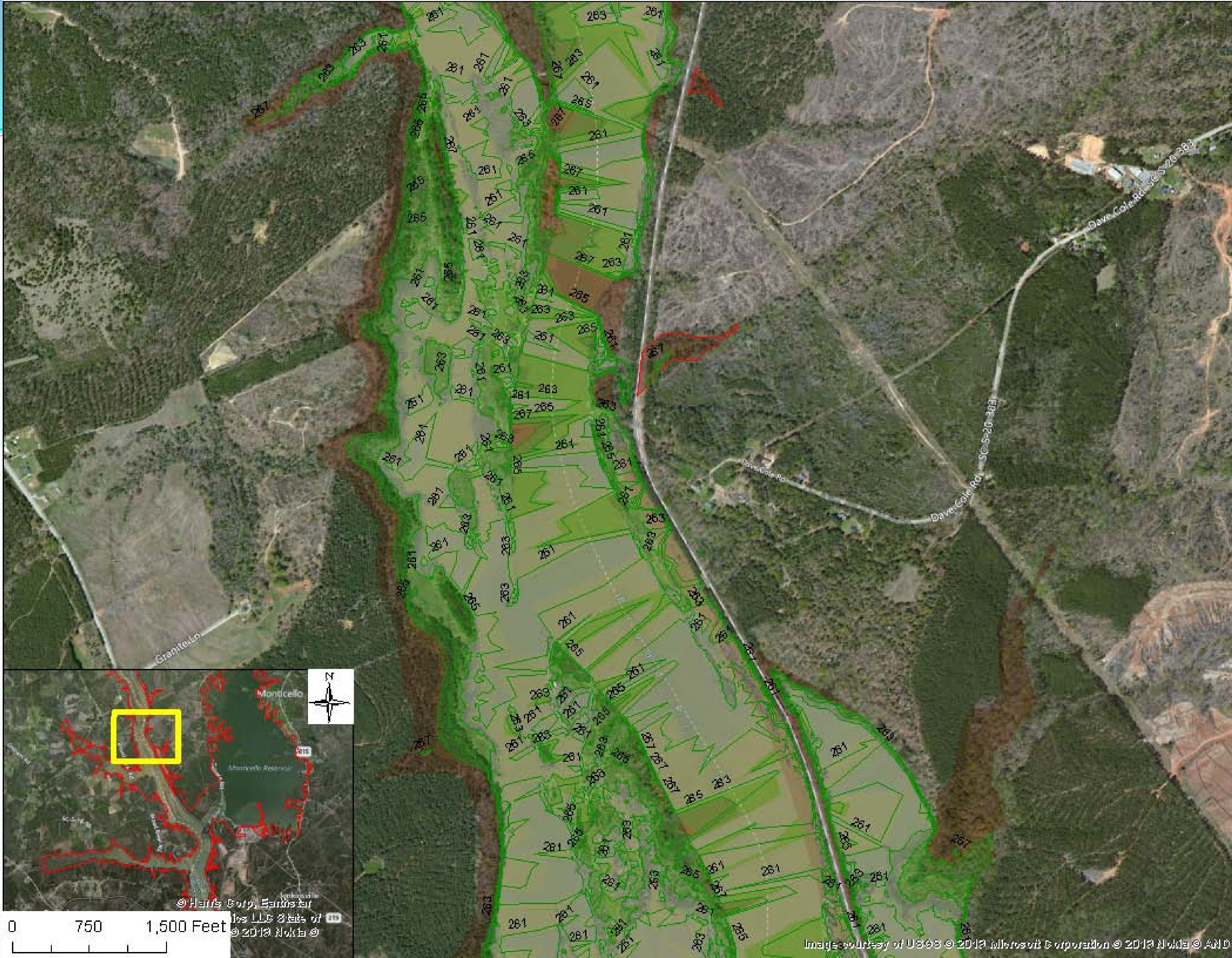

Dave Cole Rd
SC-S-20-383
Granite Ln
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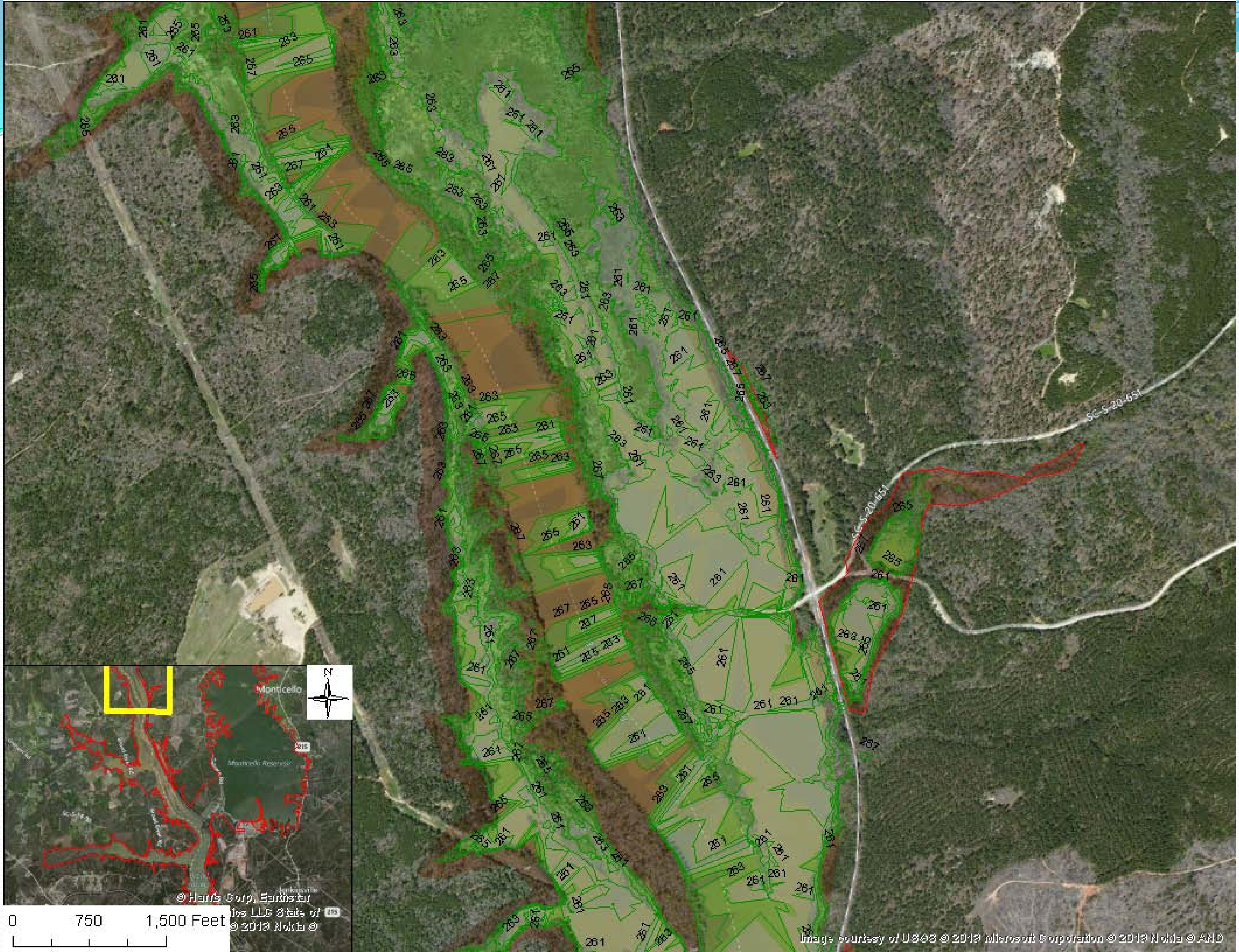
SC-S-20-651
Monticello
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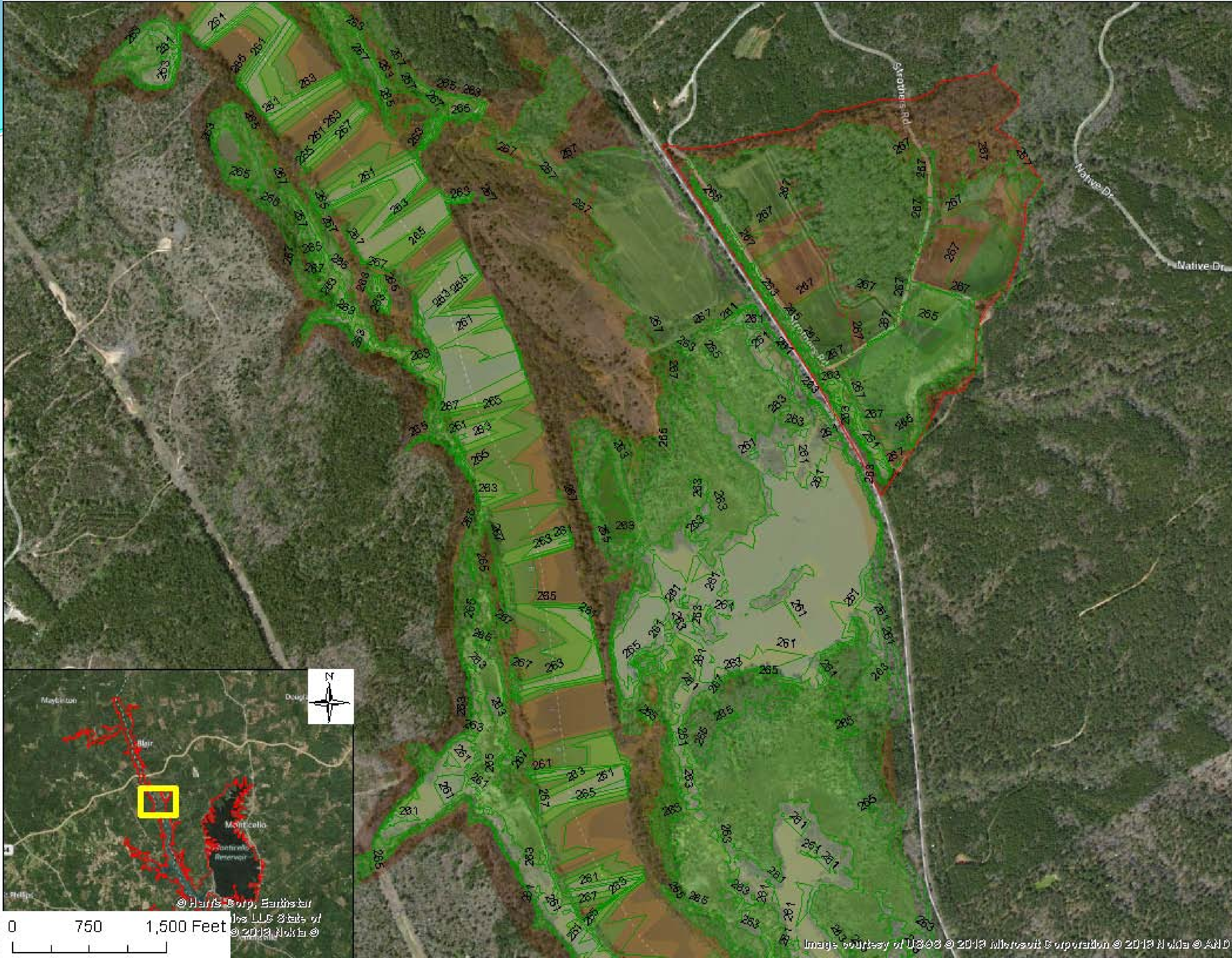
Strothers Rd
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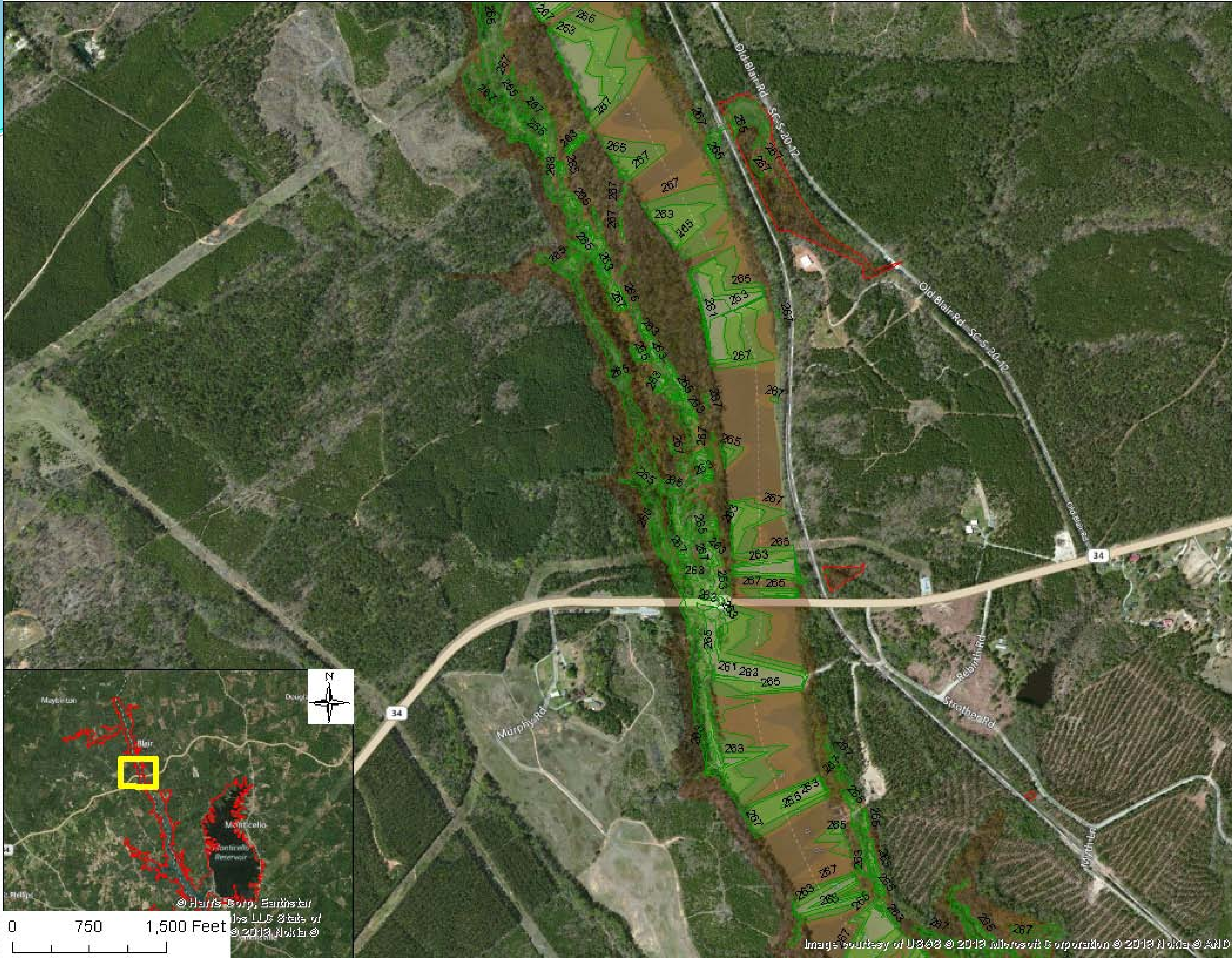

Old Blair Rd SC-S-20-12
Old Blair Rd SC-S-20-12
34
34
Murphy Rd
Rebirth Rd
Strother Rd
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Maybinton
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Monticello Reservoir
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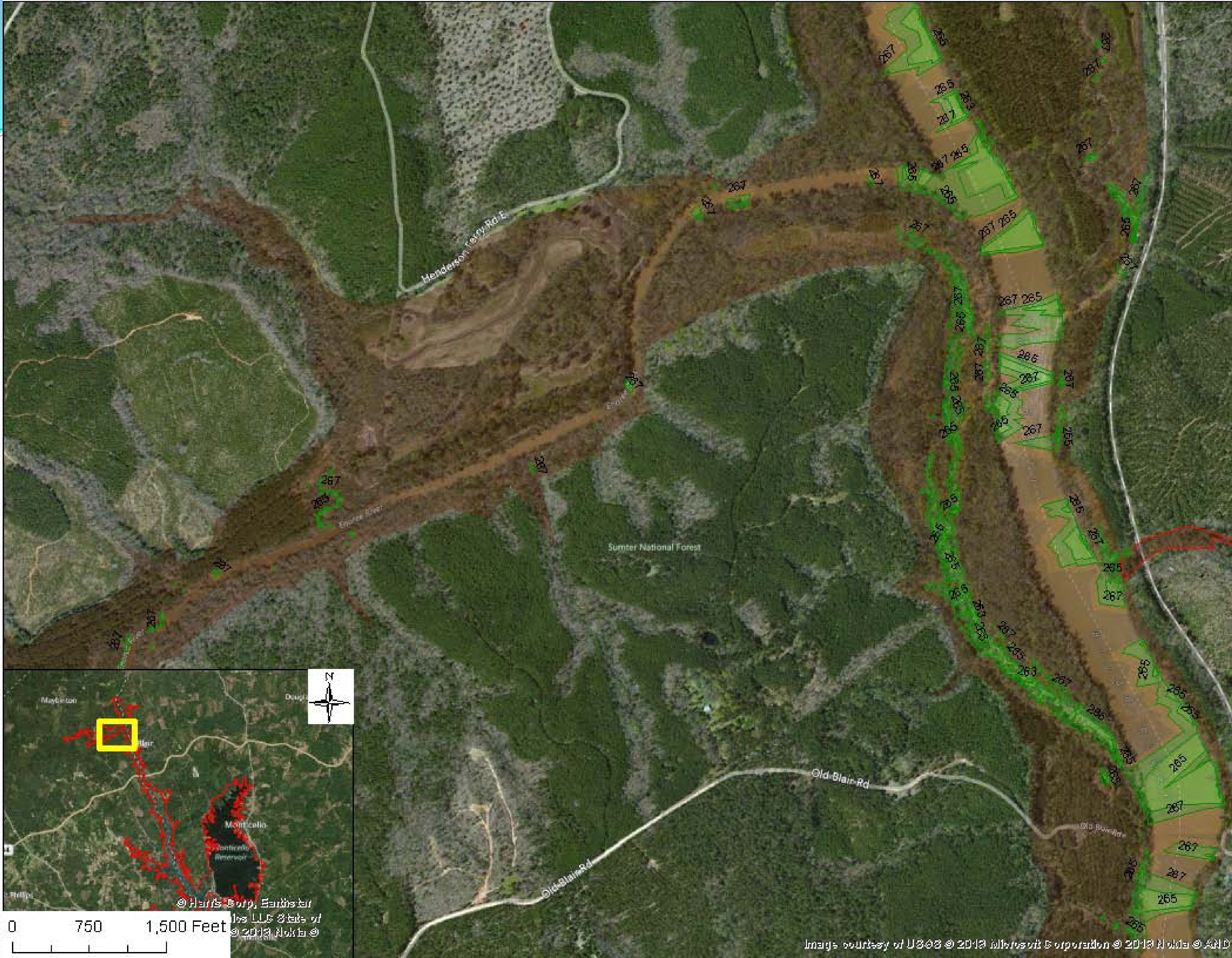
Image courtesy of USGS © 2013 Microsoft Corporation © 2013 Nokia © AND



Henderson Ferry Rd E
Enoree River
Sumter National Forest
Old Blair Rd
Old Blair Rd
Maybelton
Monticello
Monticello Reservoir
N
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Image courtesy of USGS © 2013 Microsoft Corporation © 2013 Nokia © AND

Parr Reservoir Results

Area between contours :

267-265 = 686 Acres

265-263 = 798 Acres

263-261 = 1,387 Acres

261-259 = 1,273 Acres

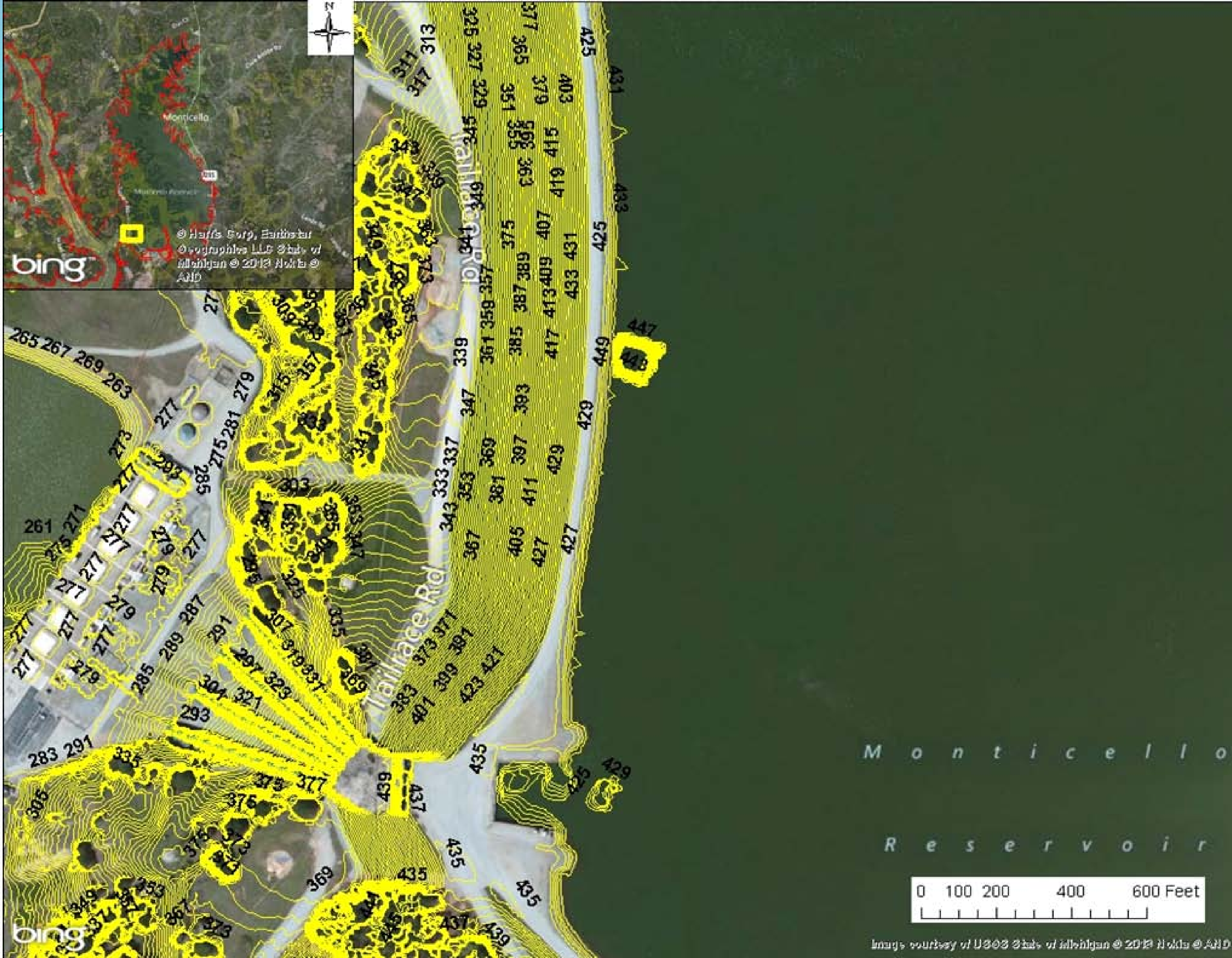
Total 267 - 259 = **4,143 Acres**

Percent of Parr Reservoir affected by Fluctuation

4,143/4,400 = **94.2%**

Results for Monticello Reservoir

- Elevations of the shoreline at 425 ft (full pool)


Monticello Reservoir
Tailrace Rd
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Tailrace Rd
Monticello Reservoir
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Image courtesy of USGS State of Michigan © 2013 Nokia © AND

Summary

- LiDAR data does not accurately depict Parr Reservoir bottom elevations
- Monticello Reservoir LiDAR extents are limited to full pool

Parr & Monticello Reservoir Fluctuation

Parr Hydroelectric Project Relicensing

Fisheries Technical Working Committee

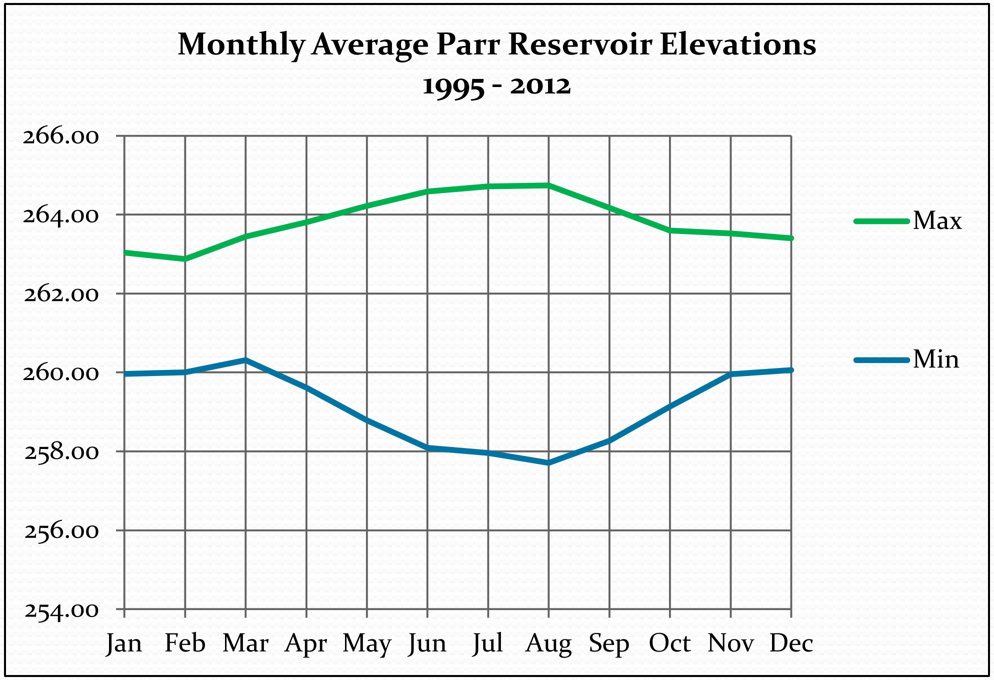
December 19,2013

Reservoir Data

- Daily minimum and maximum Parr Reservoir levels from USGS station 02160990, Parr Shoals Reservoir at Parr, SC; period of record 1995-2012.
- Daily minimum and maximum Monticello Reservoir levels from SCE&G data; period of record 2005-2012.

Parr Reservoir Monthly Data 1995-2012

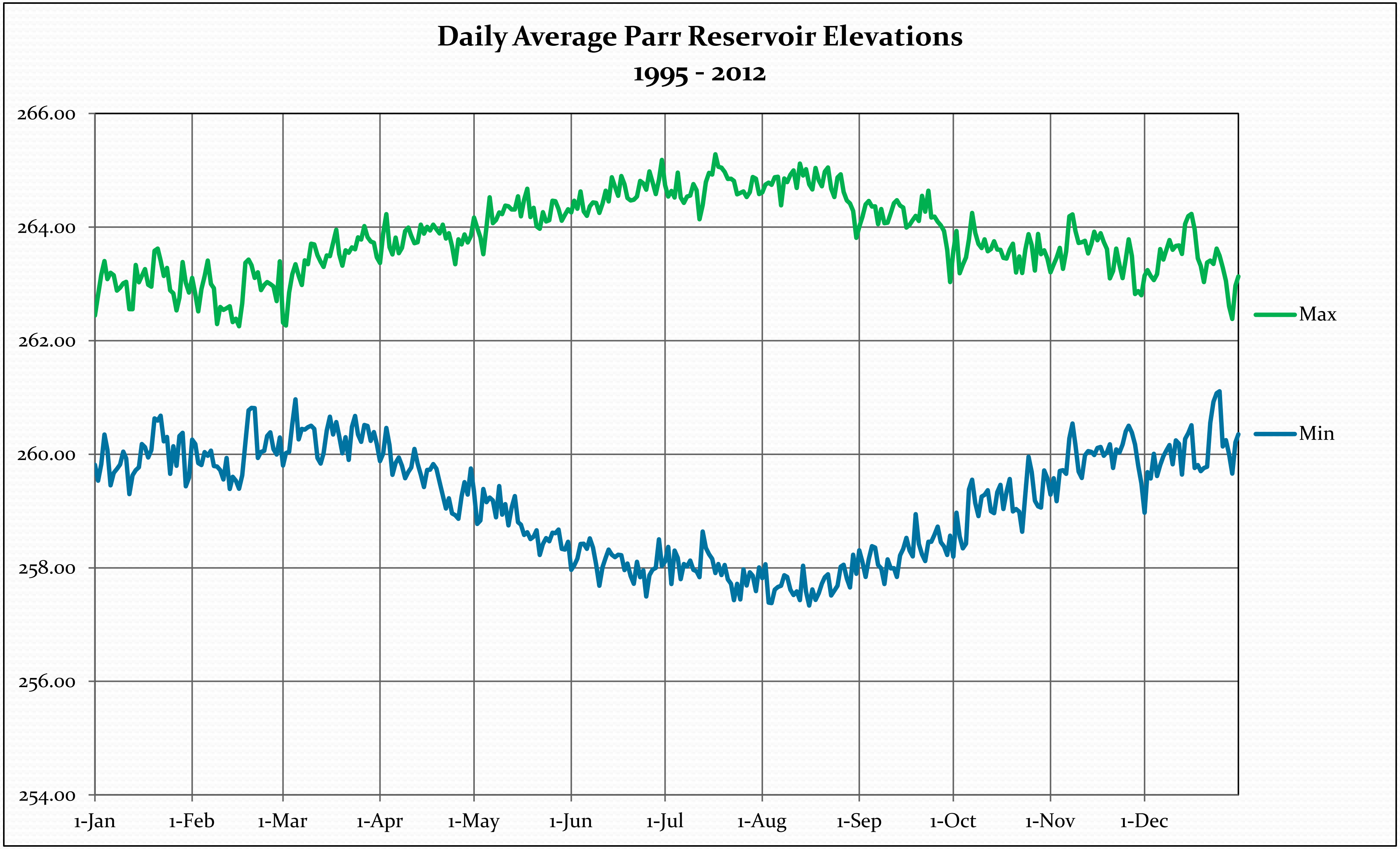
Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	263.04	259.96	3.08
Feb	262.88	260.01	2.87
Mar	263.44	260.32	3.13
Apr	263.81	259.61	4.20
May	264.22	258.79	5.43
Jun	264.59	258.09	6.49
Jul	264.72	257.96	6.75
Aug	264.74	257.71	7.03
Sep	264.17	258.27	5.90
Oct	263.60	259.14	4.46
Nov	263.53	259.96	3.57
Dec	263.41	260.06	3.34
Average	**263.84**	**259.16**	**4.69**



Parr Reservoir Average Daily Fluctuation 1995-2012

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.63	2.85	2.51	3.49	4.83	6.29	6.63	6.80	5.69	5.38	3.92	4.17
2	3.27	2.64	2.25	3.87	5.21	6.42	6.17	6.69	6.08	4.96	3.76	3.56
3	3.33	2.67	2.80	3.77	4.99	6.16	6.92	7.39	6.56	4.63	4.29	3.56
4	3.06	3.10	2.64	3.49	4.13	6.21	6.22	7.37	6.31	5.00	3.93	3.06
5	3.00	3.10	2.38	3.88	4.85	5.85	6.79	7.26	5.98	5.04	3.55	3.55
6	3.74	3.44	2.89	3.97	5.29	5.86	6.72	7.23	6.01	4.41	3.92	3.81
7	3.48	2.93	2.53	3.60	4.89	5.85	6.36	6.70	6.01	4.70	3.91	3.46
8	3.14	3.13	2.98	3.84	5.23	6.08	6.52	6.99	6.33	4.76	3.68	3.53
9	3.11	2.51	2.87	4.35	4.82	6.37	6.43	6.95	6.35	4.79	3.77	3.61
10	2.97	2.87	3.20	4.30	5.29	6.56	6.80	7.31	5.93	4.38	4.03	3.78
11	3.11	2.99	3.25	4.08	5.26	6.40	6.71	7.48	6.25	4.50	4.16	3.43
12	3.26	2.64	3.57	3.62	5.62	6.46	6.30	7.10	6.43	4.21	3.78	3.50
13	2.92	3.22	3.55	3.90	5.25	6.13	5.75	7.69	6.63	4.61	3.48	3.88
14	3.61	2.72	3.28	4.40	5.05	6.65	6.44	6.87	6.16	4.79	3.66	3.79
15	3.26	2.85	3.09	4.46	5.74	6.52	6.72	7.44	6.01	4.27	3.94	3.82
16	2.96	2.86	2.83	4.28	5.43	6.32	6.77	7.42	5.46	4.14	3.66	3.72
17	3.14	3.03	3.37	4.21	5.90	6.68	7.38	7.05	5.74	4.42	3.76	4.20
18	3.04	3.17	3.39	4.22	6.05	6.79	7.00	7.60	5.92	4.10	3.77	3.64
19	2.88	2.65	3.21	4.22	5.67	6.44	7.17	7.28	5.25	4.04	3.58	3.61
20	2.95	2.51	3.30	4.38	5.79	6.61	6.92	6.99	5.69	4.72	2.92	3.28
21	3.03	2.30	3.29	4.77	5.35	6.76	7.05	7.14	6.32	4.16	3.47	3.60
22	2.73	3.27	3.65	4.75	5.74	6.43	7.13	7.17	6.15	4.50	3.53	2.86
23	2.91	2.85	3.16	4.67	5.84	6.98	7.39	7.16	6.18	4.56	3.31	2.42
24	2.98	2.92	2.93	4.71	5.57	6.82	6.86	6.93	5.71	4.31	2.93	2.55
25	3.23	2.71	3.47	4.42	5.65	7.16	7.16	7.19	5.60	3.92	3.04	2.39
26	2.69	2.61	3.56	4.92	5.85	7.11	6.66	6.91	5.37	4.00	3.28	3.16
27	2.74	2.86	3.50	4.44	5.85	6.82	6.84	6.56	5.58	4.05	3.11	2.81
28	2.44	2.70	3.32	4.36	5.65	6.58	6.70	6.66	5.55	4.80	2.65	2.61
29	3.01	3.11	3.51	4.44	5.78	6.34	7.03	6.76	5.38	4.46	3.08	2.72
30	3.59		3.34	4.09	5.90	7.15	7.26	6.05	4.47	3.88	3.31	2.76
31	3.26		3.29		5.86		6.57	5.92		3.87		2.78
Average	**3.08**	**2.87**	**3.13**	**4.20**	**5.43**	**6.49**	**6.75**	**7.03**	**5.90**	**4.46**	**3.57**	**3.34**

Parr Reservoir Daily Data 1995-2012

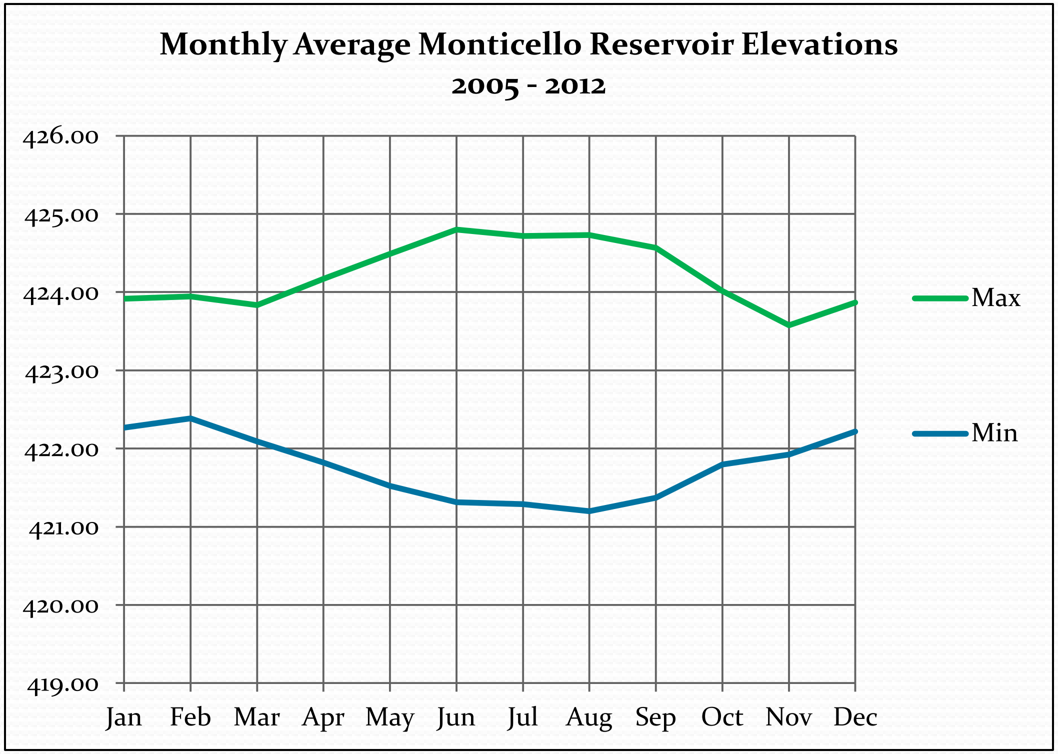


Parr Reservoir Summary

- February has smallest average fluctuation – 2.87 feet.
- August has largest average fluctuation – 7.03 feet.
- Average fluctuation for year is 4.69 feet.
- Average fluctuation March – May is 4.25 feet.
- Average fluctuation April – July is 5.72 feet.

Monticello Reservoir Monthly Data 2005-2012

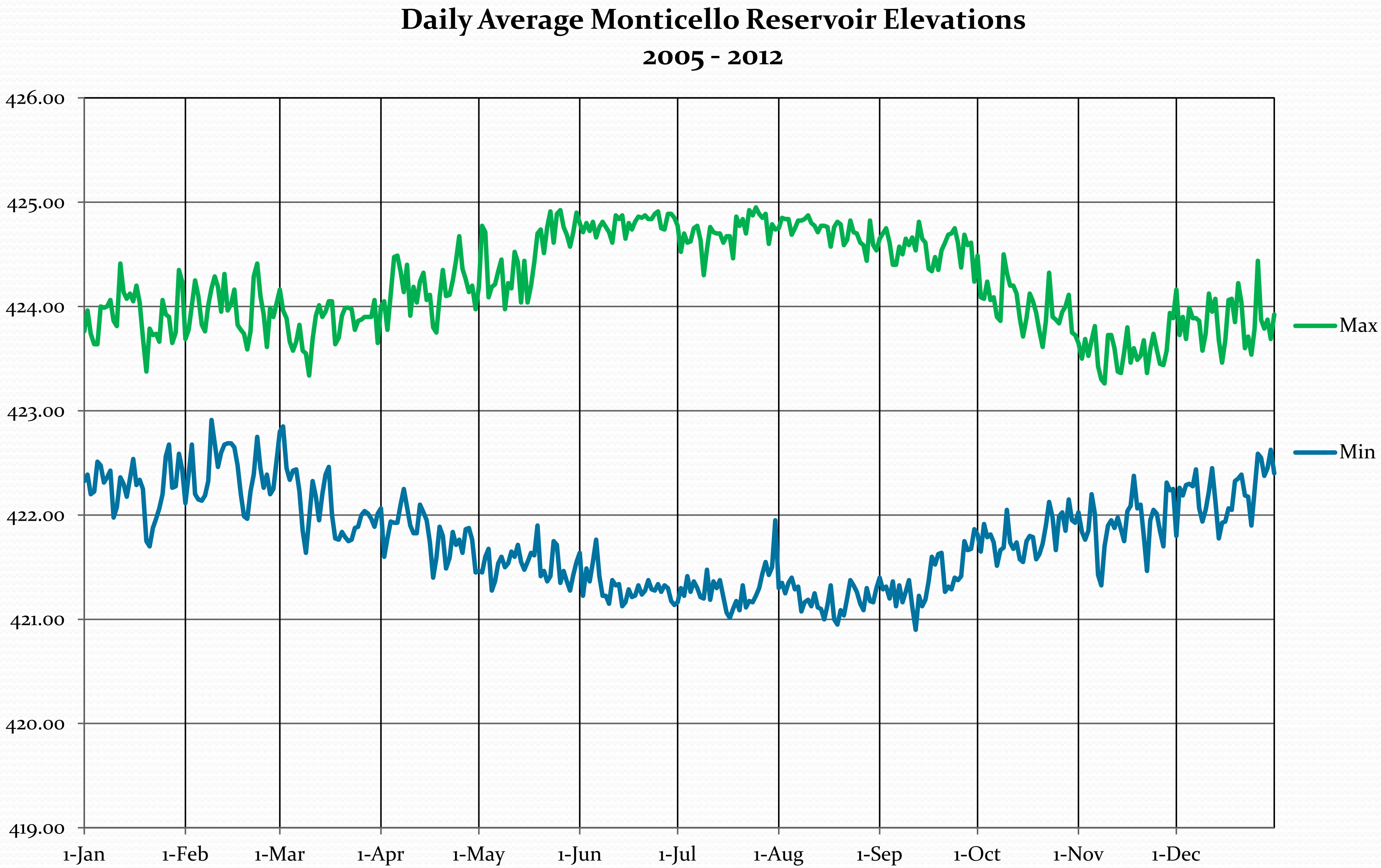
Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	423.91	422.27	1.65
Feb	423.94	422.39	1.58
Mar	423.84	422.09	1.74
Apr	424.17	421.82	2.35
May	424.49	421.52	2.96
Jun	424.80	421.31	3.48
Jul	424.72	421.29	3.43
Aug	424.73	421.20	3.53
Sep	424.57	421.37	3.20
Oct	424.01	421.80	2.22
Nov	423.58	421.92	1.65
Dec	423.87	422.22	1.65
Average	**424.22**	**421.77**	**2.45**



Monticello Reservoir Average Daily Fluctuation 2005-2012

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.44	1.57	1.36	1.94	2.73	3.16	3.61	3.45	3.25	2.68	1.62	2.36
2	1.57	1.39	1.11	2.45	3.33	3.49	3.22	3.50	3.41	2.44	1.66	1.46
3	1.54	1.34	1.44	2.00	3.11	3.31	3.48	3.59	3.44	2.16	1.93	1.71
4	1.41	2.05	1.32	2.18	2.41	3.36	3.20	3.49	3.41	2.45	1.67	1.40
5	1.12	1.95	1.15	2.55	2.91	3.26	3.36	3.29	3.04	2.25	1.47	1.69
6	1.52	1.69	1.22	2.56	2.85	2.90	3.39	3.46	3.27	2.35	1.80	1.61
7	1.68	1.58	1.60	2.24	2.80	3.35	3.48	3.51	3.25	2.39	2.00	1.45
8	1.64	1.69	1.73	1.89	2.85	3.59	3.43	3.75	3.34	2.20	1.97	1.80
9	1.64	1.26	1.91	2.32	2.47	3.54	3.10	3.68	3.39	2.81	1.56	1.64
10	1.89	1.60	1.38	2.01	2.69	3.56	3.07	3.69	3.21	2.27	1.82	1.69
11	1.74	1.73	1.36	2.36	2.52	3.24	3.58	3.68	3.54	2.46	1.78	1.90
12	2.05	1.35	1.74	2.21	2.92	3.55	3.35	3.52	3.64	2.52	1.73	1.50
13	1.84	1.64	2.06	2.14	2.71	3.50	3.40	3.60	3.59	2.39	1.40	1.94
14	1.90	1.27	1.70	2.30	2.49	3.75	3.33	3.67	3.52	2.31	1.50	1.90
15	1.78	1.34	1.56	2.11	2.96	3.49	3.40	3.78	3.43	2.16	1.81	1.54
16	1.51	1.51	1.59	2.38	2.49	3.51	3.61	3.63	3.00	2.14	1.76	1.74
17	1.91	1.35	2.05	2.40	2.56	3.53	3.66	3.25	2.74	2.32	1.38	2.00
18	1.70	1.57	1.86	2.16	2.81	3.59	3.36	3.76	2.95	2.26	1.22	2.03
19	1.45	1.75	1.94	2.20	2.80	3.54	3.69	3.86	2.73	2.36	1.42	1.53
20	1.63	1.62	2.07	2.55	3.32	3.61	3.69	3.70	2.90	2.14	1.43	1.87
21	2.09	1.54	2.20	2.61	3.05	3.60	3.51	3.55	3.35	1.89	1.87	1.65
22	1.85	1.90	2.24	2.53	3.40	3.46	3.59	3.44	3.38	1.96	1.90	1.41
23	1.78	1.66	2.21	2.41	3.50	3.55	3.75	3.45	3.41	2.20	1.64	1.54
24	1.60	1.65	1.90	2.72	2.86	3.61	3.71	3.39	3.35	1.93	1.69	1.64
25	1.86	1.66	1.98	2.91	3.18	3.57	3.73	3.44	3.24	2.21	1.58	1.55
26	1.36	1.23	1.88	2.73	3.57	3.49	3.59	3.46	2.96	1.85	1.60	1.85
27	1.23	1.79	1.86	2.40	3.30	3.41	3.41	3.50	2.94	1.93	1.74	1.33
28	1.39	1.65	1.89	2.26	3.32	3.59	3.34	3.14	2.93	2.15	1.26	1.41
29	1.48		1.94	2.44	3.30	3.71	3.17	3.65	2.94	1.96	1.70	1.43
30	1.76		2.18	2.53	3.29	3.71	3.29	3.43	2.38	1.80	1.64	1.06
31	1.80		1.64		3.35		2.79	3.24		1.80		1.53
Average	**1.65**	**1.58**	**1.74**	**2.35**	**2.96**	**3.48**	**3.43**	**3.53**	**3.20**	**2.22**	**1.65**	**1.65**

Monticello Reservoir Daily Data 2005-2012



Monticello Reservoir Summary

- February has smallest average fluctuation – 1.58 feet.
- August has largest average fluctuation – 3.53 feet.
- Average fluctuation for year is 2.46 feet.
- Average fluctuation March – May is 2.35 feet.
- Average fluctuation April – July is 3.06 feet.

DRAFT
DESKTOP FISH ENTRAINMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

October 2013

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. Collaboration and cooperation is essential in the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) comprised of interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The TWC determined that a desktop fish entrainment and mortality study should be conducted to determine the likely effects of Project-induced entrainment and impingement based on the physical characteristics of the Project. This study plan outlines the process for a desktop analysis.

2.0 BACKGROUND AND EXISTING INFORMATION

As noted, the Project is comprised of two developments. The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates continuously to pass Broad River flow. Current minimum flow license articles require that 1,000 cubic feet-per-second (cfs), or average daily natural inflow to Parr Reservoir[1], whichever is less, be provided downstream of Parr Dam from March through May. During the remainder of the year, 800 cfs daily average flow and 150 cfs minimum flow, or natural inflow, whichever is less, are required downstream of the Parr Dam. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations at the Fairfield Pumped Storage Development.

The Fairfield Pumped Storage Development is located directly off of the Broad River. Four earthen dams form the 6,800-acre upper reservoir, Monticello Reservoir. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

The Project area supports warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent survey work within the Project area has documented 30 species of fish occurring in Parr Reservoir and 24 species in Monticello Reservoir (Table 1). Although some seasonal variations in community structure have been documented, the fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch being the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). No state or federally listed threatened or endangered species have been documented in Monticello or Parr reservoirs, although robust redhorse, which is considered a

[1] Evaporative loss from Parr and Monticello Reservoirs is subtracted from average daily natural inflow to determine flows downstream of Parr Dam.

species of highest conservation concern by the SCDNR (2005), has been documented in limited[2] numbers in both reservoirs.

TABLE 1 FISH SPECIES DOCUMENTED AT PARR AND MONTICELLO RESERVOIRS (SOURCE: NORMANDEAU 2007, 2008, 2009; SCANA 2013)

COMMON NAME	SCIENTIFIC NAME	PARR	MONTICELLO
black crappie	*Pomoxis nigromaculatus*	x	x
blue catfish	*Ictalurus furcatus*	x	x
bluegill	*Lepomis macrochirus*	x	x
channel catfish	*Ictalurus punctatus*	x	x
flat bullhead	*Ameiurus platycephalus*	x	x
flathead catfish	*Pylodictis olivaris*	x	
gizzard shad	*Dorosoma cepedianum*	x	x
golden shiner	*Notemigonus chrysoleucas*	x	x
highfin carpsucker	*Carpiodes velifer*	x	
largemouth bass	*Micropterus salmoides*	x	x
longnose gar	*Lepisosteus osseus*	x	
northern hogsucker	*Hypentelium nigricans*	x	x
notchlip redhorse	*Moxostoma collapsum*	x	x
pumpkinseed	*Lepomis gibbosus*	x	x
quillback	*Carpiodes cyprinus*	x	x
redbreast sunfish	*Lepomis auritus*	x	x
redear sunfish	*Lepomis microlophus*	x	x
robust redhorse	*Moxostoma robustum*	x	x
sandbar shiner	*Notropis scepticus*	x	
shorthead redhorse	*Moxostoma macrolepidotum*	x	x
smallmouth bass	*Micropterus dolomieu*	x	x
snail bullhead	*Ameiurus brunneus*		x
spottail shiner	*Notropis hudsonius*	x	x
threadfin shad	*Dorosoma petenense*	x	x
warmouth	*Lepomis gulosus*	x	
white bass	*Morone chrysops*	x	
white catfish	*Ameiurus catus*	x	x
white perch	*Morone americana*	x	x
whitefin shiner	*Cyprinella nivea*	x	x
yellow bullhead	*Amierus natalis*	x	x
yellow perch	*Perca flavescens*	x	x

[2] To date, 2 robust redhorse have been documented in Monticello Reservoir and 3 robust redhorse have been documented in Parr Reservoir.

3.0 STUDY GOALS AND OBJECTIVES

The goal of the desktop fish entrainment and mortality study is to develop additional information necessary to estimate potential fish entrainment and impingement at the Project. This will provide a basis for understanding the effects of entrainment, impingement and turbine mortality on fisheries resources in the Project area. The study objective is to characterize and provide an order-of-magnitude estimate of entrainment at both developments using existing literature and site-specific information.

4.0 PROJECT NEXUS

Fish that reside in the Project area could be susceptible to impingement on the Project trashracks or entrainment through the Project turbines. Evaluation of the physical characteristics of each Project development along with an evaluation of expected fish behavior at the intake structures utilizing existing information will help in the understanding of the potential for continued Project operations to affect the fishery.

5.0 GEOGRAPHIC SCOPE

As this analysis is a desktop exercise, no field reconnaissance will be implemented. Fish species present within the Project vicinity that are determined to be potentially susceptible to impingement and/or entrainment through the Project will be analyzed in this study.

6.0 METHODOLOGY

Comment [b1]: Include write-up of electrofishing in tailrace and forebay of Fairfield Pumped Storage. Include fish distribution from Parr studies as a line item.

Fish impingement and entrainment at the Project may occur when fish that elect to enter into the project intake flow field during periods of operation may become impinged on the trashracks or entrained through the turbines. Fish that are small enough to pass through the projects trashracks will be considered susceptible to entrainment while those physically excluded due to size (i.e. length, width, and/or depth) will be considered as potential candidates for impingement. Not all fish species occurring in the Project reservoirs may be equally susceptible to entrainment or impingement because of their habitat use, behavior and swimming abilities relative to the project intake velocity. As noted, fish entrainment at the Project developments will be assessed through a desktop study. The primary inputs for this analysis will be as follows:

1. Develop an entrainment and turbine mortality database that can be applied to the Parr and Monticello developments. Hold Point

2. Calculate and estimate fish entrainment rates, seasonally if possible, at each Project development. Entrainment rates are defined as: number of Fish/volume of water entrained.

3. Characterize the species composition of potential fish entrainment. Hold Point

4. Apply any physical or biological filters that may influence entrainment.

5. Estimate the total annual entrainment for the Project based on normal operation. Hold Point

6. Estimate potential turbine mortality for fish entrainment based on turbine mortality estimates from similar project studies.

7. Estimate impingement mortality for fish eliminated from entrainment estimates. Draft Report Review

These inputs are described in more detail below.

Development of an Entrainment Database

Comment [b2]: Include turbine mortality description.

Over seventy site-specific studies of resident fish entrainment at hydroelectric sites in the United States have been reported to date, which provide order-of-magnitude estimates of annual fish entrainment (FERC, 1995). Descriptive information will be gathered from available entrainment studies and will include:

- Location: geographic proximity (preference given to same river basin).
- Project size: discharge capacity and power production.
- Mode of operation - e.g., peaking, run-of-river, etc.
- Biological factors: fish species composition.
- Impoundment characteristics: general water quality, impoundment size, flow regime.
- Physical project characteristics: trash rack spacing, intake velocity, etc.

This information will be assembled into a “matrix” of data to be used as a database for the desktop study. After review of the “matrix”, specific studies that are most applicable to the Project developments will be selected for use in the entrainment database. Key criteria to be used in acceptance of candidate studies may include:

- Similar geographic location, with preference given to projects located in the same river basin.

- Similar station hydraulic capacity.
- Similar station operation (peaking, run-of-river, etc.).
- Biological similarities: fish species, assemblage and water quality.
- Availability and type of entrainment data (netting vs hydroacoustic).

Estimation of Fish Entrainment

Fish entrainment by species for the proposed Project will be estimated on a monthly basis (if possible) to provide an order-of-magnitude fish entrainment estimate. As noted, the entrainment rates will be presented in fish entrained per hour of operation and fish per volume of water passed through project turbines (fish/million cubic feet). The data will be grouped by season, where appropriate, to determine an entrainment density for each season of the year. The seasonal data from each entrainment study will be averaged to develop a seasonal mean entrainment estimate at each Project development.

Species Composition Analysis

Species composition data from the accepted entrainment studies will be analyzed and compiled to determine the fish species typically entrained at other hydroelectric projects. This information will be grouped to yield predicted seasonal estimates of species-specific data for entrained fish to determine:

- Likelihood of entrainment by species.
- Expected relative abundance of each species identified as potentially entrained.
- Prediction of seasonal entrainment by species and size, if applicable.

Application of Physical or Biological Filters

Adjustment of fish entrainment rates based on site-specific characteristics of the Project may be appropriate. Factors potentially affecting entrainment rates that may warrant adjustment of estimates include:

- Trashrack spacing.
- Fish habitat available at the intakes.
- Other site specific factors as determined during the study.

Total Annual Entrainment Estimate

Total fish entrainment for each Project development will be estimated on an annual basis to provide an order of-magnitude entrainment estimate. The total fish entrainment estimate will be produced for a typical water and operating year.

Turbine Mortality

As fish move through hydroelectric turbines, a percentage are killed due to turbine mortality (i.e. blade strikes, shear forces, and pressure changes, etc.). Turbine passage survival studies have been performed at numerous hydroelectric projects throughout the country. Characteristics of these known project studies will be compared to the characteristics of the Parr and Monticello development turbines and appropriate studies will be selected for the transfer of turbine mortality data. Selected turbine survival rate data will also be obtained from the literature and used to estimate the number of fish lost due to turbine mortality. Important turbine characteristics viewed as general criteria for accepting turbine mortality studies will include but are not limited to:

- Turbine design type.
- Operating head.
- Turbine runner speed.
- Turbine diameter, and peripheral runner velocity.

Species specific turbine mortality rate data available from source studies will also be reviewed and consolidated. Where multiple tests are available for a given fish genus or family, a mean survival rate will be computed. For genus or families where no acceptable data can be identified, the survival rate data from surrogate genus and/or family groups will be utilized.

Once turbine mortality rates are developed from the study database, the rates will be applied to the fish entrainment estimates for the Project. This will be accomplished by multiplying fish entrainment estimates by the composite mortality rates for each family/genus group (where applicable).

Impingement Estimates

Fish eliminated from entrainment estimates due to their size in relation to the trashrack spacing will be considered susceptible to impingement. Swim speed information for these species and size groups will be compared to intake velocities to estimate the potential for impingement. Those species or size groups lacking the ability to avoid impingement will be considered impinged and subsequently killed due to impingement mortality.

7.0 SCHEDULE AND PRODUCTS

This study will occur during 2015. Background research for entrainment and mortality analyses will occur early in the year. Data analysis and report writing are scheduled for later in the year. In an attempt to reach consensus during the entrainment desktop study, the following process steps will be reviewed with TWC members:

Comment [ACJ3]: We would like to discuss which steps the TWC would like to review during the desktop process.

- *[TBD]*
- *[TBD]*
- *[TBD]*

Comments from the TWC will be addressed during each phase of the analysis. Upon completion of the study, a draft report will be prepared and distributed to the TWC for review and comment. The draft report will summarize the results obtained in the study; will contain appropriate tables and figures depicting estimated fish entrainment; and will contain all supporting correspondence among the TWC members. After receipt of all comments, the draft report will be revised to address final comments by TWC members and will be resubmitted as the Final Report.

8.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, RT&E TWC, and other relicensing stakeholders.

9.0 REFERENCES

Federal Energy Regulatory Commission (FERC). 1995. Preliminary assessment of fish entrainment at hydropower projects – volume 1 (Paper No. DPR-10). Office of Hydropower Licensing, FERC, Washington, DC.

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South Carolina Department of Natural Resources (SCDNR). 2005. SC Comprehensive Wildlife Conservation Strategy.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Operations RCG Meeting

January 30, 2014

Final KDM 03-27-14

ATTENDEES:

Vivianne Vejdani (SCDNR)
Dick Christie (SCDNR)
Scott Harder (SCDNR)
Steve Summer (SCANA)
Gerrit Jobsis (American Rivers)
Fritz Rohde (NOAA) via Conf. Call
Joseph Wojcicki (By-PAS) via Conf. Call
J. Hagood Hamilton, Jr. (SCANA)
Byron Hamstead (USFWS) via Conf. Call
Bill Stangler (Congaree Riverkeeper)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Kelly Miller (Kleinschmidt)
Henry Mealing (Kleinschmidt)
Bill Marshall (SCDNR)
Bruce Halverson (Kleinschmidt) via Conf. Call
Bret Hoffman (Kleinschmidt)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting with introductions and a review of the agenda. Comments on the Operations Model Study Plan were submitted by SCDNR prior to the meeting on January 15, 2014 via email and these comments, in addition to review of the Study Plan, served as the basis for discussion throughout the meeting. Comments are provided below, along with a summary of the group's corresponding discussion. The original email in which comments were submitted is attached to the end of these notes.

1. In a prior Parr-FF operations committee meeting, there was a discussion about determining the effects of the Parr Hydro on the Congaree National Park. However, from the draft report, models will only be used to assess operations to approximately 20 miles downstream. Is the study component to address Congaree NP still on the table?

Ray said that he believes the Congaree National Park (CNP) is outside of the area of Project effects. However any effects to the CNP will come when SCE&G spills water over the dam. Gerrit said there will be project effects downstream, even if they are muted by the other projects in the area. The group agreed that input was needed from representatives at the CNP to determine what flows might harm or benefit the park. The group estimated that the Project is approximately 45 miles upstream of the CNP. Bret said that the confluence of the Saluda River and two hydro projects between the Parr dam and the CNP presented so many variables that it would be difficult to accurately model. He said a statistical evaluation of flows within a range of Project effects at the CNP would be possible.

Ray pointed out that there is a storage limitation within Parr Reservoir, and so there is not much flexibility in terms of inundating the CNP. Additionally, through Article 39 of the current license, the Project cannot increase flow releases during a flood, which SCE&G has currently established as 40,000 cfs. Gerrit said there are incremental flooding levels that occur at CNP, starting at 8,000 cfs. Gerrit is concerned with how pulsing releases from Parr Shoals Dam may affect the park downstream. He also said effects to fish spawning near the confluence of the Broad and Saluda Rivers need to be examined.

Bret said that the Project Operations Model will include attenuation affects. He also said the operators of Columbia Hydro can absorb some of the smaller releases from Parr by fluctuating their storage reservoir, which is allowed in the current license for that project.

2. Refer to the discussion of metrics in section 2.4. Though we generally support the use of metrics to facilitate the reviews of various scenarios, metrics should be modified or added as needed during the scenario review process. As we have seen in other modeling efforts, defining initial metrics (or more appropriately when a given metric value denotes a significant change or impact) without reviewing the baseline and a few scenario outputs can be problematic. If metrics aren't defined carefully, then discerning the differences between two scenarios can be difficult.

Bret began discussion of this comment by saying that stakeholders can request specific metrics to be examined, and the model will be run to determine how these metrics may be affected by project operations. Scott asked if specific metrics can be identified initially with the option to go back and adjust those metrics for further or different analysis. Bret said that there will definitely be flexibility for adjustment to those requests.

Dick pointed out that information collected as part of the IFIM study, reservoir fluctuation study, navigational flows study, recreational flows study, and possibly others, will be used with the model. Gerrit said that the operations model will also be important for the Dual Flow analysis component of the IFIM study. He said that the compatibility of the Dual Flow analysis and the operations model output should be considered before the operations model is fully developed.

3. We are was pleased to see the Enoree Gages will be used to evaluate regional relationships between runoff and drainage area, as we would recommend use of these gages to help develop an inflow data set. Appropriate error analysis should accompany the determination of the regional alpha and gamma coefficients presented in section 4.1.

Bruce said that sensitivity or uncertainty analysis, also known as error analysis, will definitely be a part of the process. Scott said that he would like to see a report on the development of the inflow data set added as an appendix to the final operations study report. He would like to have enough information on the inflow data set used so that he may reproduce the data set for independently running the model. Bruce said that the hydrology data set would be developed as a separate task early in the process. A report will be developed and distributed to the RCG describing how the inflow data set was prepared.

The group then discussed what time stamp will be used with the model. Scott said that an hourly interval should be considered. Ray said the model should use hourly data to provide a finer look at project effects, especially considering the fluctuation schedule of the project. Bruce said that hourly data can be used for specific events so that more information is available, however for long term statistics, daily data would be sufficient. The time interval used could be determined based on the specific metric being examined. Scott said that data should be collected from the various sources as far back as possible. The most current data collected should be used to calibrate the longer period of record. Scott raised the idea of developing hourly inflow data from USGS gages. Data availability for this would be considered, in addition to the potential usefulness for hourly model time stamps.

4. In section 4.1.2, it is unclear whether or not the back calculation of the inflow hydrograph will be done or not.

Bruce said that an inflow data set will be developed based upon upstream gages. The group agreed to remove section 4.1.2 from the Operations Model Study Plan, as back calculation would be limited to only a few years and much more difficult than using upstream gages.

5. There is no mention of incorporating water use projections in the modeling process. We would recommend water use projections be included. It may be possible to build on previous projections done for the basin by Duke Energy (and any projections done by North Carolina, if available). Note: If Duke's projections were used they would need to be carefully reviewed and likely modified because -- (1) the projections are somewhat dated (2006), (2) experience with projections by Duke energy in the Catawba basin within the past 10 years indicate they tend to overestimate water use projections, and (3) changes in energy sources (and perhaps demand) over the past several years in the energy industry could have a large impact on future water needs for energy in the basin that may not be accounted for the in the Duke projections.

Bill A. said that it only matters what water is coming into the Project because what is occurring above the Project is outside of SCE&G control. However, there have been requests for a municipal water supply withdrawal from Monticello Reservoir. This will need to be examined as part of the operations model. Ray said that there are no intervening withdrawals between the Project and the gages that will be used in the Operations model.

Scott asked if the model will take into account future energy demands and how that will affect flows. He mentioned that Duke Energy did a study on the projected water uses for the area surrounding their projects. He said this study should be examined to see if it is applicable to the Parr Fairfield Project as it may offer some important insight into future water demands and how that may affect the Project. However, since this information is considered speculative, SCE&G will not base the entire operations study on it; it may be used to run a specific scenario. Internally SCE&G will be looking at the expected energy needs for Parr and Monticello for the next several years.

6. We request the SCDNR (and other stakeholders) be provided with the baseline HEC Res Sim operations model and the HEC-RAS hydraulic model and have the ability to independently run the models and review outputs. Any proposed scenarios should be carefully documented so that SCDNR staff can independently make appropriate edits to the model (or alternatively, the consultants can provide updated models with loaded scenarios on a periodic basis). In addition, we would request a one day seminar or training session be scheduled for stakeholders to introduce the baseline models and provide limited training on use and running of the models.

Before discussion began on this comment, Scott said that instead of a training session, he would like for there to be an introduction to the model and a demonstration, for those who are interested. Scott said this will help him and others to determine what scenarios they would like to be run. Bruce said that an introduction to the model and a demonstration can definitely be scheduled after the model is complete, however an actual training session is not feasible. Scott said he is mostly interested in learning more about the HEC-Res model in particular, but would like to see a demonstration of HEC-RAS as well. Byron, Fritz and others agreed that they would be interested in attending the model demonstration.

The group agreed that a preliminary report including model rules and parameters will be developed and submitted to stakeholders for comment, and adjustments will then be made based on comments received. After adjustments are made, there will be a demonstration of the model for any interested stakeholders. The baseline model will then be finalized. Following finalization of the model, the requested scenarios will be run and a final report summarizing the results will be issued.

The group then discussed how the various scenarios will be compared to each other. Gerrit suggested that SCE&G could decide on a specific number of scenarios to be run and stakeholders and TWCs could request which scenarios they want to see. The information gathered from each scenario would then be distributed to the appropriate TWC and joint meetings may be scheduled to discuss the results.

7. Though we understand the challenges or producing an operations model that can mimic all historic operations, we would request the consultants to elaborate on any criteria used to determine whether the model is functioning adequately enough. For example, in section 4.3.1 at the end of the first paragraph, what is meant by the average expected system response?

The goal of the operations model is to establish rules that show how the Project is normally operated, and apply requests from stakeholders to determine how they can be balanced using the available resources. The model will be based on typical operating parameters, rather than unusual or emergency circumstances. Gerrit said that we should be most interested in the average, not necessarily outliers, such as outages. Scott said we need to make sure we have a baseline. He said that this Project is complex due to the pumpback operation and it will be difficult to match what is shown on the Alston gage. The best way to validate the model will be to look at a day when the Project is in a normal operating cycle so that information from the model and from Alston can be compared.

After the meeting, Gerrit submitted the following comments via email.

- In addition to project effects on the Park, it is important to understand the effects of project operations on sturgeon and striped bass spawning in the Columbia hydro project bypass reach and Congaree River. Shortnose sturgeon are known to occur and spawn in this vicinity.
- The operational model will be important for the Dual Flow analysis to be conducted under the IFIM study. How the Ops Model/output can be made compatible [to the] Dual Flow analysis should be determined before the model is fully developed.
- Existing and projected City of Columbia’s water withdrawals and the same for any other downstream water withdrawals need to be taken into account in the Ops model and ultimately [in the] operational requirements.
- Future changes in upstream water use should be included in operational scenarios and adaptive management plans (i.e. low inflow protocol) for the new license.

Edits made to the Operations Model Study Plan were captured in track changes during the meeting and are attached to the end of these notes. Action items stemming from this meeting are included below.

ACTION ITEMS:

- SCE&G and Kleinschmidt will perform research to determine if there are any significant water withdraws planned for downstream of the Project.
- Kleinschmidt will make the requested changes to the Operations Model Study Plan and submit to the RCG for approval.
- Kleinschmidt will examine the availability of hourly USGS flow data for the upstream gages proposed in the Study Plan.

From:	Bill Marshall
To:	Kelly Miller
Cc:	Scott Harder
Subject:	Comments on Draft Hydraulic & Project Operations Model, Parr Hydro Project
Date:	Wednesday, January 15, 2014 3:04:37 PM

Hi Kelly,

DNR hydrology staff have reviewed the draft operations model study plan and we are providing comments and questions for consideration as the RCG continues developing the plan and prepares for meeting on Jan 30. DNR comments and questions are as follows:

1. In a prior Parr-FF operations committee meeting, there was a discussion about determining the effects of the Parr Hydro on the Congaree National Park. However, from the draft report, models will only be used to assess operations to approximately 20 miles downstream. Is the study component to address Congaree NP still on the table?

2. Refer to the discussion of metrics in section 2.4. Though we generally support the use of metrics to facilitate the reviews of various scenarios, metrics should be modified or added as needed during the scenario review process. As we have seen in other modeling efforts, defining initial metrics (or more appropriately when a given metric value denotes a significant change or impact) without reviewing the baseline and a few scenario outputs can be problematic. If metrics aren't defined carefully, then discerning the differences between two scenarios can be difficult.

3. We are was pleased to see the Enoree Gages will be used to evaluate regional relationships between runoff and drainage area, as we would recommend use of these gages to help develop an inflow data set. Appropriate error analysis should accompany the determination of the regional alpha and gamma coefficients presented in section 4.1.

4. In section 4.1.2, it is unclear whether or not the back calculation of the inflow hydrograph will be done or not.

5. There is no mention of incorporating water use projections in the modeling process. We would recommend water use projections be included. It may be possible to build on previous projections done for the basin by Duke Energy (and any projections done by North Carolina, if available).

> Note: If Duke's projections were used they would need to be carefully reviewed and likely modified because -- (1) the projections are somewhat dated (2006), (2) experience with projections by Duke energy in the Catawba basin within the past 10 years indicate they tend to overestimate water use projections, and (3) changes in energy sources (and perhaps demand) over the past several years in the energy industry could have a large impact on future water needs for energy in the basin that may not be accounted for the in the Duke projections.

6. We request the SCDNR (and other stakeholders) be provided with the baseline HEC Res Sim operations model and the HEC-RAS hydraulic model and have the ability to independently run the models and review outputs. Any proposed scenarios should be carefully documented so that SCDNR

staff can independently make appropriate edits to the model (or alternatively, the consultants can provide updated models with loaded scenarios on a periodic basis). In addition, we would request a one day seminar or training session be scheduled for stakeholders to introduce the baseline models and provide limited training on use and running of the models.

7. Though we understand the challenges or producing an operations model that can mimic all historic operations, we would request the consultants to elaborate on any criteria used to determine whether the model is functioning adequately enough. For example, in section 4.3.1 at the end of the first paragraph, what is meant by the average expected system response?

Thank you for consideration of our comments and questions.

Bill Marshall
SCDNR

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Monday, December 16, 2013 8:56 AM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (dchristie@comporium.net); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: draft Project Operations Model Study Plan

All,

Attached for your review is the draft Project Operations Model Study Plan for the Parr/Fairfield Project. Please have any comments or edits back to me by Wednesday, January 15th. We will discuss this study plan at the upcoming Operations RCG meeting, scheduled for Thursday, January 30th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

DRAFT
HYDRAULIC & PROJECT OPERATIONS MODEL

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

December 2013

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894)(Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

This document provides a detailed outline of the process proposed to complete a Hydrologic and Project Operations Model as part of the Parr and Fairfield relicensing project. These models will be used to assess ability to provide potential changes to project operations, and the resulting effects of potential modifications to operations of the projects. These models will primarily focus on the effects that may result from proposed changes in project operation on energy, capacity, water budget, and flood control. The intent of this effort is to develop a series of high-level fully functional modeling tools, which can be used to incorporate stakeholder requests as parameters to provide outputs and results that can be easily interpreted.

2.0 STUDY OBJECTIVES

2.1 HISTORIC INFLOW HYDROGRAPH DEVELOPMENT

Critical to the operations of hydroelectric projects is the hydrology, which generally requires using the best available gage data to determine local contributing flows. Unless there is a gage immediately upstream of the project headpond, the inflows can be derived by pro-rating available gages, to account for any ungaged drainage area between the respective gages and the site, and then summing the values. Alternatively, a downstream gage can be used to back-calculate inflow using the respective daily reservoir level and evaporation estimates. The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies.

2.2 HYDRAULIC MODELING

The operations of Parr and Fairfield may affect recreational or habitat interests on the downstream reach of the river. Rapid changes in flow result in a wave (either positive or negative) that propagates downstream, potentially affecting habitat, stream channel stability, and recreational opportunities. The hydraulics of this wave are affected by both translation and attenuation as it progresses downstream. The impacts of existing and proposed modifications to operations (if any) can best be evaluated with a 1-D hydraulic model, which will allow the evaluation of the unsteady flow wave along the downstream reach under several different operating conditions. The goal of this study is to either construct a model (or utilize an existing model) that will evaluate stage (water level), discharge, and velocity with time, along the Broad River downstream of the Parr Dam.

2.3 OPERATIONS MODEL

The Parr-Fairfield project includes several components that need to be included in an operational model. These include the Parr Dam and powerhouse hydraulic capacities, the Fairfield Pumped Storage project operational parameters (for both pumping and generating), the Monticello Reservoir, and the Parr Reservoir. The operations of this system have historically been closely coordinated for the primary purpose of supporting the electrical grid (both demand and stability). SCE&G will need to maintain this coordination during future operating conditions. Additionally, any potential changes to operations in the future will need to be evaluated for effects on dam safety, and operating rules or limitations. This is best accomplished by developing a comprehensive operation model. The goal of this task is to assess and quantify historic operations and limits, and to incorporate these rules into a comprehensive and flexible operations model that can be easily modified to simulate proposed future operations. We propose using the HEC Res Sim model to investigate headpond fluctuations and associated hydro generation hours that SCE&G could have.

2.4 SCENARIO COMPARISON

2.4.1 A process will be developed through which TWCs/RCGs and various stakeholders will submit scenarios to be run and compared to evaluate potential future operations and their effects.

~~2.4~~

2.4.2 ~~Once models are constructed,~~ The operations model will be used to run scenarios proposed by various stakeholders and submitted through TWC's or RCG's. Results will be reviewed by the RCGs/TWCs during a series of meetings. Model results will be summarized and integrated into the final recommendations presented in the license application.

~~and different operating scenarios have been run, we will summarize the results into easily compared and intelligible metrics. Without this step, the results of a given scenario or study may be lost in the details and vast quantity of data.~~

2.4.1 2.4.3 SUMMARY STATISTICS

With several integrated modeling efforts, each including possibly several different scenarios, it is critical to develop summary tables and/or summary metrics for each scenario. The goal of this task is to consider each of the studies, and the potential set of results, and develop a standardized means of summarizing and quantifying the results. As an example, it may include the number or percent of flood days changed from baseline conditions, the change in habitat area, the change in streamflow variance, or the increase/decrease in potential MWh. Using the summary statistics, stakeholders and TWC members can prioritize their requests and work to minimize the negative aspects of operational changes.

3.0 STUDY DOMAIN

The focus of this study includes the Parr Reservoir (defined as the elevation of the top of the crest gates, or El. 266.0'), the Fairfield Pumped Storage facility and the Monticello Reservoir, and the Broad River downstream of Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island.

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4.0 METHODOLOGY

4.1 INFLOW HYDROGRAPH DEVELOPMENT

Development of the inflow hydrograph can be accomplished by two methods: the use of upstream gages prorated to the dam's drainage area, or the use of the gage immediately downstream with detailed information of the project's past operations. In the case of the Parr model, the upstream gage proration method will be used, due to the limited availability of detailed Project operation data. Historic data will be reviewed to determine the period of record and time increment to be used to represent project inflow. The proposed inflow data will be reviewed by the Operations RCG for agreement.

4.1.1 UPSTREAM GAGE PRORATION

Proration of streamflow gages, in order to account for ungaged drainage area, is not necessarily a linear relationship. In order to evaluate the regional relationship between runoff and drainage area, two unregulated stream gages on the same river with overlapping records is required. The only gages that meet this in the immediate Parr Dam watershed are two gages on the Enoree River. These two gages will be used to assess an appropriate proration coefficient (α) and exponent (γ), which may be used to regionally prorate all of the gages required in construction of an historic inflow series.

An equation that may be used with the fitted regional coefficients to determine inflow to Parr is below, where the values are the ratios of the total area to gaged area for each gage location. Additionally, these gages are at different distances from the Parr Reservoir, and drain through different channels, thus the arrival times should be adjusted accordingly. The angled brackets denote a routed hydrograph series.

$$Parr\ Inflow = \langle \alpha * BRC \left(\frac{3250.8}{2790}\right)^{\gamma} \rangle + \langle \alpha * TRD \left(\frac{807.9}{759}\right)^{\gamma} \rangle + \langle \alpha * ERW \left(\frac{731.3}{444}\right)^{\gamma} \rangle$$

where,

BRC – Broad River at Carlisle
TRD – Tyger River near Delta
ERW – Enoree River at Whitmire
α – Fitted Regional Coefficient
γ – Fitted Regional Exponent
⟨...⟩ - Routed Translation

Routing will be completed using a simplified Muskingum approach, and will allow for wave attenuation and travel time, which are more critical for shorter period flows. Daily flow rates would not require this routing, as the average daily flows can simply be summed.

~~4.1.2 Downstream Gage with Operational Information~~

~~Using the USGS gage at Alston, which is immediately below the dam, provides the simplest means of determining project releases. However, back-calculating an inflow hydrograph would require data from project operations, including releases and spills from Parr, generation and pumping information from the pumped storage (or Monticello Reservoir elevations), a stage-storage curve for the Parr Reservoir, and estimates for evaporation from the reservoir. Alternatively to the pumped storage generation and pumping information, Monticello Reservoir elevations could be used, but would also require a stage-storage curve and evaporation estimates.~~

Table 1 Summary of Available Hydrologic Data

Data Source	Period of Record	Data Type
Parr Reservoir (#02160990)	10-1-1984 to Current	Stage
Broad R. at Alston (#02161000)	10-1-1896 to Current	Stage & Discharge
Congaree R. at Congaree NP (#02169625)	10-1-1984 to 8-9-2013	Stage
Broad River at Blair (#02160750)	9-11-2010 to 3-7-2013	Discharge
Broad River near Carlisle (#02156500)	10-1-1938 to Current	Stage & Discharge
Broad River below Neal Shoals (#021564493)	3-27-2012 to 9-26-2013	Stage & Discharge
Broad River at Diversion Dam (#02162100)	10-1-1987 to 9-24-2012	Stage
Enoree River at Whitmire (#02160700)	10-1-1973 to Current	Stage & Discharge
Enoree River near Woodruff (#02160390)	2-9-1993 to Current	Stage & Discharge
Tyger River near Delta (#02160105)	10-1-1973 to Current	Stage & Discharge
Fairfield Pumped Storage Generation/Flow	TBD	Discharge
Monticello Reservoir	TBD	Stage

4.2 Hydraulic Modeling

The downstream reach of the Broad River below Parr Shoals Dam will be modeled using the Army Corps of Engineers' HEC-RAS v4.1, which is a 1-dimensional model that will allow correlation between flow releases from Parr Reservoir and resulting water level stage in the river downstream. Wave travel times, rates of rise, and stage recession times will also be available from this model. Readily available data will be used for developing the model. The model will be developed to include the hydraulic affects of flow releases down to the Frost Shoals area near Boatwright Island (approximately 20 miles downstream of the Parr Shoals Dam). The results of the model will be used to determine flow estimates for other interests in the project, such as navigation, recreation, or habitat benefits.

4.3 OPERATIONS MODEL

Development of the operations model includes two major tasks: develop the rules and patterns from historical operations, and secondly use these rules to construct a model for testing alternative scenarios. Success of this task can be measured by the ability of the model to replicate historical operations, but can also be measured by the ease and flexibility of testing future scenarios that produce easily interpreted results by stakeholders and TWC members (i.e. important information is not lost in modeling details). The operations model can become quite complicated very quickly, thus to successfully accomplish both of these goals, an appropriate model framework using the best available data is required early in the process.

4.3.1 OPERATION RULES & REGULATIONS

Not only is hydrology a stochastic process, but operating history and generation (pumping/generating) can also be stochastic as a response to weather patterns, random outages, increased grid demand, changes to grid support via addition of other generators, low flow periods, or even differences in decisions between operators using forecast data. Therefore, it is impossible to state explicit rules that define the operating regime for any of the projects, but both extreme limits (i.e. minimum/maximum pond levels, or minimum/maximum flow rates, rates of change, etc.) may be extracted from specified rules, curves, or observations of the system. Additionally, subjective operational patterns may be inferred from historic operations (i.e. typical pumping volumes in June are a certain amount, generating is typically highest during a given period of the week, etc.). Both the hard and soft rules are important for developing an understanding of conjunctive project operations. Although the rules may not exactly depict the operations at any given point in time, from either the past or the future, they should be able to depict the ~~average~~ expected system response.

Several key components of data will be concurrently analyzed:

- Pond Operating Levels (Parr Dam & Monticello Reservoir)

- Spillway gate operating guidelines
- Pumping Rates (Fairfield)
- Generation Rates (Parr & Fairfield)
- Rates of Change from Generation Flows
- Typical Generation Periods (time of day, weekday, months)
- Seasonal Influences
- Influence of low river flow conditions boundary
- Influence of high river flow conditions boundary
- Influence of water withdrawals from Monticello Reservoir
- Potential impacts of future upstream and downstream water withdrawals on Project inflow and downstream effects.

In order to appropriately define typical system responses, detailed historic information is required. This includes as available:

- Hourly (or finer) generation records for Parr & Fairfield
- Parr and Monticello Reservoir stage records
- Meteorological Data (precipitation, temperature)
- River Flow gage records

These records will be reviewed, plotted, regressed and inferred upon to develop an understanding of 'typical' system responses. Again, exact operations for a complicated system are impossible due to the stochastic nature of all influences, but typical rules may be inferred.

4.3.2 Operations Model Framework

Once a comprehensive understanding and documentation of typical operating rules has been developed, they may be used within a modeling framework to replicate historic operations (validation process), and then test future or altered operating conditions.

The model will be constructed at hourly time steps to allow testing of different release rates and spilling events from the Parr Dam, and/or operating conditions at Fairfield. Longer durations may miss critical operating responses, and unnecessarily short time steps would be excessive and not add additional value. The duration of the validation period will vary based on the available data, but should cover as many sequential years as manageable.

The operations model will be developed using the Army Corps of Engineers HEC-ResSIM software package. This package is freely available, easily integrates with other models (such as

HEC-RAS), and has the capacity to model multiple projects (including the Fairfield pumped-storage) with a range of complex and even contradictory operating rules. Results of the model are easily viewed either within HEC-ResSIM, or externally using the HEC-DSSVue software package.

4.4 SCENARIO COMPARISON

From the early development of the study plan, model runs should be sufficiently detailed to outline how the projects' operations will be tested. For example, what river flows are critical (low flows to high flows) and should be emphasized? What rates of generation are important, and how quickly can they be changed? A matrix defining each scenario, and how each component of the project is being operated, should be developed. This will naturally confine modeling efforts, and maintain focused efforts for comparison by the TWC members and stakeholders.

4.4.1 STATISTICS

Statistics are valuable for concisely summarizing the nature or property of a random or stochastic variable. For example, the sample mean is commonly used to describe a set of data, but additional information may be obtained from higher order moments (variance, skew, kurtosis). The critical statistic (metric) should be determined early in the study process for each study or model output. For example, the total habitat area may be critical, the average generating rate, the 1% exceedance flow rate, the variance in water levels during a critical period, the maximum headpond level, the 7Q10 flow rate, etc. are all examples of summary statistics. These should be discussed early, and concurrence with working groups or stakeholders should be achieved early in the process to determine what is considered critical.

Additional examples of potential flow statistics include:

- Rise-Fall Rates
- Mean, Median, Quartile Flow Rates
- Variance, skew, kurtosis
- Autocorrelation Function & Partial Autocorrelation Function lags
- Flow-Duration Curves
- Excess Distribution Functions and Conditional Excess Distribution Functions
- 7Q10 flow
- 5,10,50,100-year peak flows
- Stage-Duration Curves (Parr Reservoir)

5.0 REPORTING

A preliminary report documenting the development of the operations model will be provided to the TWC for review prior to the completion of the model. This preliminary report will include the methods and information as follows:

- Discussion of model data acquisition
- Inflow hydrograph development
- Development of future inflow hydrograph(s)
- Hydraulic 1D Model Development & Calibration
- Operations Model Development & Verification
  - Parr Operations
  - Fairfield Pumping/Generating

Following a comment period, a demonstration session will be conducted to familiarize interested stakeholders with the implementation of the HEC-RES SIM and HEC RAS models for this Project. During this session, the input data and Project parameters will be reviewed, and a "hands-on" session can be conducted to allow stakeholders to learn how to run the model. After the demonstration session is conducted, the final model will be ~~development~~developed and used to analyze operations scenarios. ~~will conclude, and the implementation of the model will be conducted~~.

~~Scenarios proposed by various stakeholders and submitted through TWC's or RCG's will be incorporated into the model to determine the statistical implications of each set of parameters.~~

A final report will document methods and results as encountered in the modeling effort, including:

- Scenario Results
- Hydraulic Routing Model
- Operations Model
- Energy Modeling
- Scenario Comparison Matrices & Statistics

6.0 SCHEDULE

Data collection and model development will begin no later than the spring of 2015, with a preliminary report documenting the development of the model completed by the end of 2015. The methodology for this modeling effort may be revised or supplemented based on consultation with TWCs and other interested stakeholders. Model results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, USFWS, RT&E TWC and other relicensing stakeholders. The final report, which will include the scenario results, will be completed for filing with the final license application.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Water Quality TWC Meeting

February 4, 2014

Final KDM 3-14-14

ATTENDEES:

Bill Marshall (SCDNR)	Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)	Randy Mahan (SCANA)
Rusty Wenerick (SCDHEC)	Steve Summer (SCANA)
Henry Mealing (Kleinschmidt)	Byron Hamstead (USFWS)
Kelly Miller (Kleinschmidt)	Gerrit Jobsis (American Rivers)
David Eargle (SCDHEC)	Bill Stangler (Congaree Riverkeeper)
Kerry Castle (SCDNR)	Jaclyn Daly (NOAA) via conference call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Kelly opened the meeting by reviewing the changes that were made to the Baseline Water Quality Report, based on comments submitted by USFWS and SCDHEC following the September 2013 meeting of the Water Quality TWC. These edits consisted of the following:

- Regarding the vertical profile data collected by SCANA for Parr and Monticello Reservoirs, tables were added summarizing the max, min and mean values for temperature, pH, dissolved oxygen, and conductivity.
- Data was added from all base and random SCDHEC monitoring sites within the Project Boundary. Parameters include water temperature, dissolved oxygen, pH, turbidity, total phosphorus and total nitrogen, chlorophyll-a, and metals.
- Information on SCDHEC sites listed on the 2012 303(d) list was included.
- USGS data from the Carlisle gage was included.
- Turbidity data collected by SCDNR was included.
- Data from four SCDHEC monitoring sites located at various points throughout the Project Boundary were graphically compared.
- Appendix B was added, which consists of the Thermal Mixing Zone Evaluation at VC Summer Nuclear Station.

Steve noted that an addendum is currently being added to the Thermal Mixing Zone Evaluation, and this information will be added to Appendix B of the Baseline Water Quality Report once the addendum is filed with SCDHEC. Also, all of the raw data used in the report is available to any stakeholder who is interested. Byron and Bill S. requested a copy of the raw data.

Kelly then asked the group for any additional comments or edits to the report. Byron asked about the vertical profile data for Parr Reservoir. Vertical profile data included in the report for Parr

Reservoir was collected from January 2011 through July 2013 so some of the graphs only included two years of averaged data, while others included three years. The data that has been collected from July 2013 through December 2013 is now available and will be included in the updated version of the report.

Bill S. asked why the SCDHEC data from 2004 was used for the comparison of upstream and downstream water quality. Kelly explained that this was the only year that had a complete set of data available for the comparison. There was discussion about the seasonal temperature shift in the reservoir. Steve noted that Monticello stays warmer in the winter and cooler in the summer, which may result in some slight temperature changes in the reservoir. The group then discussed using USGS data to compare water quality upstream and downstream of the Project. Everyone agreed that temperature and dissolved oxygen (DO) data from the USGS gages at Carlisle, Parr Dam, Tyger River and Enoree River should be analyzed to detect potential project effects. Bill A. pulled up available data on the USGS website for the group to view. The Parr Dam data showed events when DO levels in the tailrace dropped below 4.0 mg/l. The group also noted that there was a seasonal temperature shift in the reservoir. The group agreed that data from the gages listed above would be gathered from 2004 through 2013 and graphically compared to identify low DO events, determine how often, when, how long those events occurred and to see if there are common events related to the low DO. Flow data will also be collected to determine if there is a correlation between low or high flows and low or high dissolved oxygen. All of these analyses will be included in an addendum to the Baseline Water Quality Report.

Several stakeholders said they were not comfortable with some of the conclusions made in the report, including that the reservoirs are healthy and that the Project doesn't appear to cause significant impacts to water quality downstream. This wording will be removed from the report.

Gerrit asked which sites were listed on the 303(d) list. Kelly said that SCDHEC monitoring site B-346 was listed for a total phosphorus excursion, site B-236 was listed for a copper excursion, and sites RL-04370, RL-04374 and RL-11031 were listed for pH excursions.

Byron asked that section 3.1.5 include wording that explains data presented in this section was collected on a monthly basis.

Byron asked about the metals data collected by SCANA and the detection limits listed by SCANA versus the state standards. Steve stated that SCANA was performing screening tests to determine presence or absence of specific metals.

Bill M. noted that the map on page 2-2 did not show the location of SCDHEC monitoring site B-236. Kelly will correct this and include the updated map in the updated version of the report.

David and Rusty then requested a macroinvertebrate study to be performed, in addition to the Baseline Macroinvertebrate and Mussel Report that has already been prepared and is available at the Project website www.parrfairfieldrelicense.com. David would like SCE&G to perform a rapid bioassessment at three sites within the Project Vicinity over two or three years. The three sites identified by David were as follows: a site located within a one-mile shoal section immediately below Henderson Island, at the upstream reach of Parr Reservoir; a site located immediately below Parr Shoals Dam; and a site about 8.1 river miles below Parr Shoals Dam near the upstream end of Haltiwanger Island in an area known as Freshly Shoals. Rusty said that this additional macroinvertebrate study is necessary for SCE&G to obtain the 401 water quality certification for the Parr Fairfield Project. David said that SCDHEC has already collected macroinvertebrate data from the area near Haltiwanger Island and he will provide that data to SCE&G and Kleinschmidt to include in the Macroinvertebrate Report.

Bill S. asked if aquatic invasive species management is being addressed through any of the TWCs or RCGs. This issue will be addressed in the Shoreline Management Plans that will be developed for Parr Reservoir and Monticello Reservoir by the Lake and Land Management TWC.

Edits to the Baseline Water Quality Report discussed during the meeting will be completed and the report will be resubmitted to the TWC for approval. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Kelly will provide Byron and Bill S. with a CD containing the raw data used in the Baseline Water Quality Report.
- Kelly will incorporate all edits discussed in the meeting into the Baseline Water Quality Report and will perform all additional analyses to include in an addendum to the report.
- SCE&G and Kleinschmidt will pull together the USGS data and perform the analysis discussed during the meeting.
- Kerry will send Kelly additional SCDNR turbidity data.
- Kleinschmidt will develop a Macroinvertebrate Study Plan and submit to the TWC for approval.
- David will send Kelly the macroinvertebrate data collected by SCDHEC at Haltiwanger Island.
- Steve Summer will send Kelly the Addendum to the Thermal Mixing Zone Evaluation for VCSNS unit 1 when it becomes available.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

March 5, 2014

Final KDM 04-8-14

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Gerrit Jobsis (American Rivers)
Shane Boring (Kleinschmidt)
Henry Mealing (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Brandon Kulik (Kleinschmidt) via conf. call
Dick Christie (SCDNR)
Randy Mahan (SCANA)
Byron Hamstead (USFWS)
Fritz Rhode (NOAA) via conf. call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting with introductions and then Shane lead the group in a review of the Mesohabitat Assessment Report. Shane explained the intent of the study and reviewed the results, including an overview of the maps. Ron asked to see an individual breakdown of maps 2a, 2b and 2c and Shane said he will provide these maps to the group.

Bill M. asked if we learned anything new from the study. Shane said that the most restricted point on the river for fish passage and boat navigation was identified. This area is right above the Bookman Shoals complex. This area is identified in the IFIM Study Plan as an area that needs further study. Shane said they also did a survey for Robust Redhorse spawning areas during the mesohabitat study. Two areas were identified including a location right downstream of Parr Shoals Dam and another location upstream of Bookman Shoals. Shane said that Scott Lamprecht agreed that these spots seemed ideal for Robust Redhorse spawning. Milton said he also went out on the river with Scott and they identified another area near the Bookman Shoals complex and Hickory Island. A spot near Haltiwanger Island was also identified. Shane will develop a memo summarizing all of this information on Robust Redhorse spawning sites and will distribute this memo to the group. He will also append the memo to the final IFIM report. Shane will edit the IFIM Study Plan so it mentions that the Robust Redhorse memo will be appended to the final IFIM report.

Shane also said that during the mesohabitat assessment they learned that Bookman Island is very complex with lot of cross channels, braiding and varying elevations. He said that at least seven channels had been identified in the area. Fritz added that seams of bedrock add complexity because they act as weirs, moving the water in different directions depending on flow. He said it is good that 2D modeling will be performed in this area during the IFIM study. Byron asked if the 2D

Kleinschmidt

modeling will include the two Robust Redhorse sites identified in the Bookman Island complex and Shane said yes. Shane added that the upstream site at Haltiwanger Island will be studied using PHABSIM along with the site right below Parr Shoals Dam at Hampton Island. Ron said that the area just downstream of the Parr Shoals Dam is good for Robust Redhorse because there seems to be a dike formed by the rock with a gravel bed, covered by deep water. Ron said suckers are often found in this area.

Ron said that the Broad River downstream of Parr Shoals Dam is very complex, and that the maps included in the Mesohabitat Assessment Report are generalized. But he believes they are fairly accurate and that the proportions of the various mesohabitat types found in the river are accurate. Shane agreed and said that sometimes while looking at a cross section of the river, one side of the river may have a run and the other side may have a backwater pool. Shane said this was hard to convey in the maps, but that overall the map delineations and the report are very accurate.

Byron asked if areas of constriction throughout the river have been mapped out. Shane said GPS points have been taken and can be provided to the group, but cross sections detailing depth and other information has not been mapped out yet and will be completed as part of the IFIM study. Shane showed the group, using Bing maps, two areas in the river where fish passage and navigation may be possible. These areas will be studied in more detail during the IFIM study.

The group began reviewing the IFIM Study Plan and Shane mentioned that the Mesohabitat Assessment Report will be added as an appendix to the final IFIM Report. Byron wanted to know how the information collected in the IFIM study would be used for determining suitable crayfish habitat. Will the amount and type of cover available at various depths be examined? Henry said this will not be done using PHABSIM, but this information can be collected as part of the general description of the study area. Gerrit asked if when determining cover types, isn't it typical to not only look at the transect, but upstream as well? Brandon said yes because at the upstream/ downstream cell boundary level, the area is reasonably homogenous but within the cross section localized substrate variations can be like a mosaic, so it is typical to look upstream and downstream a reasonable distance to characterize the substrates assigned to a particular vertical. Brandon said that in regards to crayfish, the group can establish what the important cover types are for a particular species beforehand so that the field crews know what to look for during data collection. Byron said he will do some additional research to identify the preferred covers for the spiny crayfish. He is interested in determining how much cover is available and how much is exposed at varying water levels. Henry said that this may be possible with rocky substrates since they are fairly permanent, but that the abundance and distribution of woody debris can change from year to year so only general qualitative observations can be made. Henry said that if large woody debris is located at a PHABSIM transect, it will be surveyed in depth, otherwise just general descriptions of what is located upstream and downstream will be recorded to characterize conditions and where it is located relative to water levels. Brandon said that photos and possibly videos will also be taken to document the substrate and cover types in the area. If Byron develops a specific list of the type of substrate and cover that is important for crayfish, including a description of the types of woody debris preferred (approximate size and position in the water column), it will make it easier to document these during the study. Brandon said they can look at what is exposed during low flows and also record how high flows mobilize these substrates. Ron said that in his experience the large woody debris found in the central portion of the river is usually located in areas of accumulating sand and is typically transient and moving. All other woody debris tends to be found along the shorelines. Byron said that the wetted perimeter study will provide a lot of information on the woody debris found throughout the river. He will determine what the specific habitat requirements are for the spiny crayfish, an at risk species which is currently under candidate review, and provide these to the group prior to the IFIM study.

In section 3.2.2 of the IFIM Study Plan, Shane added in a description of the downstream ledge which may be a possible navigation site.

Bill S. asked why the river directionality is positioned looking upstream. Shane said that it just depends on how the biologist is trained. The group agrees to change all direction references to looking downstream.

Prior to the meeting, Gerrit submitted a comment regarding the inclusion of a Dual Flow analysis (DFA) into the IFIM Study Plan. Brandon explained to the group what a DFA is and his description is attached to the end of these notes. He said the goal of a DFA is to assess Project generating flows and how various operating scenarios affect habitat suitability. Base flow and generating flow couplets of interest are identified, along with selection of key species and lifestages. Effectively available habitat for a particular study site is calculated at pair of stream flows. A comparison of the amount of units of WUA available at the base flow versus the units of WUA at the generating flow is completed. DFA only records WUA corresponding to the lower of the two paired values regardless of whether the lower WUA occurs at the low or high flow. The assumption is that the lower WUA value represents the level of suitability persisting under both conditions For example, if the habitat value is zero at the low or high flow, then the value for that pairing is zero. Shane said this can be done as a desktop exercise and doesn't require any extra field effort however a basic PHABSIM analysis must be completed and reviewed first since this step establishes the quantification basis.

Gerrit said DFA can also be done to mitigate the effects of peak flows by changing the base flow. He said you can iteratively move the base flow up or peak flow down to mitigate and lessen the affect on habitat to assess different operating scenarios. The idea is that if the higher the habitat suitability is a majority of the time, then the episodes of lower habitat suitability are less stressful to the aquatic species . Bill A. asked if base flows would be changed during certain times of the day or seasonally. Gerrit said this is a seasonal change. Brandon said spatially peaking effects attenuate going downstream so that the effect is most pronounced nearest the tailrace. The group would have to decide if the analysis should focus on the upstream reaches of the river or the downstream reaches.

The group decided that the study plan needs to include information on process steps regarding the DFA. The TWC will review initial WUA output and then meet to determine the DFA scope. No additional field work will be needed. Shane will add a few paragraphs to the IFIM Study Plan describing the DFA process. Kelly will send these paragraphs out to the TWC for review and comment.

Other additions to the IFIM Study Plan include mentioning the Robust Redhorse memo, adding in crayfish habitat suitability information (provided by Byron) and adding wording on the identification of substrates for crayfish during the IFIM study. Ron mentioned he would like to see a more specific schedule for when the IFIM study will take place because he would like to help. He would like to see the schedule already included in the IFIM Study Plan expanded to include more specifics. He would also like to see qualifiers added in to account for bad weather or flows that might inhibit data collection.   All of these changes will be made to the study plan in track changes and sent out to the TWC for review and approval.

Dick asked the group if they want to specify the goals of the analyses in the study plan. For example, SCDNR's recommendation is to identify a minimum flow that would provide 80 percent of maximum WUA. The group decided to add a list or table outlining the process of the study, which will include an expanded section on TWC consultation.

Gerrit asked if there will be demonstration flows scheduled following the results of the IFIM study regarding navigation and fish passage. Bill A. said that there can be demonstration flows and Shane will add this into the process schedule.

Dick mentioned the navigation component of the IFIM Study Plan and said that it was not consistent with the Navigational Flows Study Plan, which is discussed in the Recreation TWC. The Navigational Flows Study Plan needs to be changed to include a description of the two-way navigation requirement. This study will still only focus on one way navigation, but a description of two-way navigation needs to be included. This study plan will be re-circulated to the Recreation TWC for approval and then finalized.

Shane then gave the group an overview of the 2014 field season efforts for the IFIM study. Level loggers will be deployed in late March or early April in 12 different locations from the Parr Shoals Dam to the Columbia Dam pool, near the rowing facility. Level logger data is being collected to examine travel time for flows and to develop stage discharge relationships. Additionally, 2-D data collection will be completed in the Bookman Shoals area (Study Site 10), which includes latitude, longitude and elevation data for the entire two mile study area. At Study Site 1, a terrain model for quantifying pools and fish passage will be created. Cross sectional profiles including bed elevations and water surface elevations will also be collected at Study Site 4. Bill S. asked how many points will be examined at Study Site 10. Shane said he isn't sure yet, but it will be a good idea to look at existing LiDAR data and DEM data to make sure they establish an adequate number of points. This should give clarity to the density of points needed for the model. Densities could be as tight at every three meters. Shane said that the TWC is welcome to help with these efforts this year as well. Emails will be sent to the group to notify them as soon as possible when the work will be done.

The IFIM Study Plan will be updated to reflect the items discussed at the meeting and sent back out to the TWC for approval. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Byron will identify the preferred habitat substrates for the spiny crayfish and provide this information to the group for use during the IFIM study.

- Shane will change the language in the IFIM Study Plan to reflect a "looking downstream" perspective.

- Shane will add in a section describing the process steps of the IFIM study with an expanded section on TWC consultation. He will also expand the schedule to include more specific dates and times which will include demonstration flows if possible. He will also add qualifiers to account for bad weather or flows that might inhibit data collection.

- Shane will add in a section to the IFIM Study Plan discussing Dual Flow Analysis. He will also add in a few sentences discussing the information collection on Robust Redhorse spawning areas. Additionally, once Byron provides the information regarding preferred spiny crayfish habitat substrates, Shane will include this in the IFIM Study Plan.

- Kleinschmidt will update the Navigational Flows Study Plan with information on two-way navigation and redistribute to the Recreation TWC.

DUAL FLOW ANALYSIS

- The basic WUA/flow relationship is the foundation
- Base flow/generating flow couplets of interest are identified
- Key species/lifestages (or guilds) are strategically selected
- Effectively available habitat for a study site[1] is calculated at pairs of stream flows: (base) non-peaking and a (generation) peaking flow.
- Dual Flow analysis only records WUA corresponding to the lower (*"effectively available"*) of the two paired values. If the habitat value is zero at either the low or high flow, then the value for that pairing is zero.
-

Example:

basic WUA/flow relationship (*example from Chippewa River, WI*):

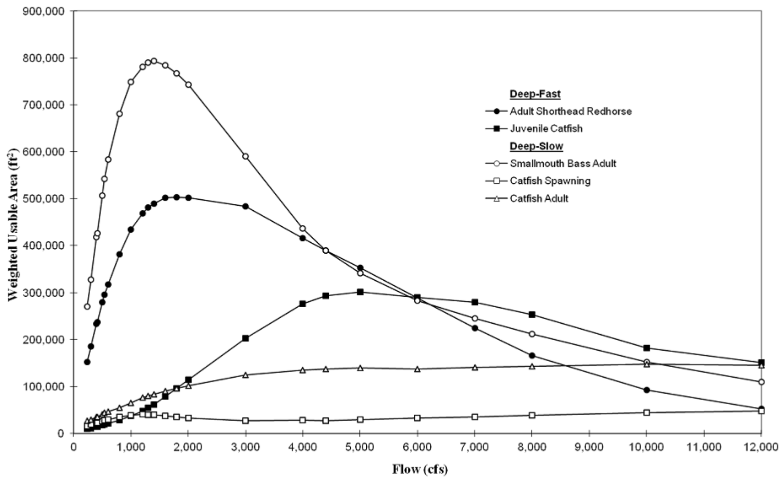
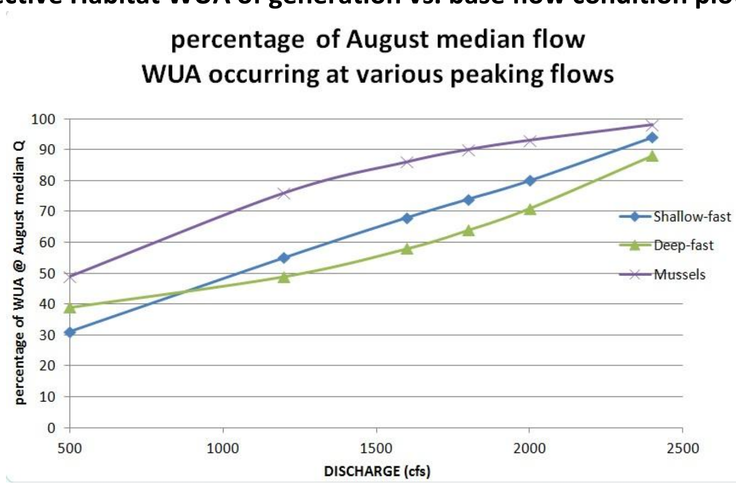


Figure 4. Habitat-discharge relations for fishes in Deep-Fast and Deep-Slow habitat guilds within the Cornell Project instream flow study area.

Effective Habitat WUA of generation vs. base flow condition plotted



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[1] For non-mobile life stages such as macroinvertebrates or nest spawning, calculations can optionally be performed at the cell level using the "HABEF" routine in PHABSIM

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Fisheries TWC Meeting

April 1, 2014

Final KDM 05-06-14

ATTENDEES:

Bill Marshall (SCDNR)	Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)	Ray Ammarell (SCE&G)
Steve Summer (SCANA)	Randy Mahan (SCANA)
Henry Mealing (Kleinschmidt)	Hal Beard (SCDNR)
Dick Christie (SCDNR)	Fritz Rohde (NOAA) via conference call
Kelly Miller (Kleinschmidt)	Vivianne Vejdani (SCDNR)
Byron Hamstead (USFWS)	Gerrit Jobsis (American Rivers)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting with introductions. Ray then gave the group a presentation on lake level fluctuations. This presentation was an updated version of the one given at the last Fisheries TWC meeting, held on December 19, 2013. Ray addressed the stakeholder requests to examine wet and dry years and how they might affect fluctuations. He also added in data collected in 2013. The updated presentation is included at the end of these notes.

After Ray's presentation, the group reviewed the comments received from SCDNR on the Fluctuation Study Plan. Dick mentioned that some of the comments submitted may not be applicable anymore, after discussion with members of the TWC. Henry said that many of SCDNR's comments were actually related to the addition of more information on the fish that could be affected by the fluctuations.

In Section 2.0, information is included on the percentage of shoreline that is affected by the fluctuations at Parr and Monticello Reservoir. SCDNR mentioned that this information was very important to them. Henry said that mitigation efforts at Monticello Reservoir should be focused on areas with gentle slopes (less than 25% slope), which are typically found in the upstream portions of the reservoir. There is a higher potential for habitat enhancement in these areas. Dick said that collecting elevations at study sites needs to be listed in the study objectives section. He said that elevation of habitat enhancements (spawning benches, gravel beds, ect.) is critical to their successfulness. Largemouth bass are obviously spawning in Monticello Reservoir, most likely in deeper waters, because that is the more stable habitat in relation to water levels. Therefore, having a spawning bench that is located 1-2 feet below low pool (which is covered by approximately 5 feet during high pool) would be expected to be used by fish. Dick mentioned the need to evaluate the feasibility of various enhancement measures so that accurate recommendations can be made. He suggested evaluating centrarchids, which spawn in summer months in Monticello Reservoir.

SCDNR submitted a comment on the study plan requesting the use of the Recreation Lake as a control to help evaluate the impacts in Monticello Reservoir. The group decided that this was unnecessary since the objective of the study at Monticello Reservoir is more qualitative. Dick said that since we already have determined how much shoreline can be exposed in Monticello Reservoir during fluctuations (approximately 333 acres), it is more important to focus on enhancement measures than to spend a lot of effort on quantifying impacts.

SCDNR is less interested in exploring habitat enhancements on Parr Reservoir because the potential for making meaningful habitat enhancements on Parr would be difficult due to of the magnitude of fluctuations. Monticello Reservoir has a lower magnitude of fluctuation where habitat enhancement has a better chance of benefitting the aquatic resource. Gerrit said that American Rivers isn't interested in skipping to mitigation without considering the possibility of adjusting the fluctuation range. He said that it is state law to maintain navigable waters, which isn't always something that can be mitigated. Gerrit said he has heard many people say it is difficult to navigate Parr Reservoir and so we need to determine what the navigation hindrance is and quantify it. Henry said this is why a quantification element was included in the study plan. Henry said if Gerrit has specific information from boaters and anglers on locations where navigation is difficult, he should share this information so that it can be considered during the study. Milton and Steve identified a few areas in Parr Reservoir where navigation could possibly be an issue, and so transects will be established in these areas during the study. The group discussed the state navigation criteria for rivers. There are no state-established navigation criteria for reservoirs. Hal said that the navigability of a reservoir or river also depends on the experience of the navigator. Bill M. said that it is important that people can get in and out of the boat ramps on Parr Reservoir. This information will be collected during the proposed Recreation Use and Needs Study that will be included in the PAD. Viviane shared that SCDHEC has a general "guideline" that no more than one-third the waterway should be obstructed for navigation by a proposed structure. This relates to building a structure in the waterway but could be interpreted that one-third the waterway should be left open for public navigation. The group continued to discuss the possibility of establishing navigation criteria for reservoirs. Byron asked the TWC if determining navigation criteria is necessary before approving the proposed methodology in the study plan. Should we focus on finalizing the methodology proposed in the study plan and discuss navigation criteria later? Henry mentioned that one way to improve navigation in Parr Reservoir is to increase signage and create maps that display the best navigation routes.

The group decided to amend the study plan so that the study objectives are listed separately for Parr and Monticello Reservoirs. It was also discussed that the Parr study would include data that would help qualify how reservoir fluctuations may affect navigation in the reservoir. For example what happens when there is a 5 ft or 9 ft drawdown? What portions of the reservoir are potentially impacted in relation to dewatering of aquatic habitat and constricted channel (navigation).

Henry reminded the group that the fluctuation study will not include the same methodology as an IFIM study. This study will focus more on documenting the reservoirs at various pool elevations through pictures and some transect data. Henry said that TWC members are welcome to help choose the transects for each reservoir. Byron said that identifying slope (bed topography) and documenting habitat type along each transect will address the USFWS's concerns regarding impacted habitat.

Gerrit mentioned that the polygons on the maps included in the study plan need to extend from shoreline to shoreline. Milton said he would change the maps to show this.

The group then discussed the methodology for studying Monticello Reservoir. The group decided that pictures will be taken along the shoreline to document effects. Henry also said that the group can pick two characteristic areas, such as a cove or an island, to document for use in determining appropriate mitigation measures. The group then looked at some pictures Dick pulled together displaying the various types of habitat enhancements that could be used at Monticello. Hal asked how much area is going to be covered with enhancements and is this only going to be done one time. Dick said that all of those terms will be negotiated later in the process. Vivianne said that an Army Corps of Engineers permit may be required before installing any fish attractors. This is something the group needs to keep in mind later in the process.

Bill M. asked if the group foresees any habitat enhancement at Parr. Henry said that enhancement measures could possibly be implemented in backwater areas. Hal said that he believes enhancement efforts should be focused on areas that are more likely to get a response from fish, such as in Monticello Reservoir. The group decided to focus on identifying areas in Parr Reservoir to study and evaluate the potential for enhancement measures pending the results of the study.

Edits will be made to the study plan including separating the objectives section into two subsections for Parr and Monticello. The edited objectives section will be distributed to the TWC for approval via email. A complete draft version of the study plan will then be sent out to the TWC and a meeting will be scheduled to discuss the edits. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Kleinschmidt will revise the study plan to include comments and edits discussed at the meeting. The revised draft study plan will be sent to TWC members for further review and a Fisheries TWC meeting will be scheduled to discuss the revised plan.

- Milton will redo the maps in the study plan to ensure the polygons extend from shoreline to shoreline.

Parr & Monticello Reservoir Fluctuation Update

Parr Hydroelectric Project Relicensing

Fisheries Technical Working Committee

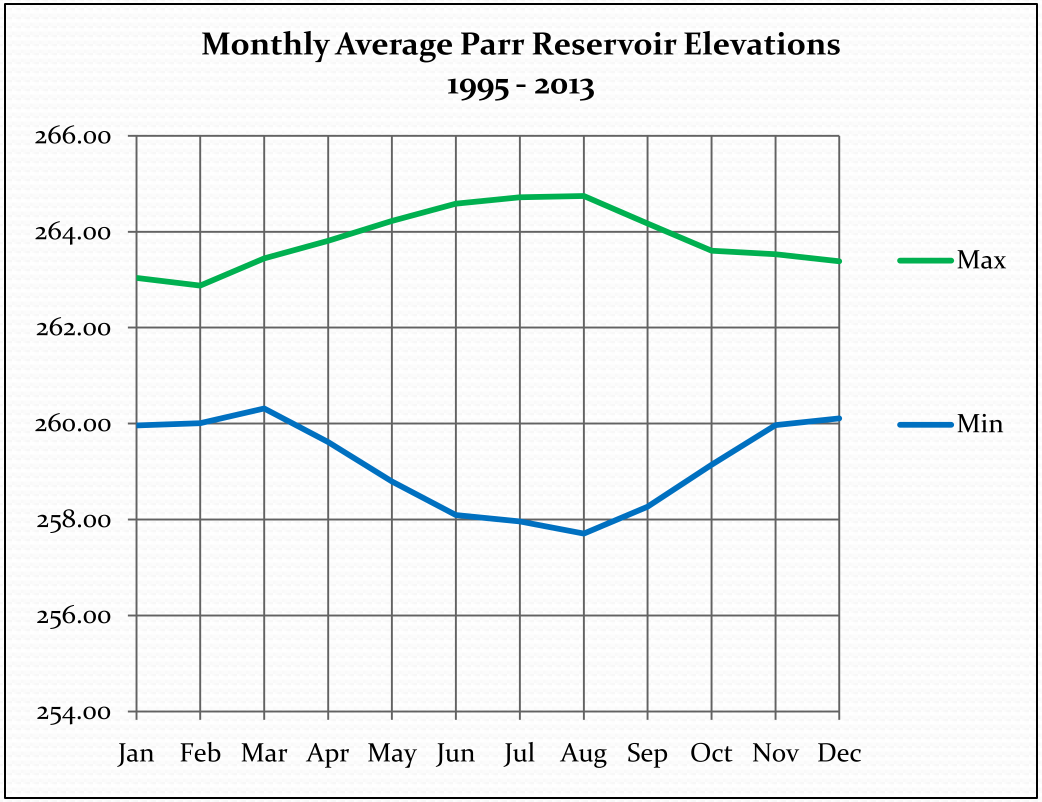
April 1, 2014

Reservoir Data

- Daily minimum and maximum Parr Reservoir levels from USGS station 02160990, Parr Shoals Reservoir at Parr, SC; period of record 1995-2013.
- Daily minimum and maximum Monticello Reservoir levels from SCE&G data; period of record 2005-2013.

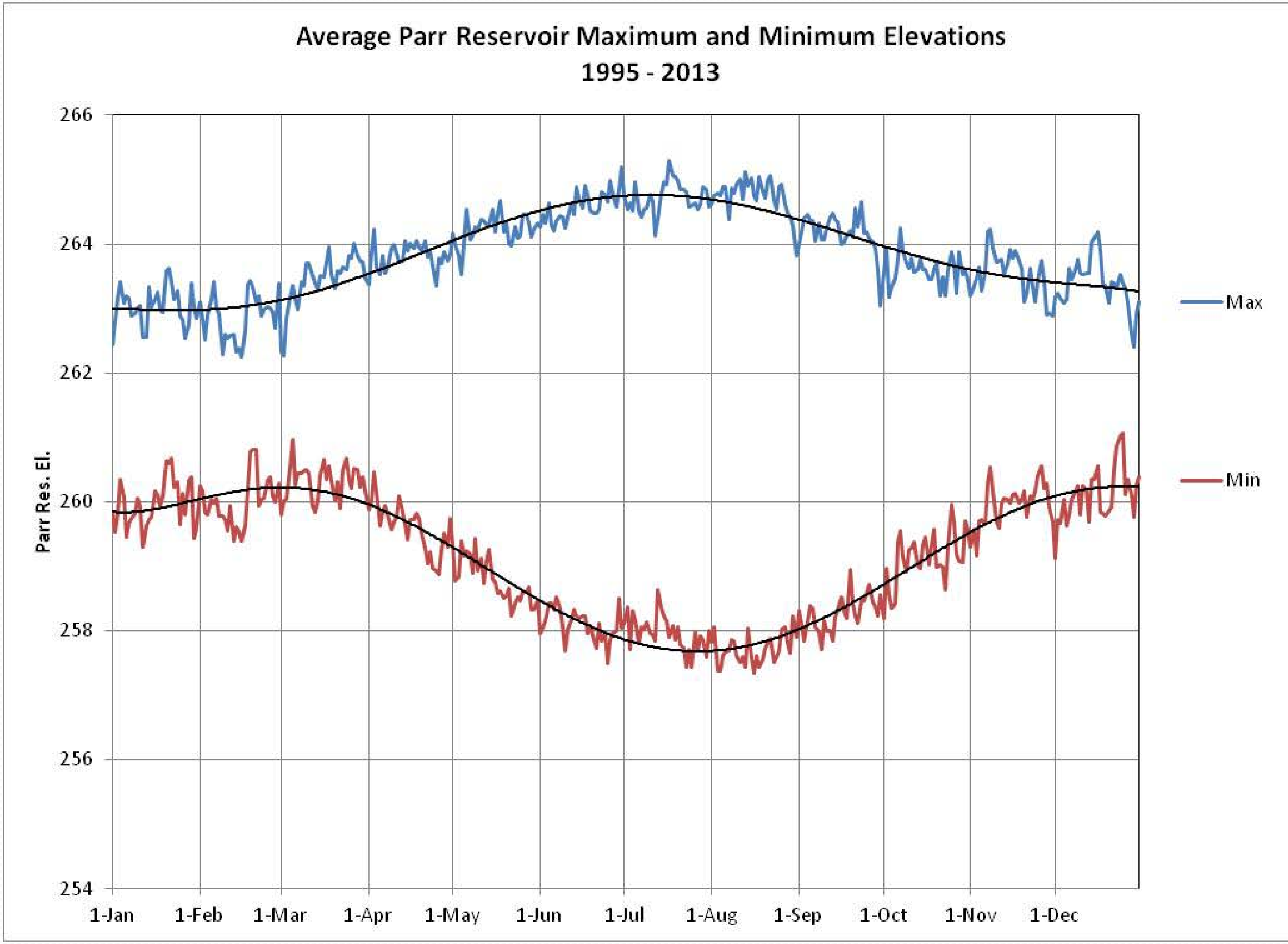
Parr Reservoir Monthly Data 1995-2013

Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	263.04	259.96	3.08
Feb	262.88	260.01	2.87
Mar	263.44	260.32	3.13
Apr	263.81	259.61	4.20
May	264.22	258.79	5.43
Jun	264.59	258.09	6.49
Jul	264.72	257.96	6.75
Aug	264.74	257.71	7.03
Sep	264.17	258.27	5.90
Oct	263.60	259.14	4.46
Nov	263.53	259.97	3.56
Dec	263.38	260.11	3.28
Average	**263.84**	**259.16**	**4.68**



Parr Reservoir Average Daily Fluctuation 1995-2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.63	2.85	2.51	3.49	4.83	6.29	6.63	6.80	5.69	5.38	3.92	4.17
2	3.27	2.64	2.25	3.87	5.21	6.42	6.17	6.69	6.08	4.96	3.76	3.56
3	3.33	2.67	2.80	3.77	4.99	6.16	6.92	7.39	6.56	4.63	4.29	3.56
4	3.06	3.10	2.64	3.49	4.13	6.21	6.22	7.37	6.31	5.00	3.93	3.06
5	3.00	3.10	2.38	3.88	4.85	5.85	6.79	7.26	5.98	5.04	3.55	3.55
6	3.74	3.44	2.89	3.97	5.29	5.86	6.72	7.23	6.01	4.41	3.92	3.81
7	3.48	2.93	2.53	3.60	4.89	5.85	6.36	6.70	6.01	4.70	3.91	3.46
8	3.14	3.13	2.98	3.84	5.23	6.08	6.52	6.99	6.33	4.76	3.68	3.53
9	3.11	2.51	2.87	4.35	4.82	6.37	6.43	6.95	6.35	4.79	3.77	3.61
10	2.97	2.87	3.20	4.30	5.29	6.56	6.80	7.31	5.93	4.38	4.03	3.78
11	3.11	2.99	3.25	4.08	5.26	6.40	6.71	7.48	6.25	4.50	4.16	3.43
12	3.26	2.64	3.57	3.62	5.62	6.46	6.30	7.10	6.43	4.21	3.78	3.50
13	2.92	3.22	3.55	3.90	5.25	6.13	5.75	7.69	6.63	4.61	3.48	3.88
14	3.61	2.72	3.28	4.40	5.05	6.65	6.44	6.87	6.16	4.79	3.66	3.79
15	3.26	2.85	3.09	4.46	5.74	6.52	6.72	7.44	6.01	4.27	3.94	3.82
16	2.96	2.86	2.83	4.28	5.43	6.32	6.77	7.42	5.46	4.14	3.66	3.72
17	3.14	3.03	3.37	4.21	5.90	6.68	7.38	7.05	5.74	4.42	3.76	4.20
18	3.04	3.17	3.39	4.22	6.05	6.79	7.00	7.60	5.92	4.10	3.77	3.64
19	2.88	2.65	3.21	4.22	5.67	6.44	7.17	7.28	5.25	4.04	3.58	3.61
20	2.95	2.51	3.30	4.38	5.79	6.61	6.92	6.99	5.69	4.72	2.92	3.28
21	3.03	2.30	3.29	4.77	5.35	6.76	7.05	7.14	6.32	4.16	3.47	3.60
22	2.73	3.27	3.65	4.75	5.74	6.43	7.13	7.17	6.15	4.50	3.53	2.86
23	2.91	2.85	3.16	4.67	5.84	6.98	7.39	7.16	6.18	4.56	3.31	2.42
24	2.98	2.92	2.93	4.71	5.57	6.82	6.86	6.93	5.71	4.31	2.93	2.55
25	3.23	2.71	3.47	4.42	5.65	7.16	7.16	7.19	5.60	3.92	3.04	2.39
26	2.69	2.61	3.56	4.92	5.85	7.11	6.66	6.91	5.37	4.00	3.28	3.16
27	2.74	2.86	3.50	4.44	5.85	6.82	6.84	6.56	5.58	4.05	3.11	2.81
28	2.44	2.70	3.32	4.36	5.65	6.58	6.70	6.66	5.55	4.80	2.65	2.61
29	3.01	3.11	3.51	4.44	5.78	6.34	7.03	6.76	5.38	4.46	3.08	2.72
30	3.59		3.34	4.09	5.90	7.15	7.26	6.05	4.47	3.88	3.31	2.76
31	3.26		3.29		5.86		6.57	5.92		3.87		2.78
Average	**3.08**	**2.87**	**3.13**	**4.20**	**5.43**	**6.49**	**6.75**	**7.03**	**5.90**	**4.46**	**3.57**	**3.34**

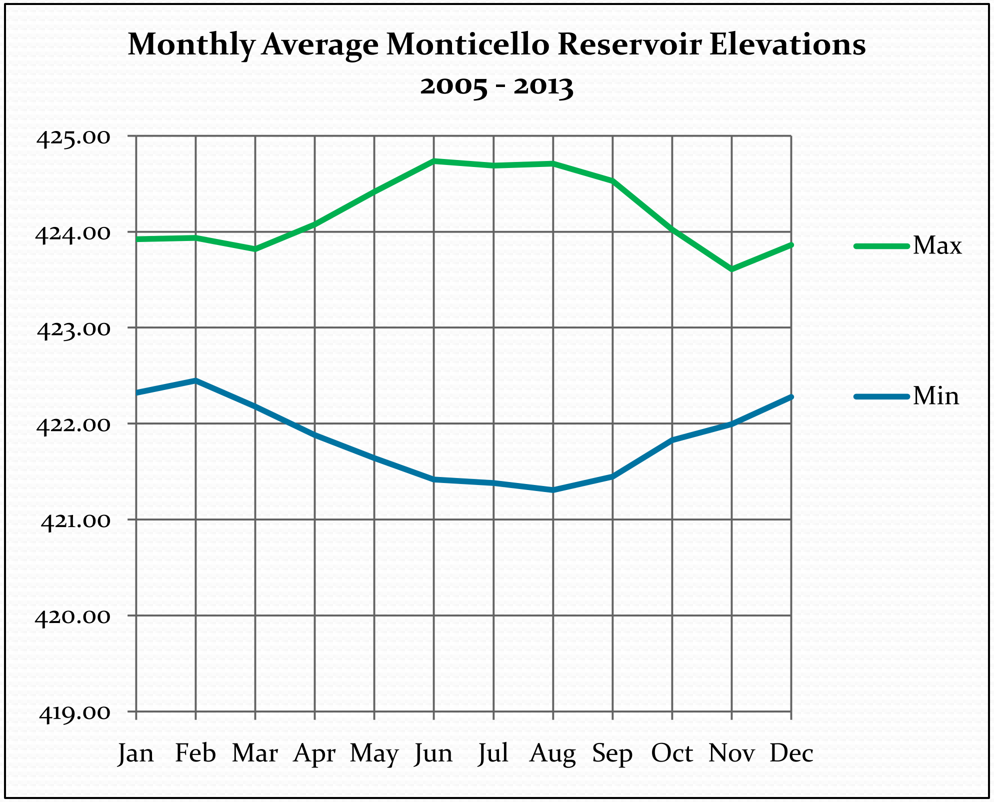

Average Parr Reservoir Maximum and Minimum Elevations
1995 - 2013
Parr Res. El.
266
264
262
260
258
256
254
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min

Parr Reservoir Summary

- February has smallest average fluctuation – 2.87 feet.
- August has largest average fluctuation – 7.03 feet.
- Average fluctuation for year is 4.68 feet.
- Average fluctuation March – May is 4.25 feet.
- Average fluctuation April – July is 5.72 feet.

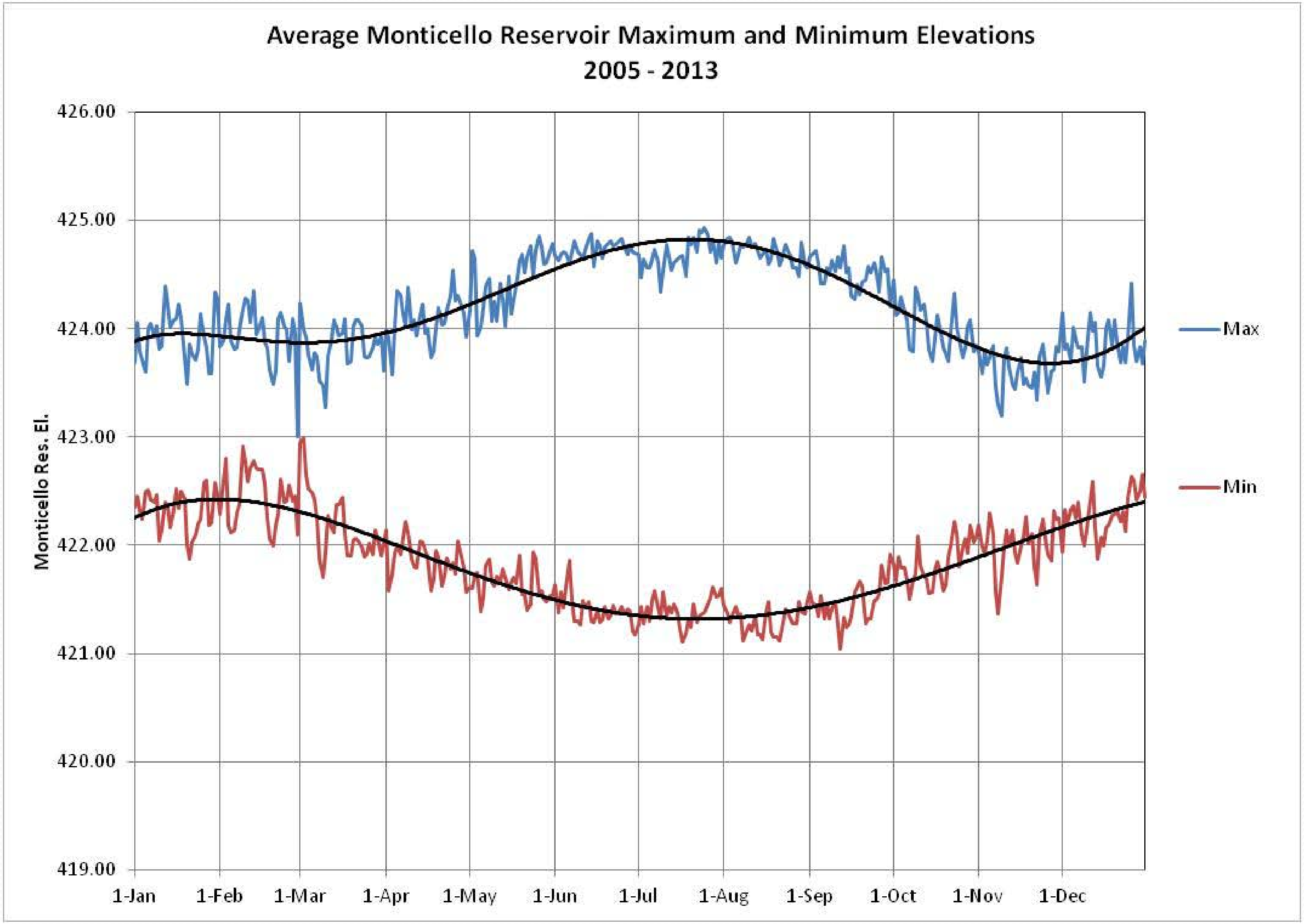
Monticello Reservoir Monthly Data 2005-2013

Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	423.92	422.32	1.60
Feb	423.93	422.45	1.49
Mar	423.82	422.18	1.66
Apr	424.08	421.88	2.22
May	424.42	421.64	2.80
Jun	424.74	421.42	3.33
Jul	424.69	421.38	3.29
Aug	424.71	421.31	3.40
Sep	424.53	421.45	3.06
Oct	424.02	421.83	2.18
Nov	423.61	422.00	1.61
Dec	423.86	422.28	1.58
Average	**424.19**	**421.84**	**2.35**



Monticello Reservoir Average Daily Fluctuation 2005-2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.33	1.54	1.29	1.84	2.56	3.04	3.42	3.33	3.10	2.63	1.60	2.21
2	1.60	1.29	1.00	2.33	3.12	3.26	3.04	3.45	3.22	2.46	1.61	1.48
3	1.47	1.29	1.28	1.84	2.93	3.12	3.37	3.56	3.28	2.26	1.87	1.64
4	1.47	2.03	1.23	2.09	2.19	3.29	3.13	3.44	3.26	2.50	1.63	1.38
5	1.10	1.77	1.13	2.37	2.62	3.09	3.27	3.18	2.89	2.37	1.43	1.64
6	1.49	1.67	1.36	2.39	2.67	2.76	3.16	3.34	3.10	2.40	1.73	1.64
7	1.62	1.52	1.50	2.06	2.59	3.22	3.16	3.41	3.10	2.31	1.89	1.42
8	1.52	1.61	1.66	1.81	2.59	3.51	3.20	3.63	3.18	2.11	1.93	1.73
9	1.56	1.27	1.78	2.27	2.41	3.41	3.01	3.58	3.22	2.66	1.48	1.52
10	1.78	1.51	1.34	2.12	2.62	3.42	2.97	3.58	3.06	2.22	1.74	1.66
11	1.69	1.67	1.47	2.28	2.36	3.16	3.43	3.54	3.40	2.36	1.68	1.72
12	2.00	1.34	1.73	2.14	2.76	3.31	3.23	3.44	3.52	2.51	1.66	1.39
13	1.84	1.57	1.96	2.09	2.49	3.36	3.17	3.54	3.43	2.37	1.34	1.89
14	1.84	1.23	1.63	2.20	2.32	3.58	3.16	3.48	3.28	2.26	1.52	1.79
15	1.74	1.30	1.56	2.00	2.90	3.29	3.27	3.56	3.30	2.13	1.77	1.49
16	1.57	1.40	1.51	2.11	2.48	3.41	3.44	3.34	2.96	2.14	1.74	1.67
17	1.88	1.31	1.98	2.16	2.57	3.48	3.57	3.12	2.70	2.28	1.41	1.83
18	1.59	1.57	1.78	2.11	2.76	3.34	3.30	3.44	2.80	2.24	1.28	1.89
19	1.30	1.57	1.80	2.06	2.73	3.32	3.52	3.68	2.64	2.24	1.47	1.57
20	1.50	1.50	1.98	2.30	3.14	3.47	3.53	3.57	2.81	2.13	1.34	1.79
21	1.99	1.42	2.02	2.41	2.98	3.46	3.39	3.47	3.18	1.81	1.81	1.56
22	1.74	1.80	2.04	2.33	3.27	3.32	3.42	3.41	3.26	1.98	1.71	1.47
23	1.61	1.53	2.04	2.29	3.31	3.41	3.57	3.37	3.20	2.10	1.66	1.52
24	1.61	1.62	1.86	2.52	2.54	3.42	3.52	3.34	3.12	1.90	1.61	1.56
25	1.89	1.58	1.82	2.71	2.84	3.40	3.56	3.36	3.01	2.10	1.59	1.48
26	1.34	1.15	1.73	2.52	3.31	3.39	3.41	3.29	2.79	1.76	1.50	1.79
27	1.22	1.68	1.91	2.27	3.18	3.28	3.20	3.29	2.86	1.77	1.76	1.24
28	1.40	1.50	1.78	2.32	3.10	3.39	3.21	3.01	2.89	2.10	1.30	1.28
29	1.38	0.90	1.80	2.34	3.13	3.50	3.09	3.41	2.90	1.89	1.59	1.33
30	1.76		2.02	2.36	3.19	3.52	3.27	3.22	2.29	1.77	1.53	1.02
31	1.81		1.60		3.26		3.06	3.08		1.78		1.44
Average	**1.60**	**1.49**	**1.66**	**2.22**	**2.80**	**3.33**	**3.29**	**3.40**	**3.06**	**2.18**	**1.61**	**1.58**


Average Monticello Reservoir Maximum and Minimum Elevations
2005 - 2013
Monticello Res. El.
426.00
425.00
424.00
423.00
422.00
421.00
420.00
419.00
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min

Monticello Reservoir Summary

- February has smallest average fluctuation: 1.49 feet.
- August has largest average fluctuation: 3.40 feet.
- Average fluctuation for year is 2.35 feet.
- Average fluctuation March – May is 2.23 feet.
- Average fluctuation April – July is 2.91 feet.

Annual Comparison Graphs

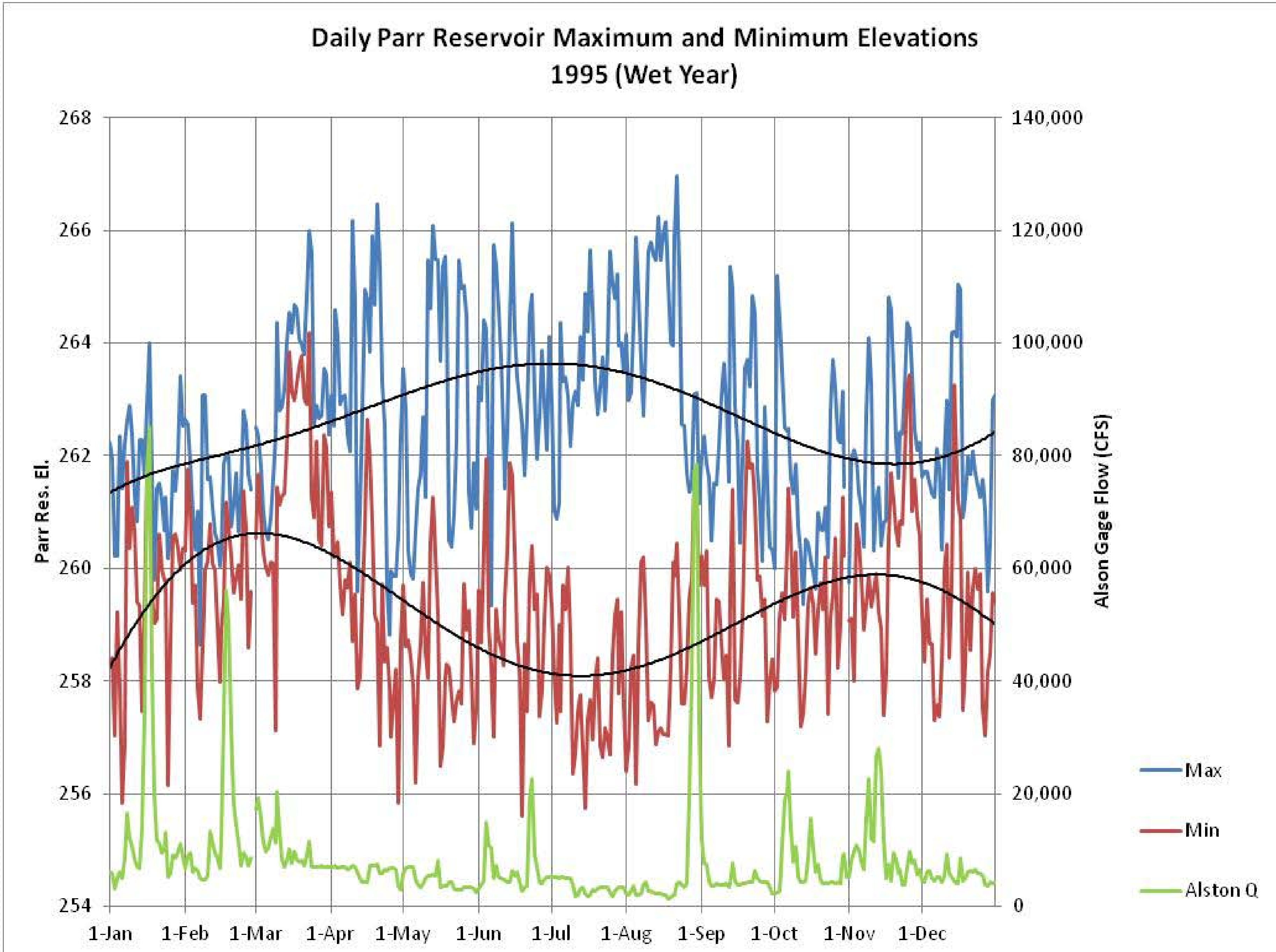
- Pairs of graphs for each year, one each for Parr Reservoir and Monticello Reservoir.
- Years are denoted as "Dry", "Normal", or "Wet" based on percentile rank of annual average flow at Alston gage site for each year during the period 1981 – 2013.
  - < 25^{th} Percentile Rank = "Dry", or Low Flow
  - 25^{th} to 75^{th} Percentile Rank = "Normal"
  - > 75^{th} Percentile Rank = "Wet", or High Flow
- Similar to USGS stream flow ranges.
- Added a polynomial best fit line to show overall trend.

Flow Rankings by Year

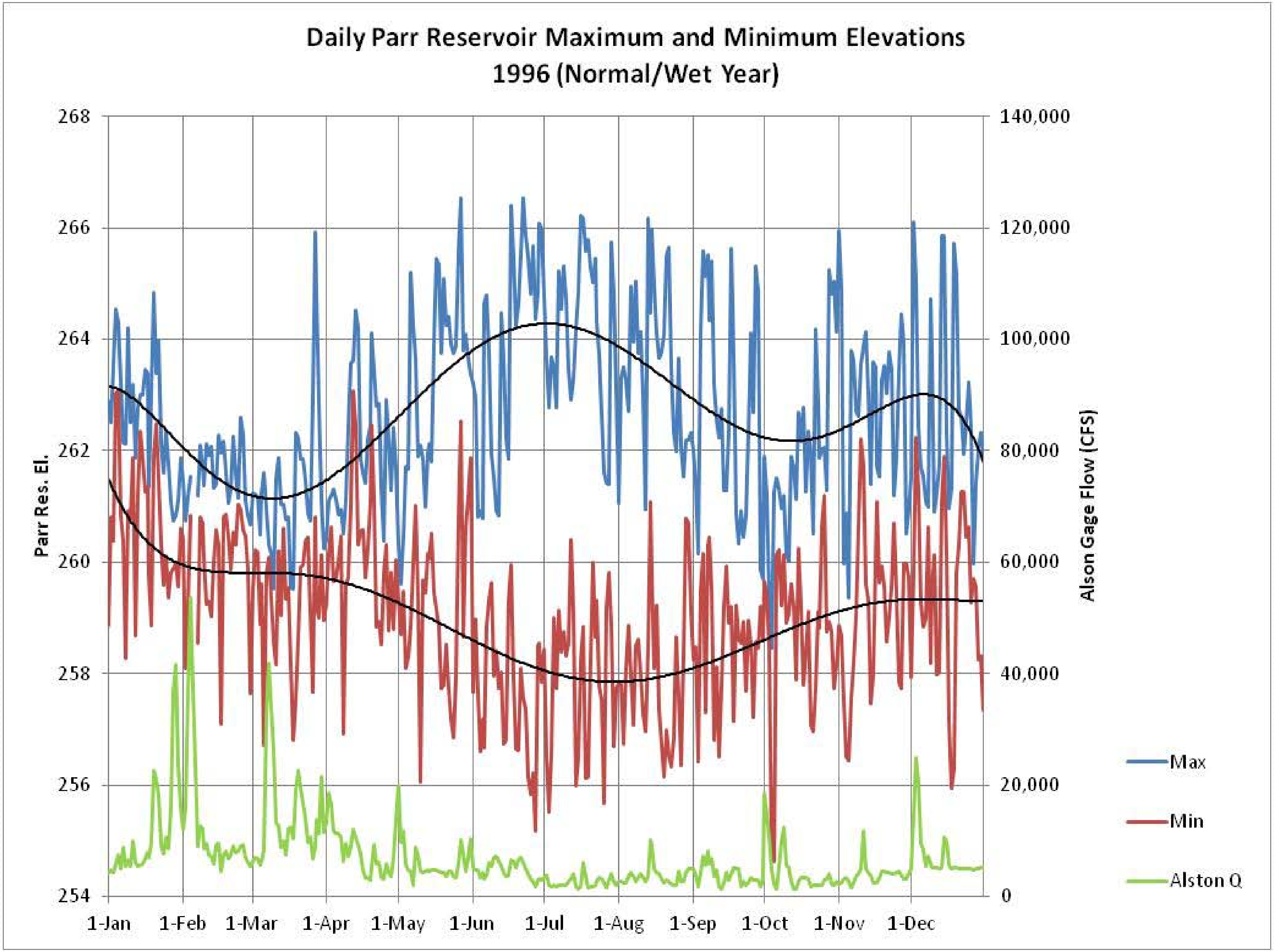
Year	Annual Mean Flow	P-Rank	Flow Range
1981	3313	29%	Normal
1982	6076	65%	Normal
1983	7399	84%	High
1984	7743	94%	High
1985	5295	48%	Normal
1986	4002	35%	Normal
1987	5795	58%	Normal
1988	2897	13%	Low
1989	5536	55%	Normal
1990	7203	81%	High
1991	6530	71%	Normal
1992	6821	74%	Normal
1993	7558	90%	High
1994	6091	68%	Normal
1995	8187	97%	High
1996	6917	77%	High
1997	5949	61%	Normal

Year	Annual Mean Flow	P-Rank	Flow Range
1998	7482	87%	High
1999	3350	32%	Normal
2000	3015	19%	Low
2001	2418	3%	Low
2002	3164	23%	Low
2003	8791	100%	High
2004	5146	45%	Normal
2005	5490	52%	Normal
2006	3186	26%	Normal/Low
2007	2922	16%	Low
2008	2115	0%	Low
2009	4718	42%	Normal
2010	4538	39%	Normal
2011	2483	6%	Low
2012	2499	10%	Low
2013	6459	69%	Normal

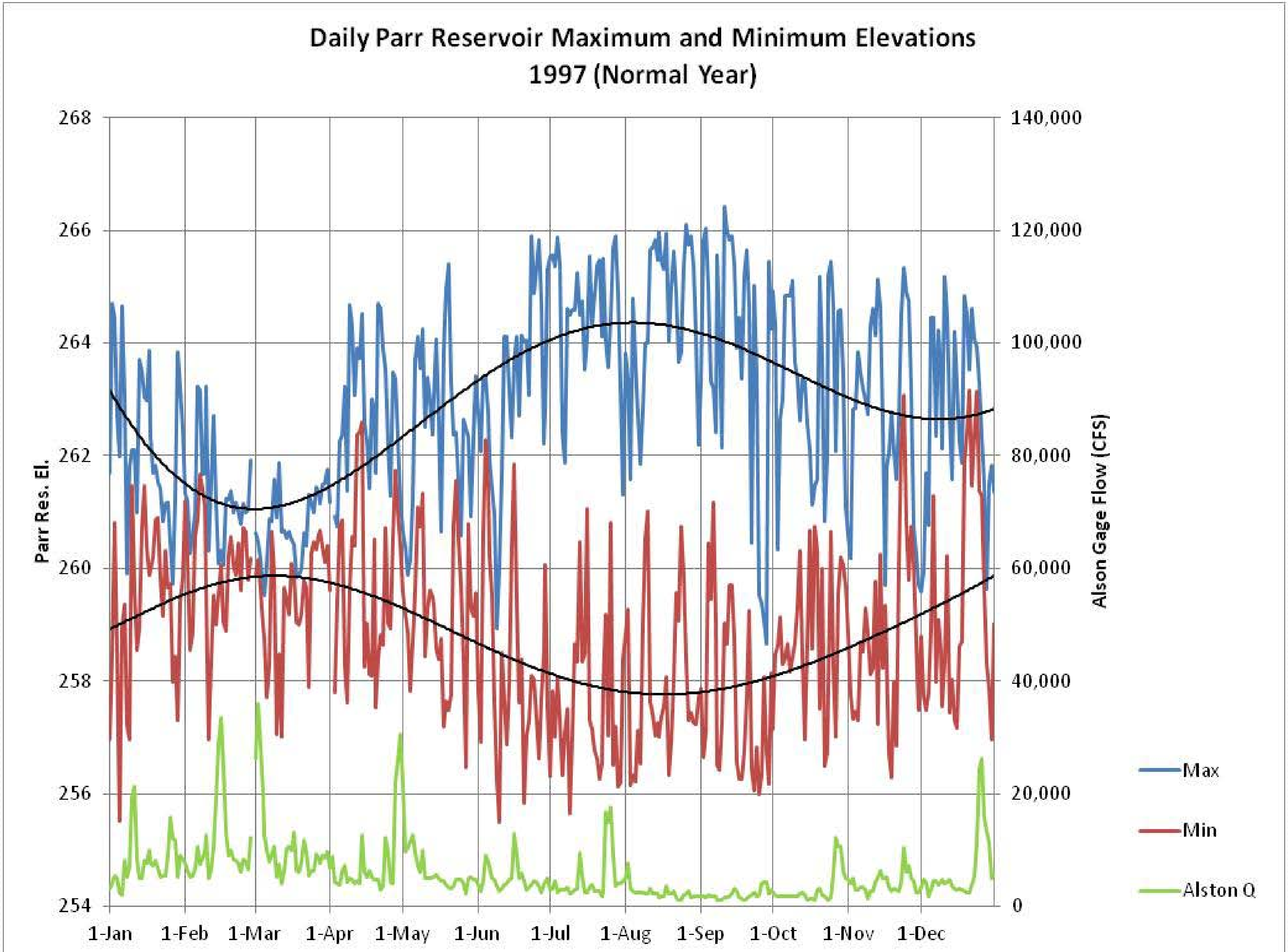
Red years were graphed for Parr Reservoir only. Green years were graphed for both Parr and Monticello Reservoirs.



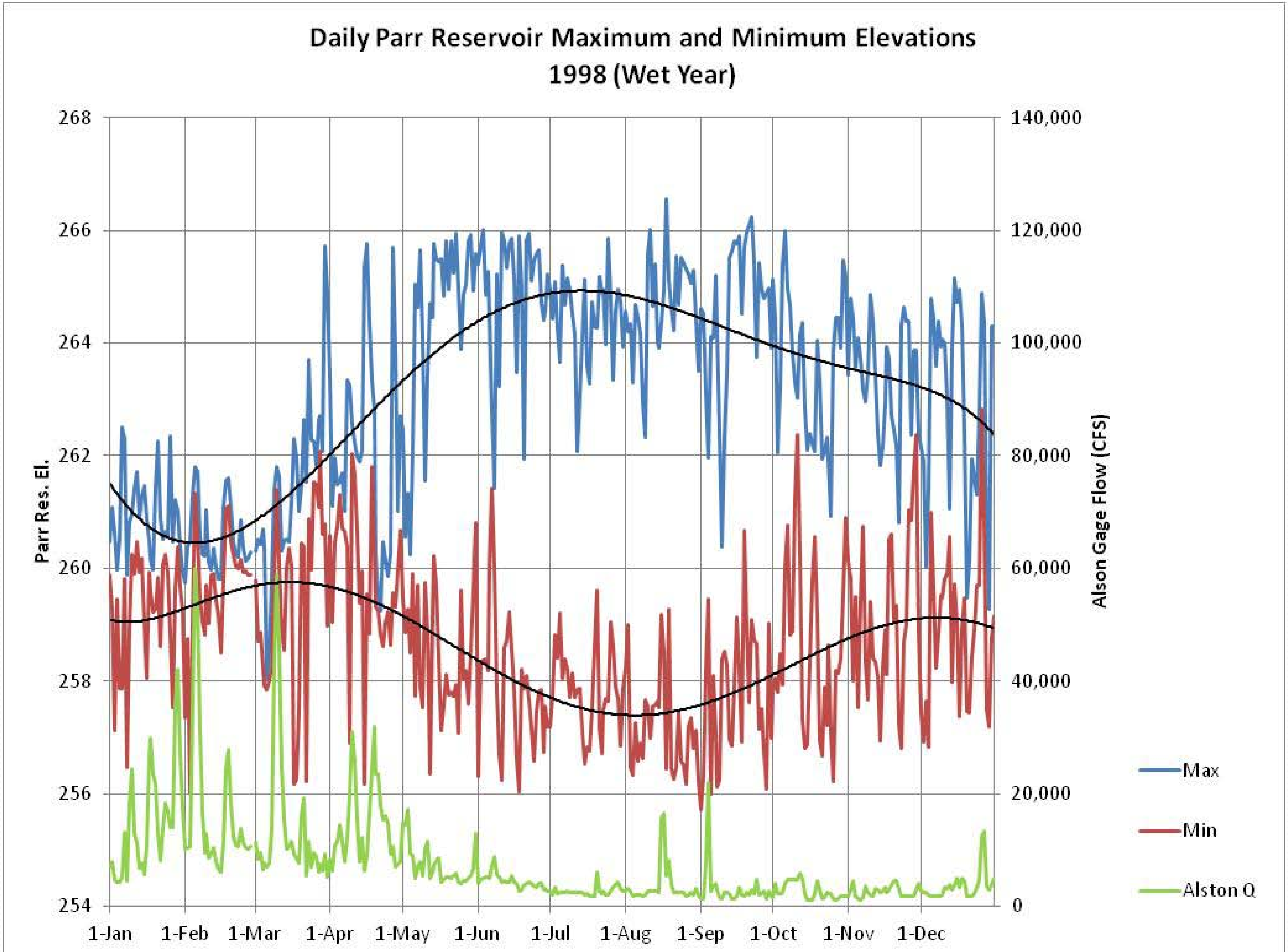
Daily Parr Reservoir Maximum and Minimum Elevations
1995 (Wet Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q



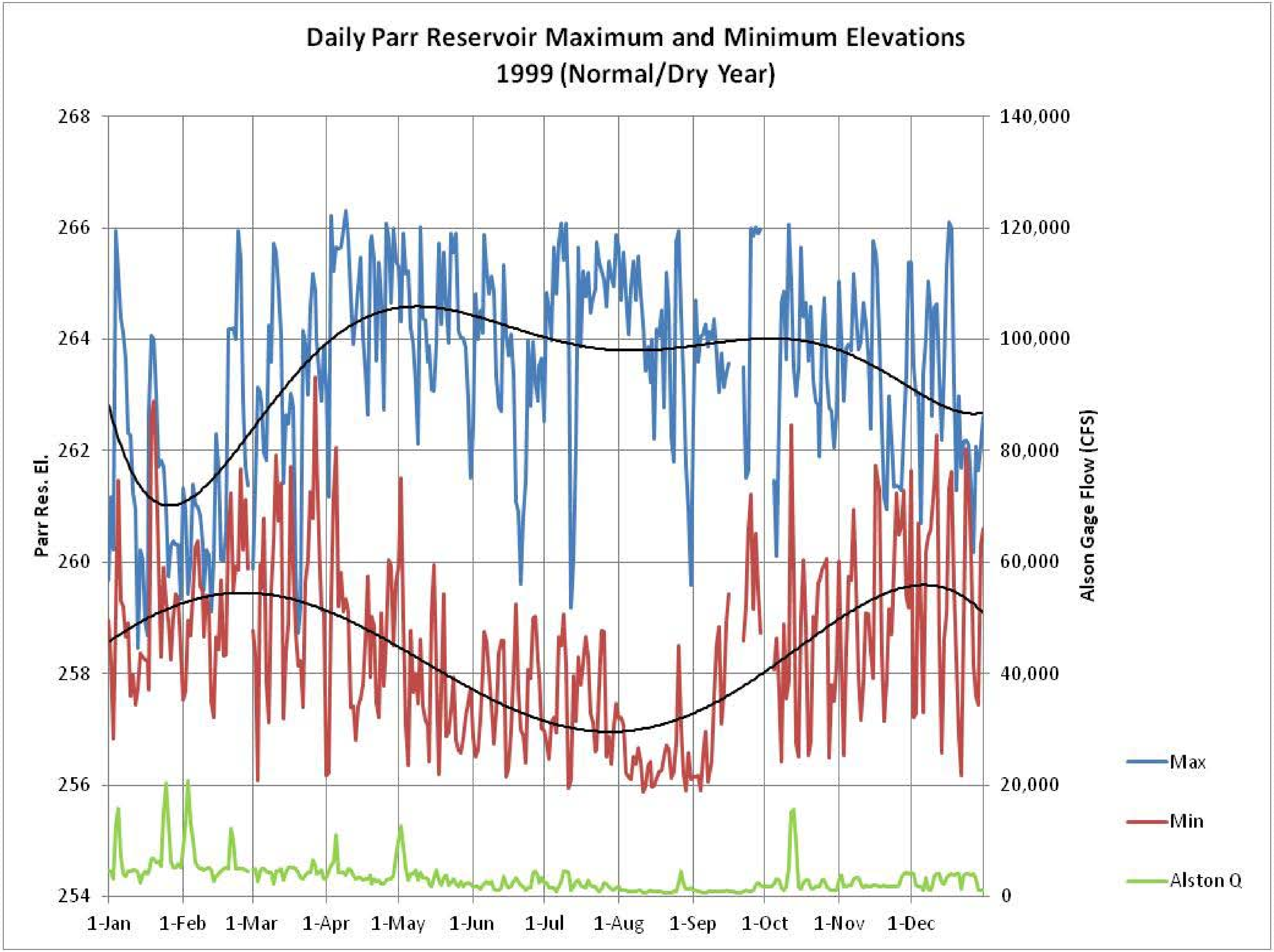
Daily Parr Reservoir Maximum and Minimum Elevations
1996 (Normal/Wet Year)
268
266
264
262
260
258
256
254
Parr Res. El.
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Alson Gage Flow (CFS)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

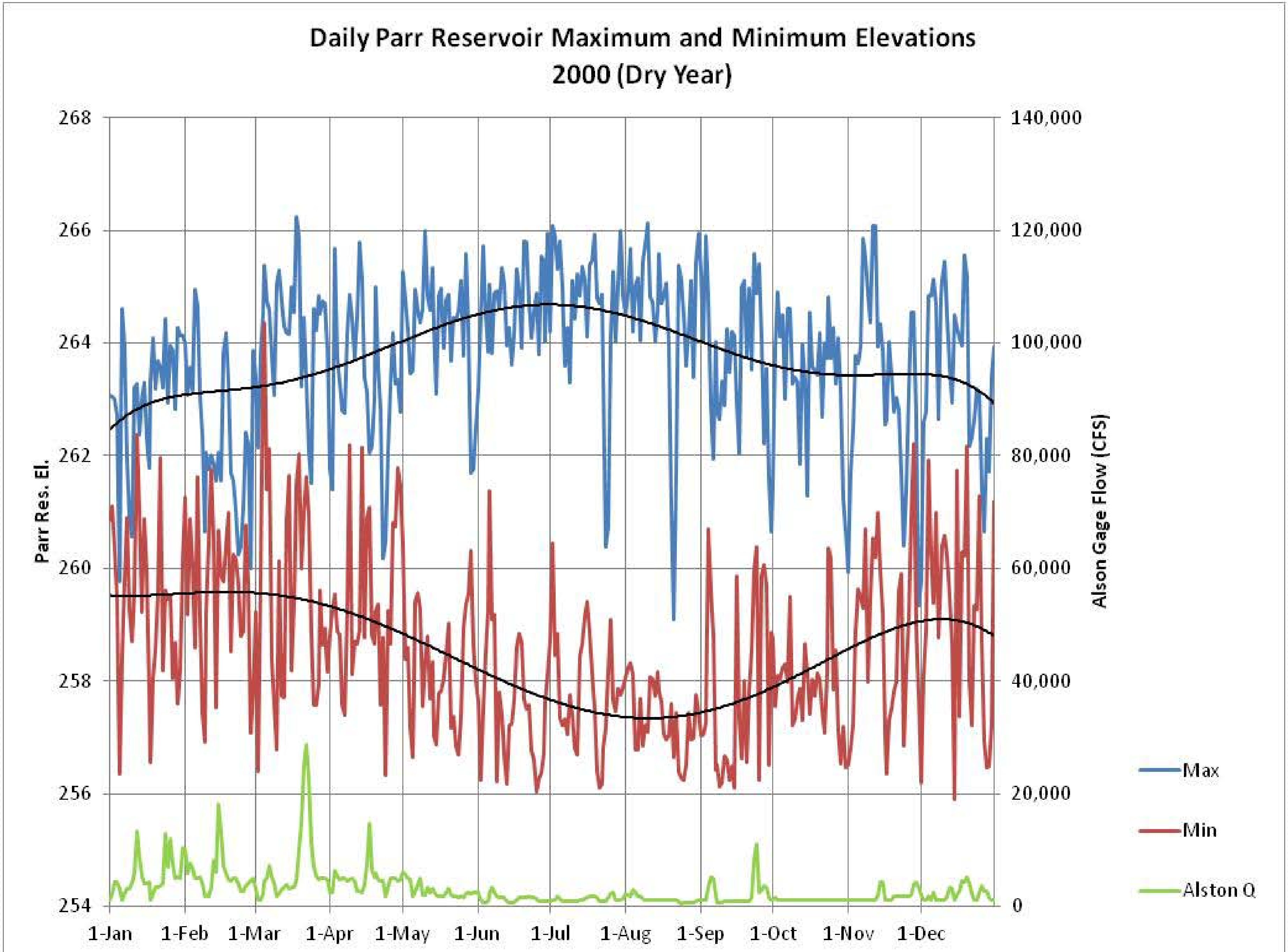


Daily Parr Reservoir Maximum and Minimum Elevations
1997 (Normal Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

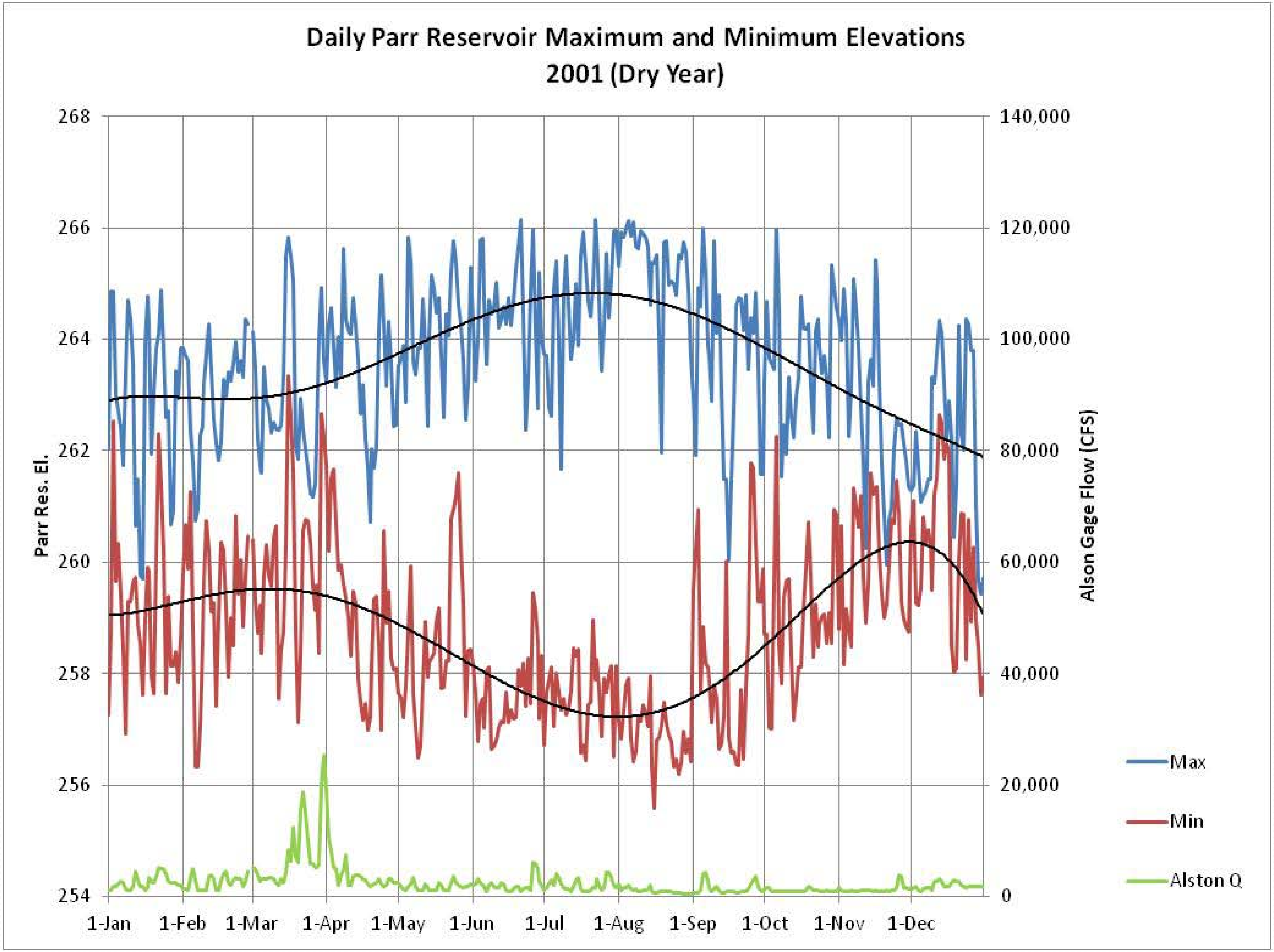


Daily Parr Reservoir Maximum and Minimum Elevations
1998 (Wet Year)
Parr Res. El.
268
266
264
262
260
258
256
254
Alson Gage Flow (CFS)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

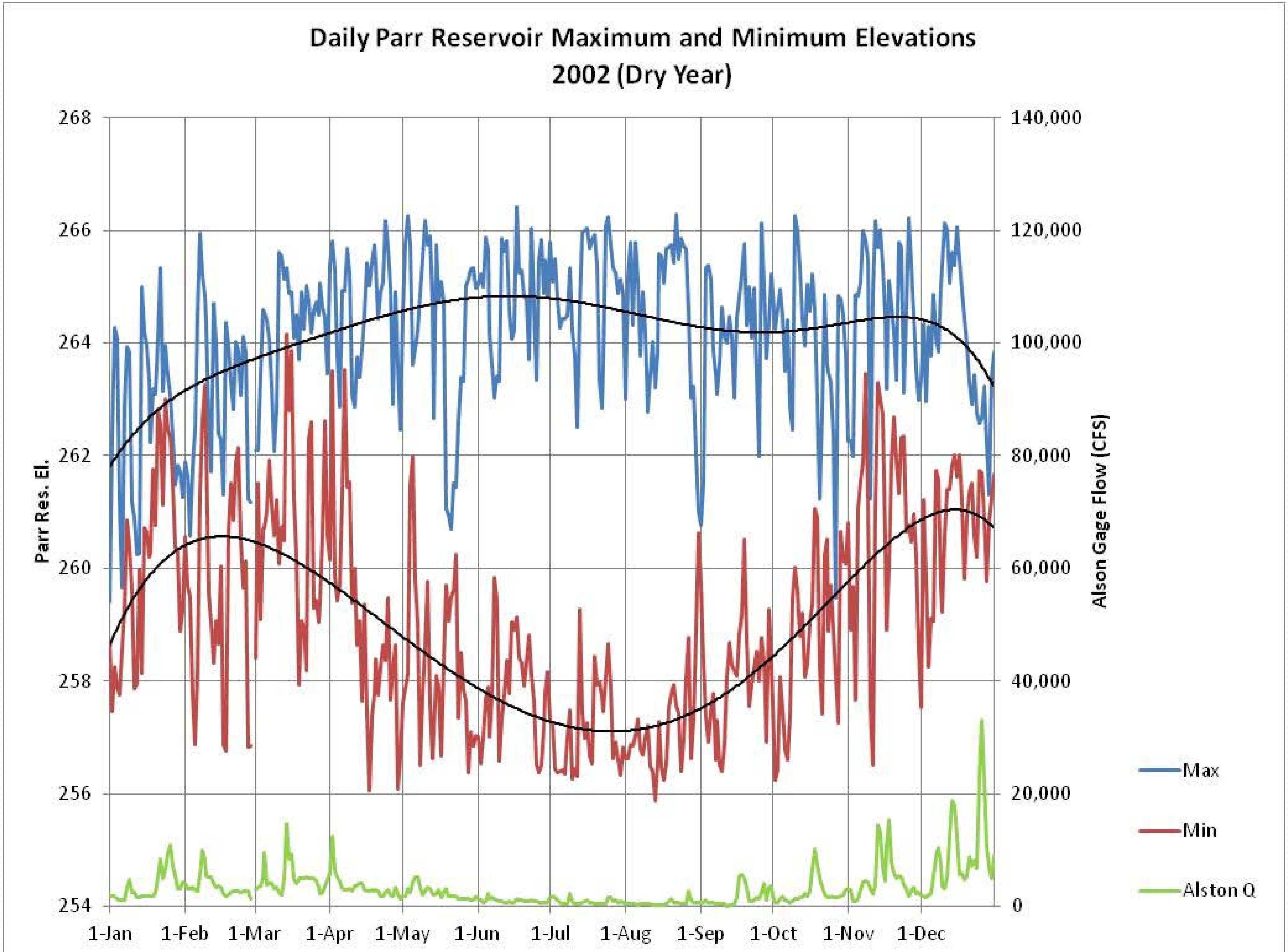

Daily Parr Reservoir Maximum and Minimum Elevations
1999 (Normal/Dry Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

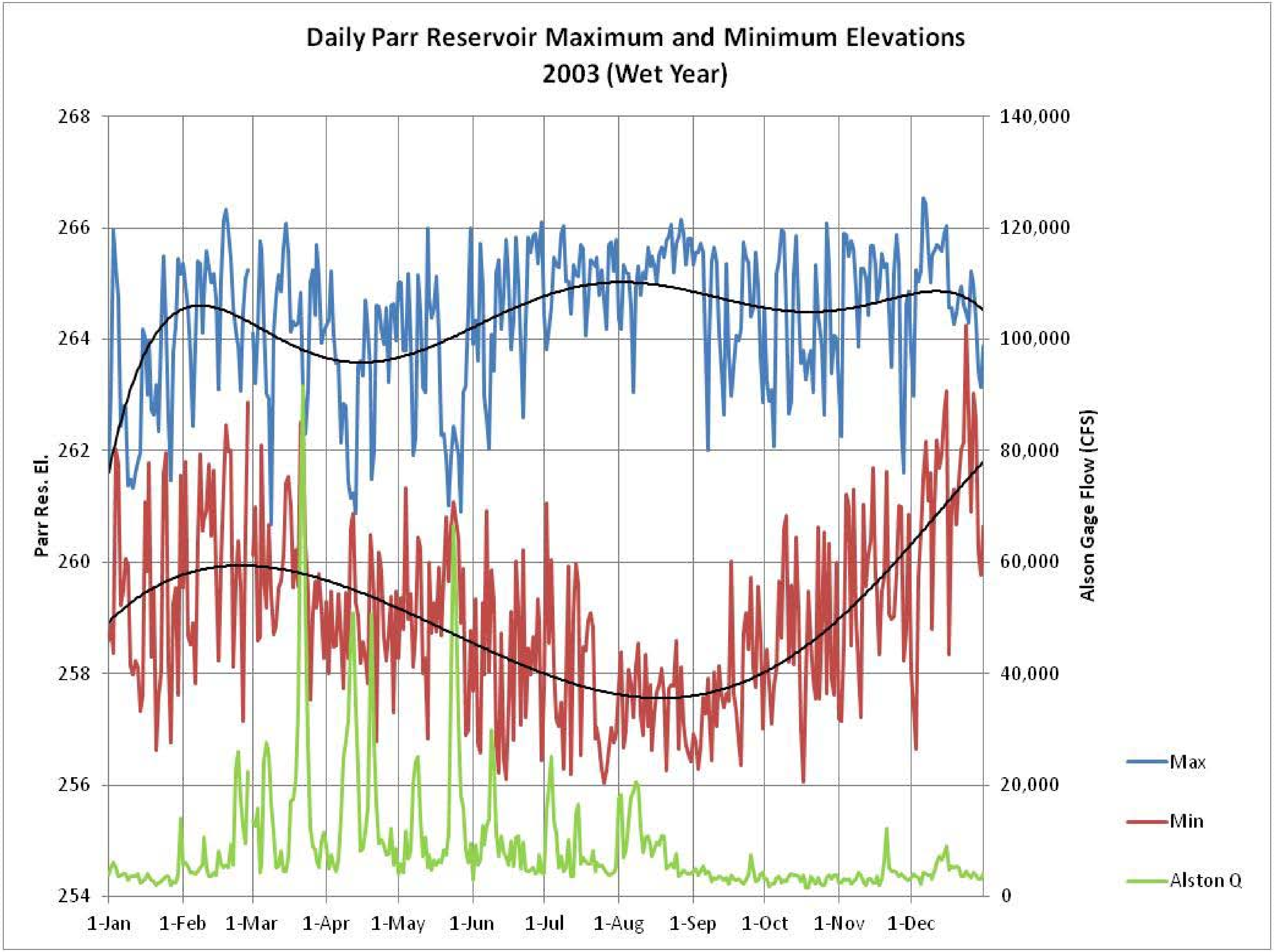


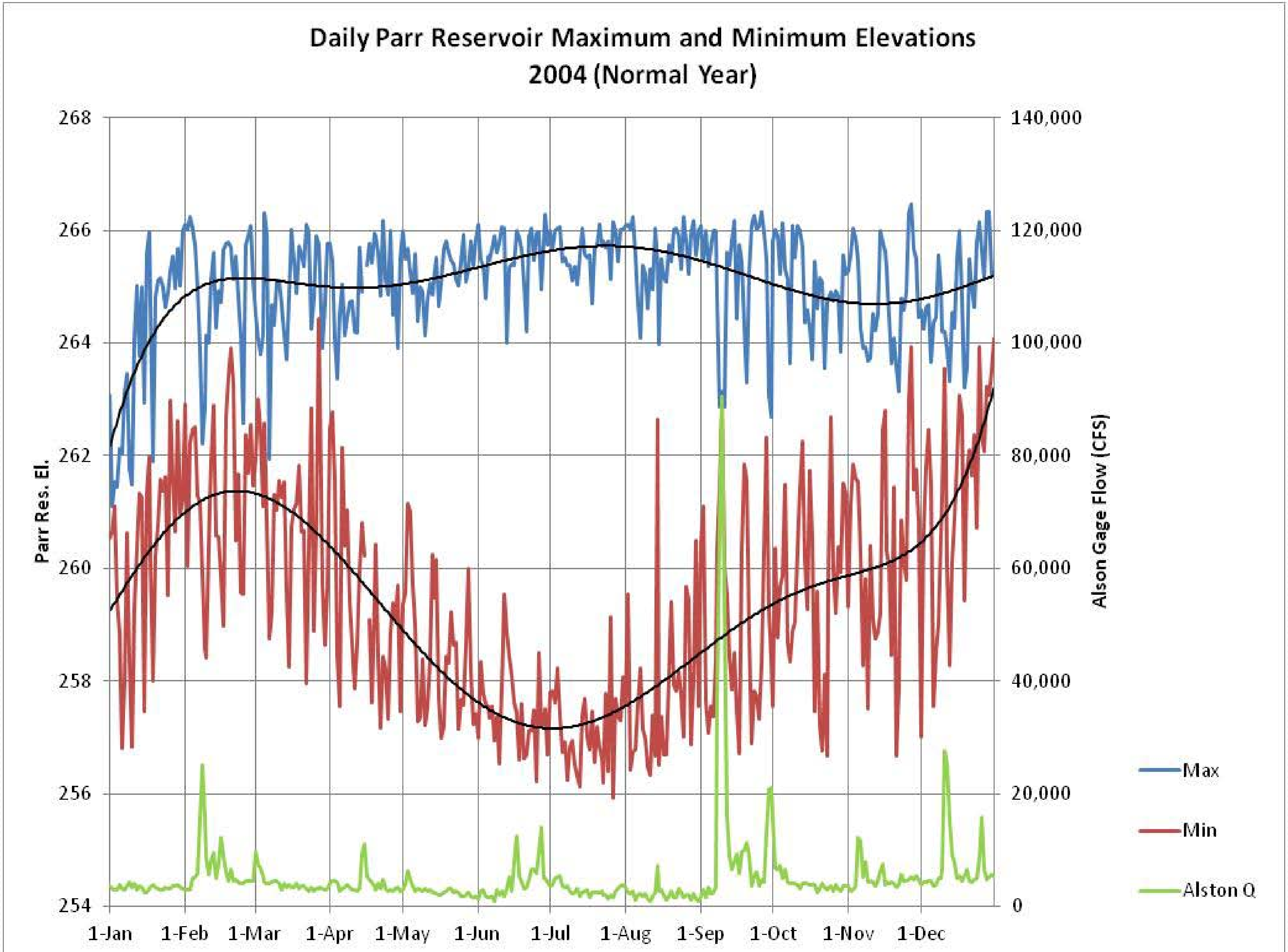
Daily Parr Reservoir Maximum and Minimum Elevations
2000 (Dry Year)
Parr Res. El.
268
266
264
262
260
258
256
254
Alson Gage Flow (CFS)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q



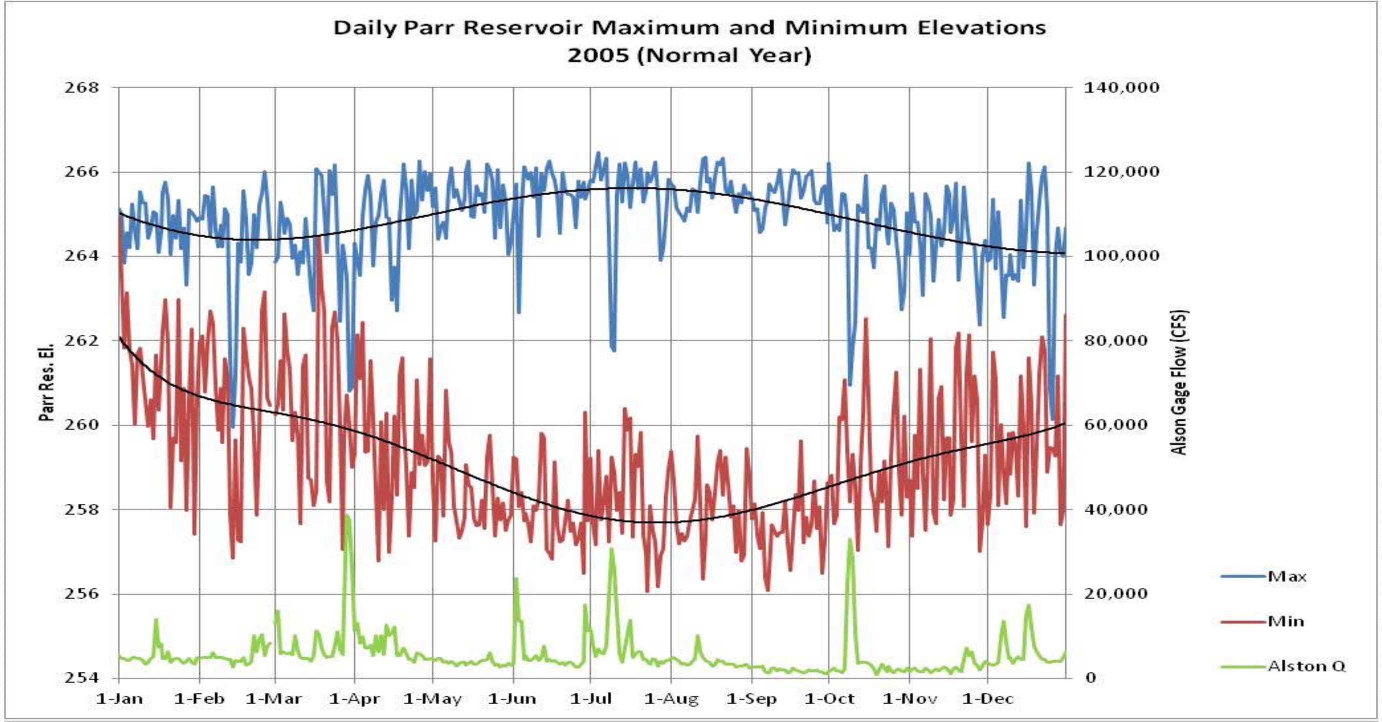
Daily Parr Reservoir Maximum and Minimum Elevations
2001 (Dry Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

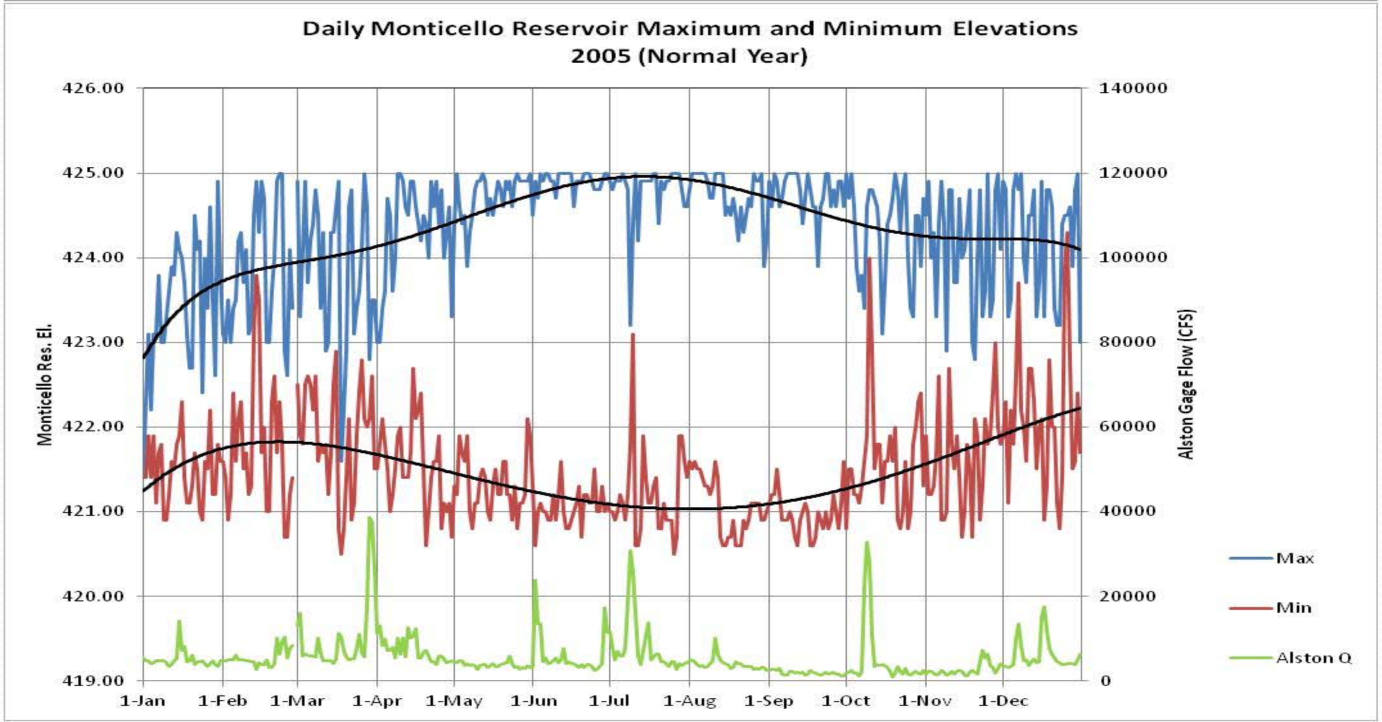

Daily Parr Reservoir Maximum and Minimum Elevations
2002 (Dry Year)
268
266
264
262
260
258
256
254
Parr Res. El.
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Alson Gage Flow (CFS)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

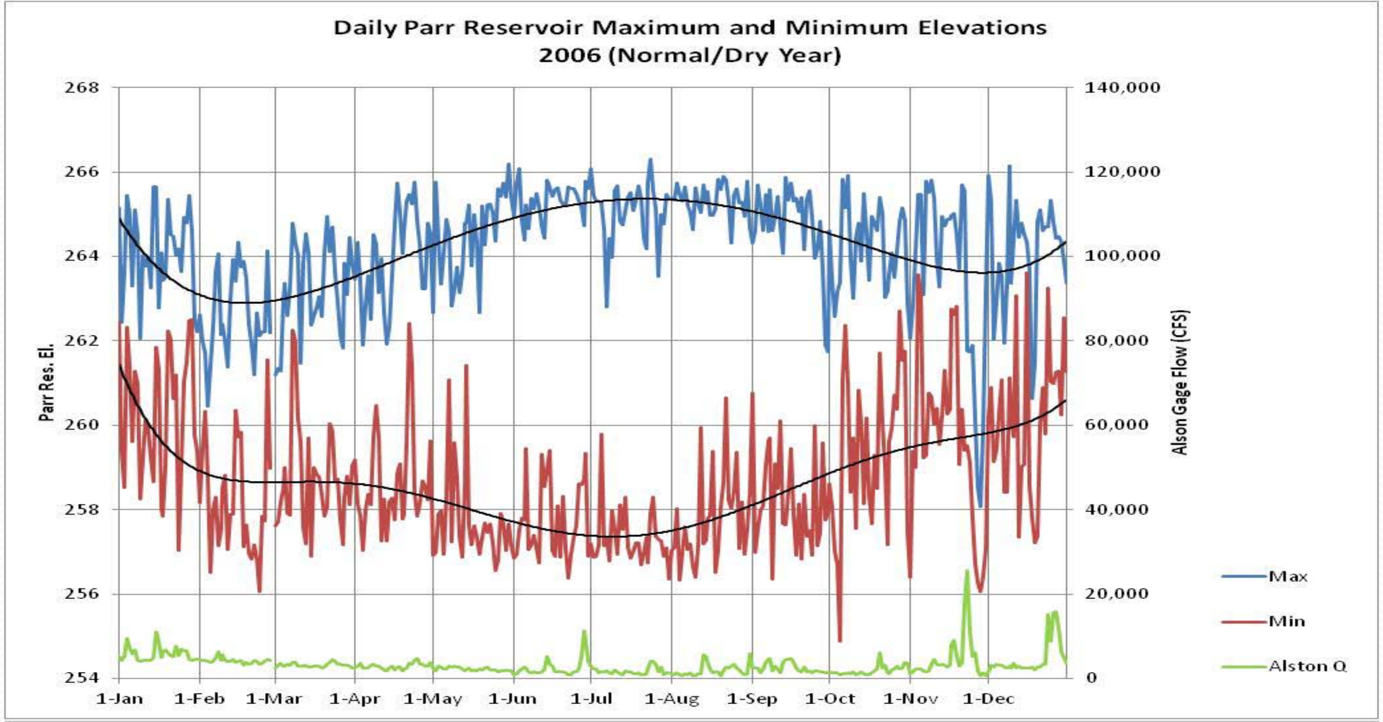

Daily Parr Reservoir Maximum and Minimum Elevations
2003 (Wet Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q

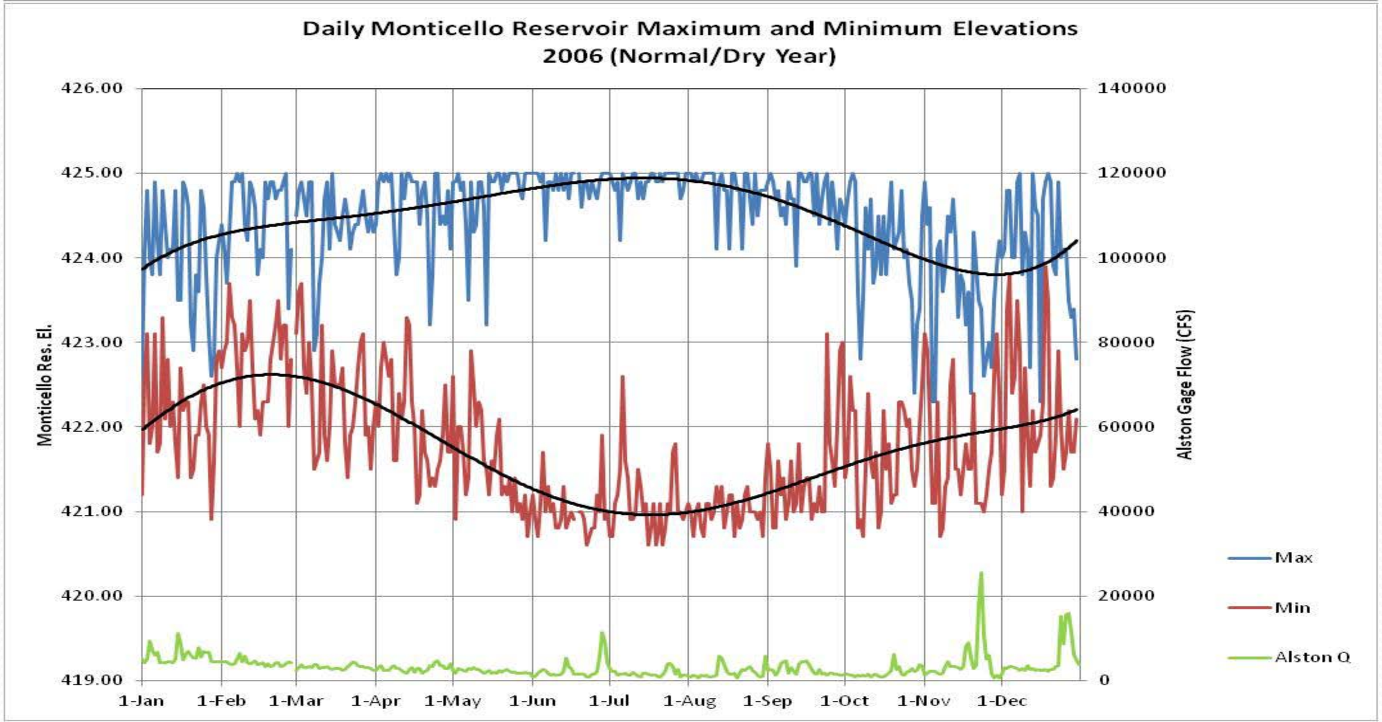


Daily Parr Reservoir Maximum and Minimum Elevations
2004 (Normal Year)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Parr Res. El.
Alson Gage Flow (CFS)
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q


Daily Parr Reservoir Maximum and Minimum Elevations
2005 (Normal Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q


Daily Monticello Reservoir Maximum and Minimum Elevations
2005 (Normal Year)
Monticello Res. El.
Alston Gage Flow (CFS)
426.00
425.00
424.00
423.00
422.00
421.00
420.00
419.00
140000
120000
100000
80000
60000
40000
20000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q


Daily Parr Reservoir Maximum and Minimum Elevations
2006 (Normal/Dry Year)
Parr Res. El.
Alson Gage Flow (CFS)
268
266
264
262
260
258
256
254
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
Max
Min
Alston Q


Daily Monticello Reservoir Maximum and Minimum Elevations
2006 (Normal/Dry Year)
Monticello Res. El.
Alston Gage Flow (CFS)
426.00
425.00
424.00
423.00
422.00
421.00
420.00
419.00
140000
120000
100000
80000
60000
40000
20000
0
1-Jan
1-Feb
1-Mar
1-Apr
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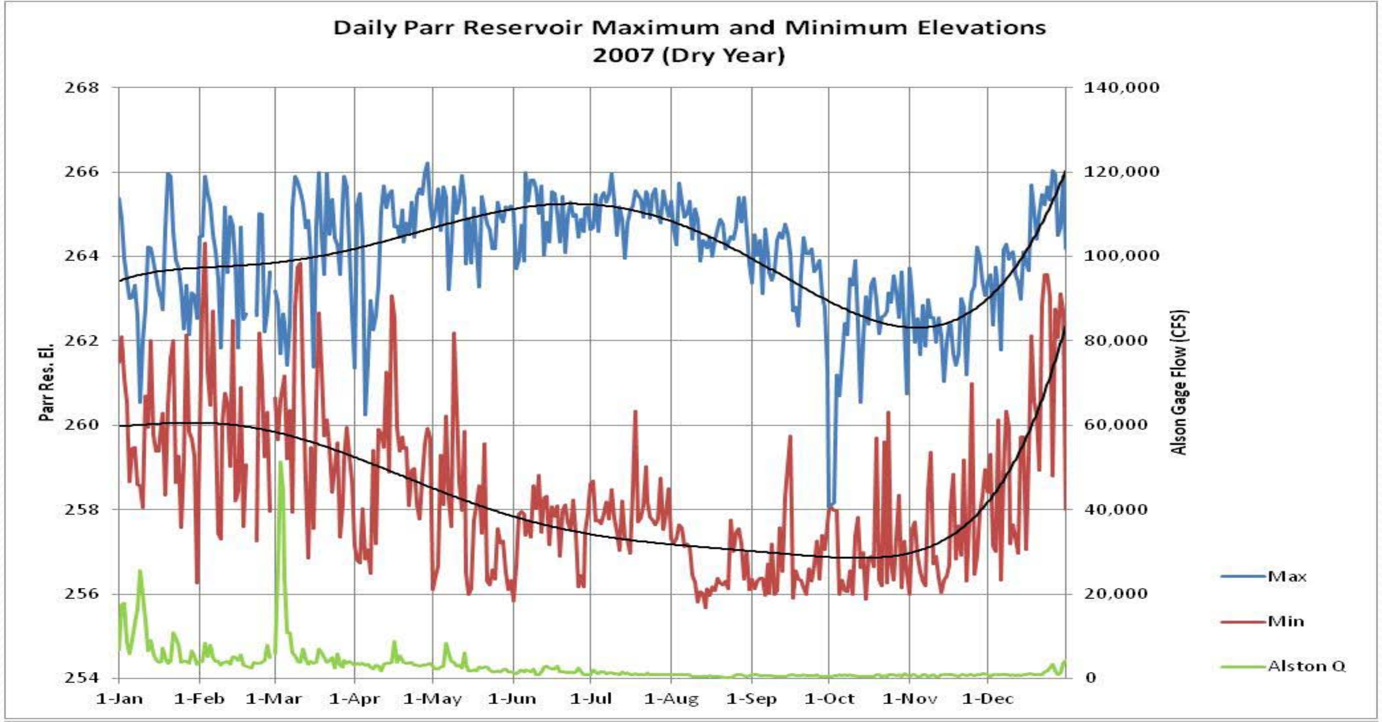

Daily Parr Reservoir Maximum and Minimum Elevations
2007 (Dry Year)
Parr Res. El.
Alson Gage Flow (CFS)
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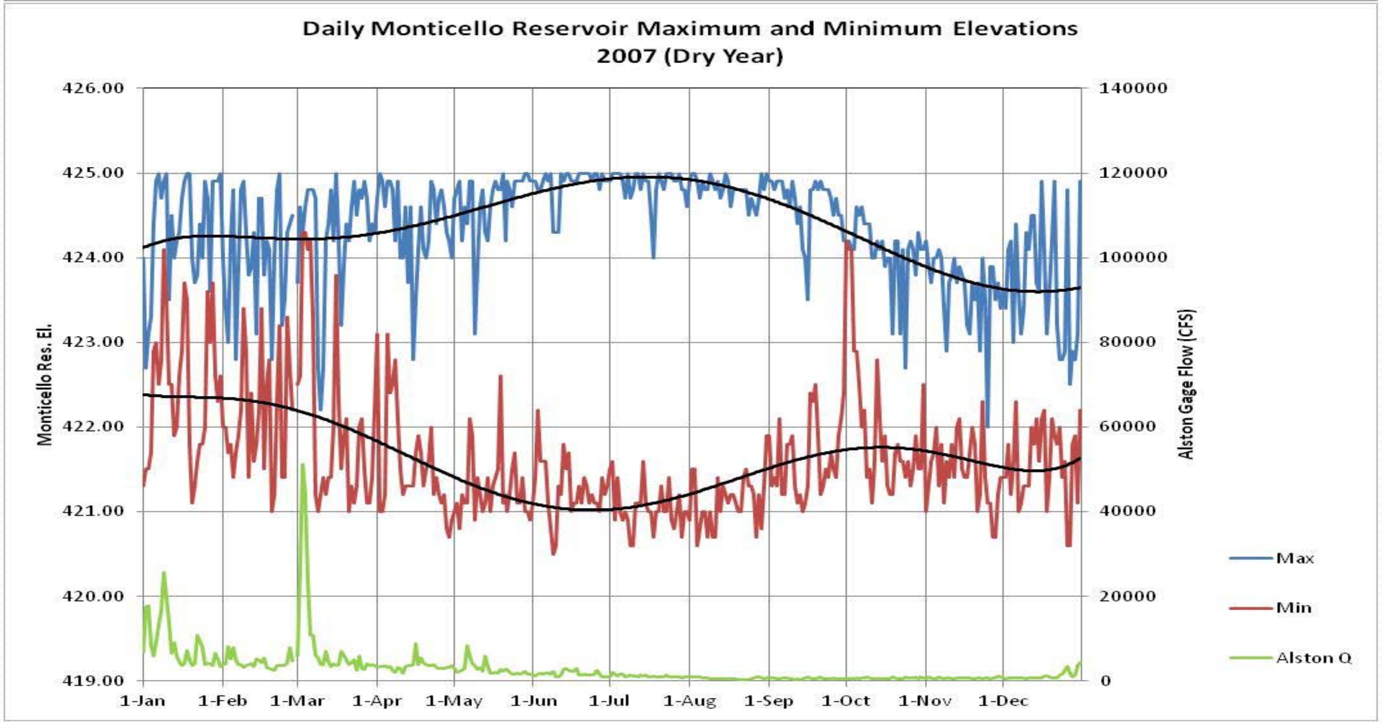

Daily Monticello Reservoir Maximum and Minimum Elevations
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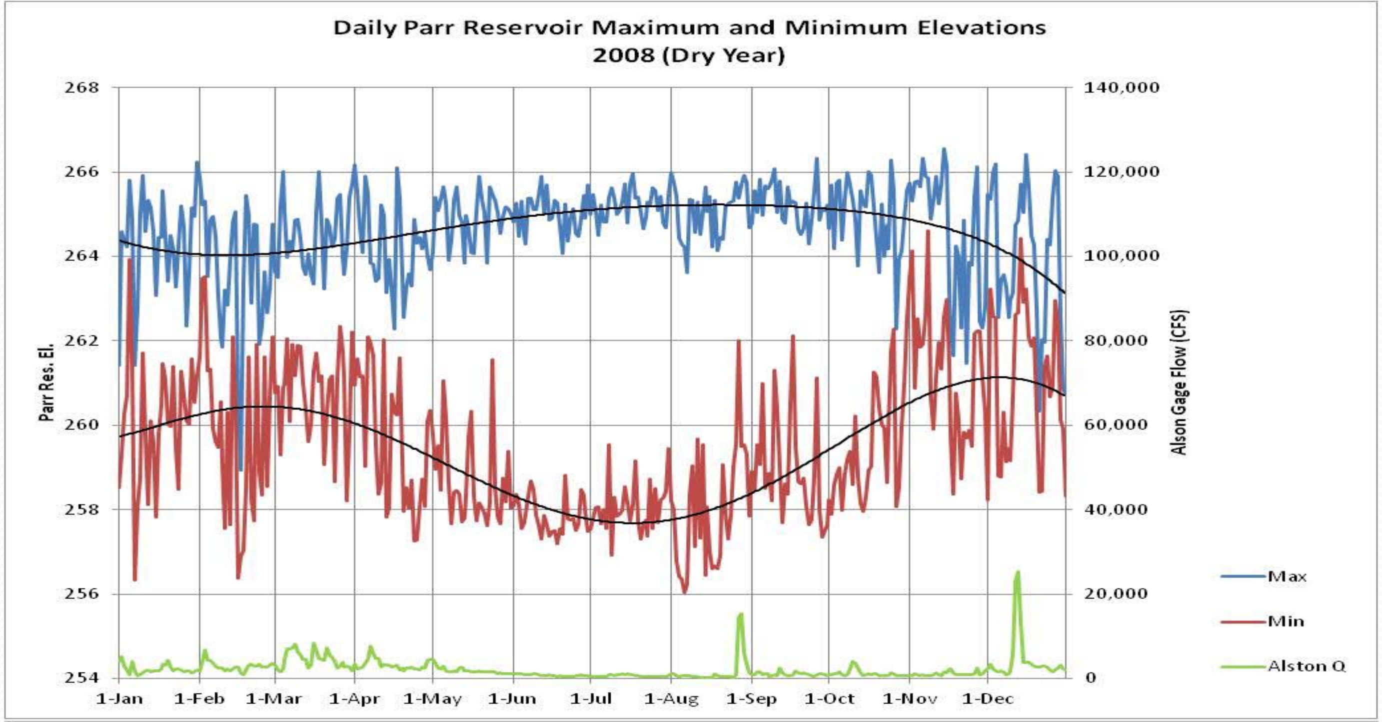

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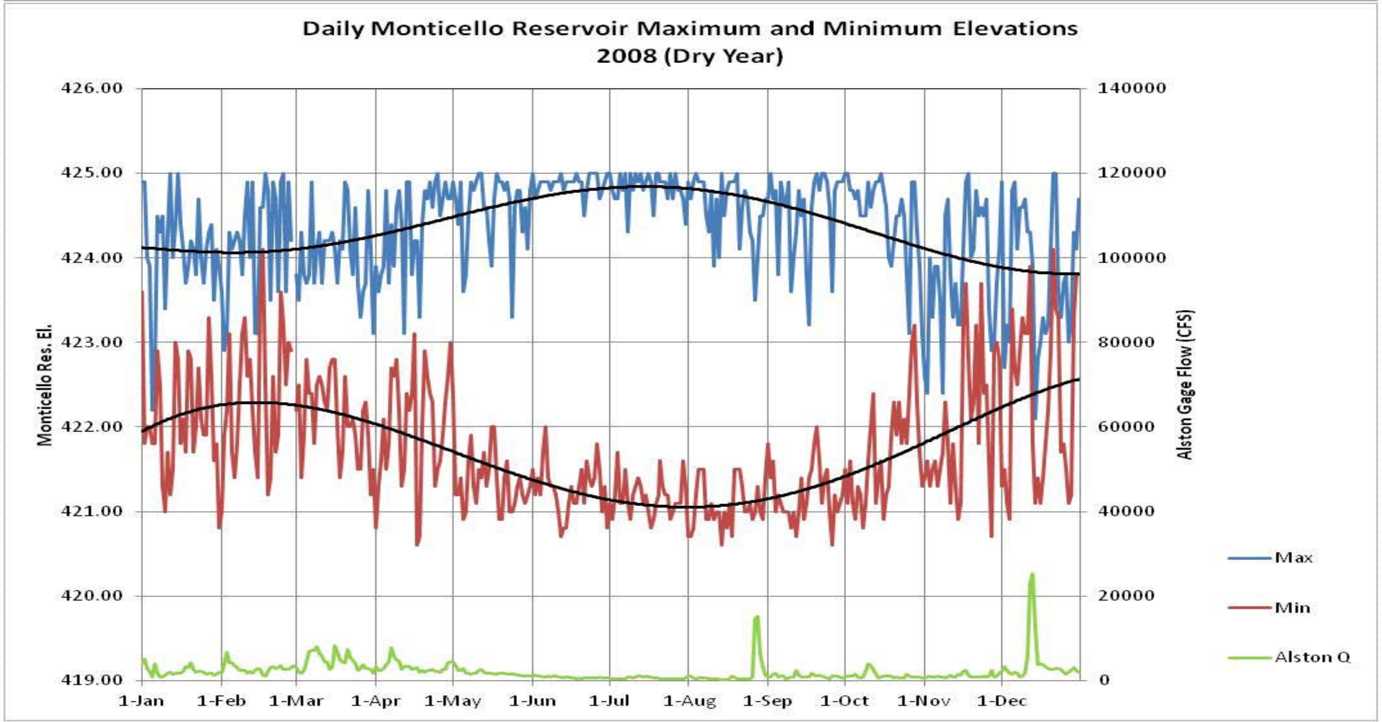

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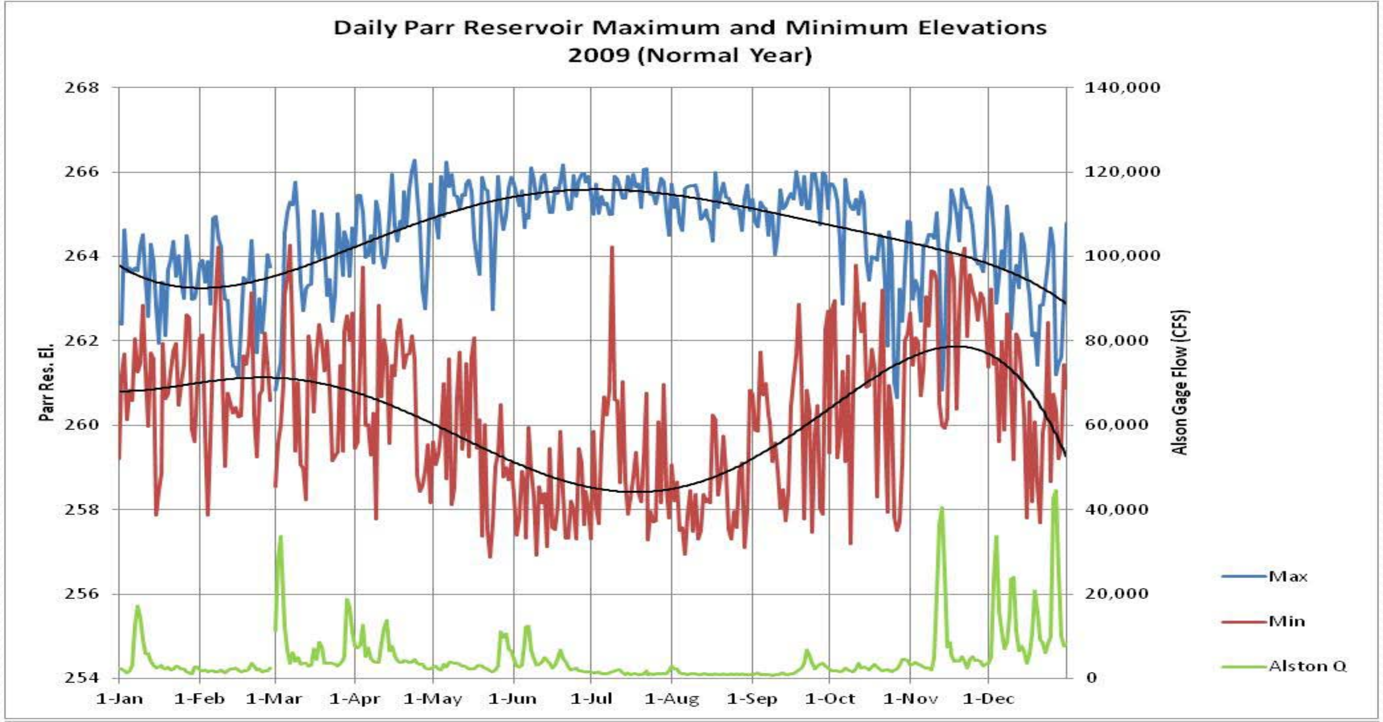
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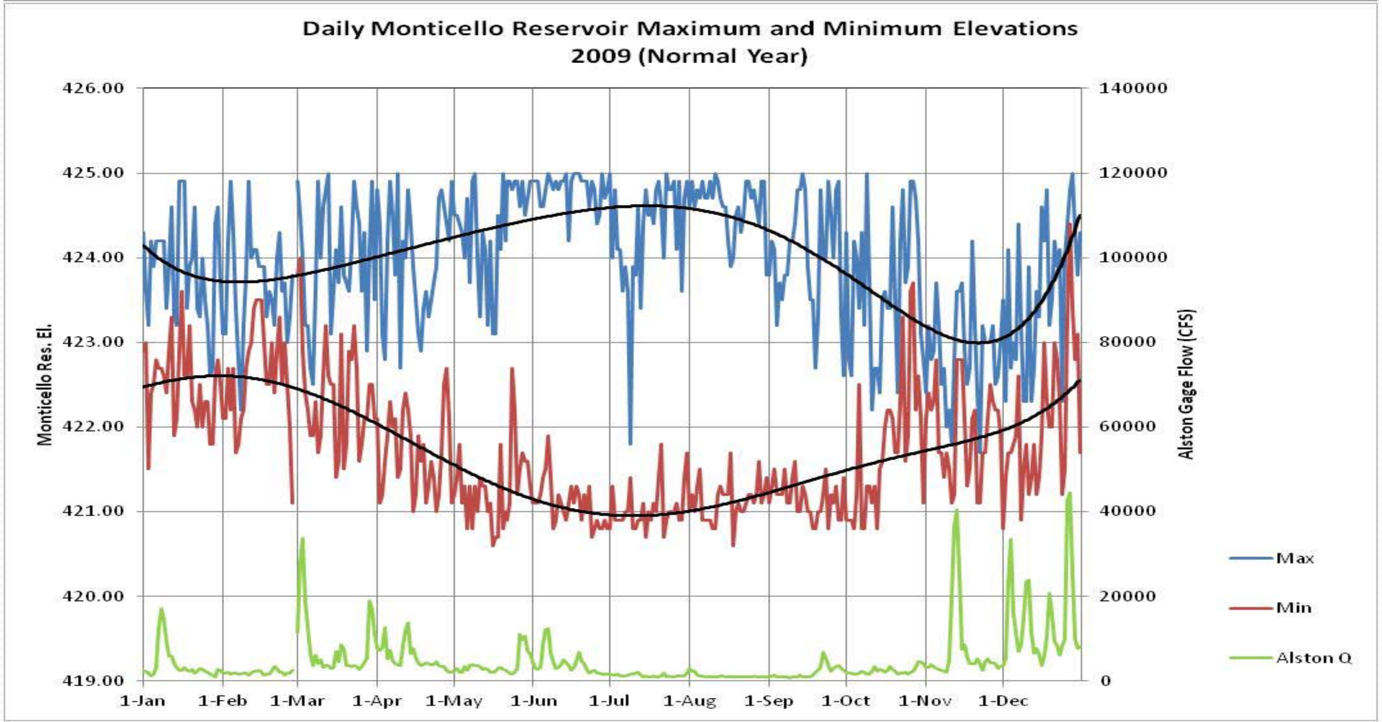
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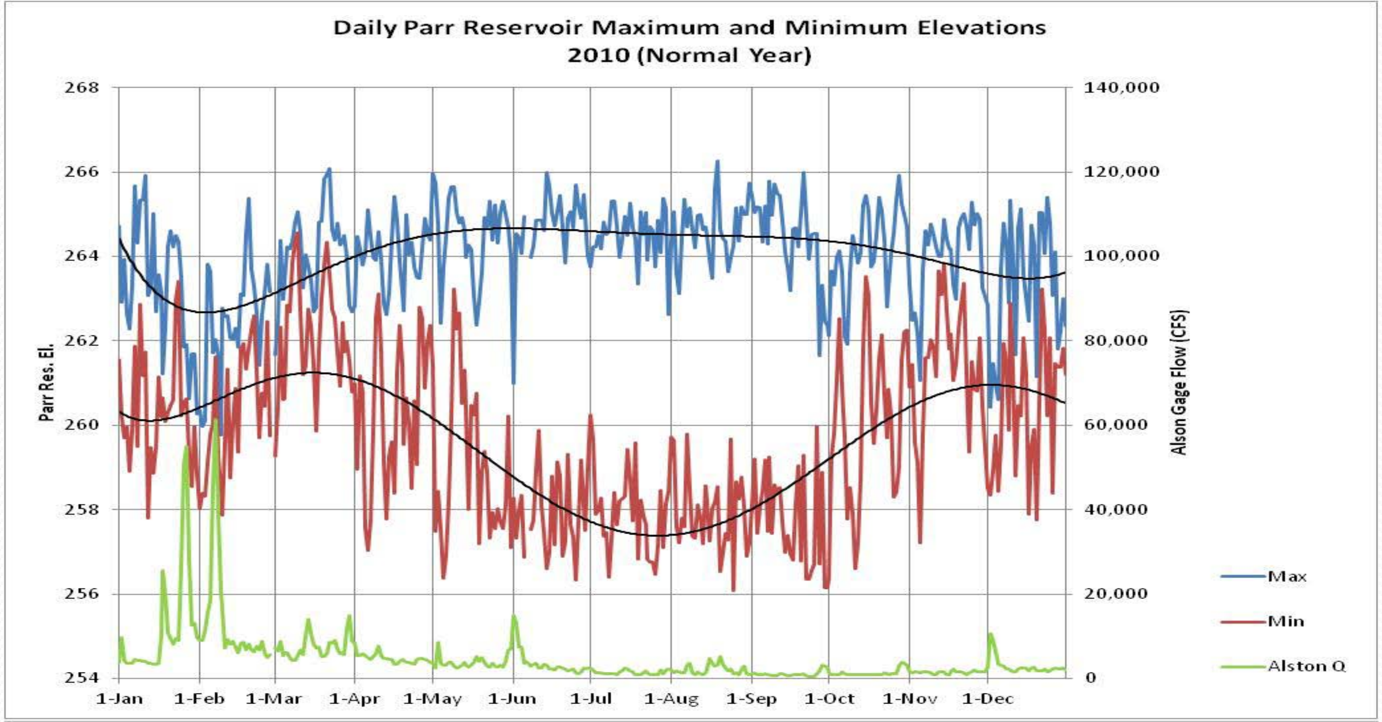
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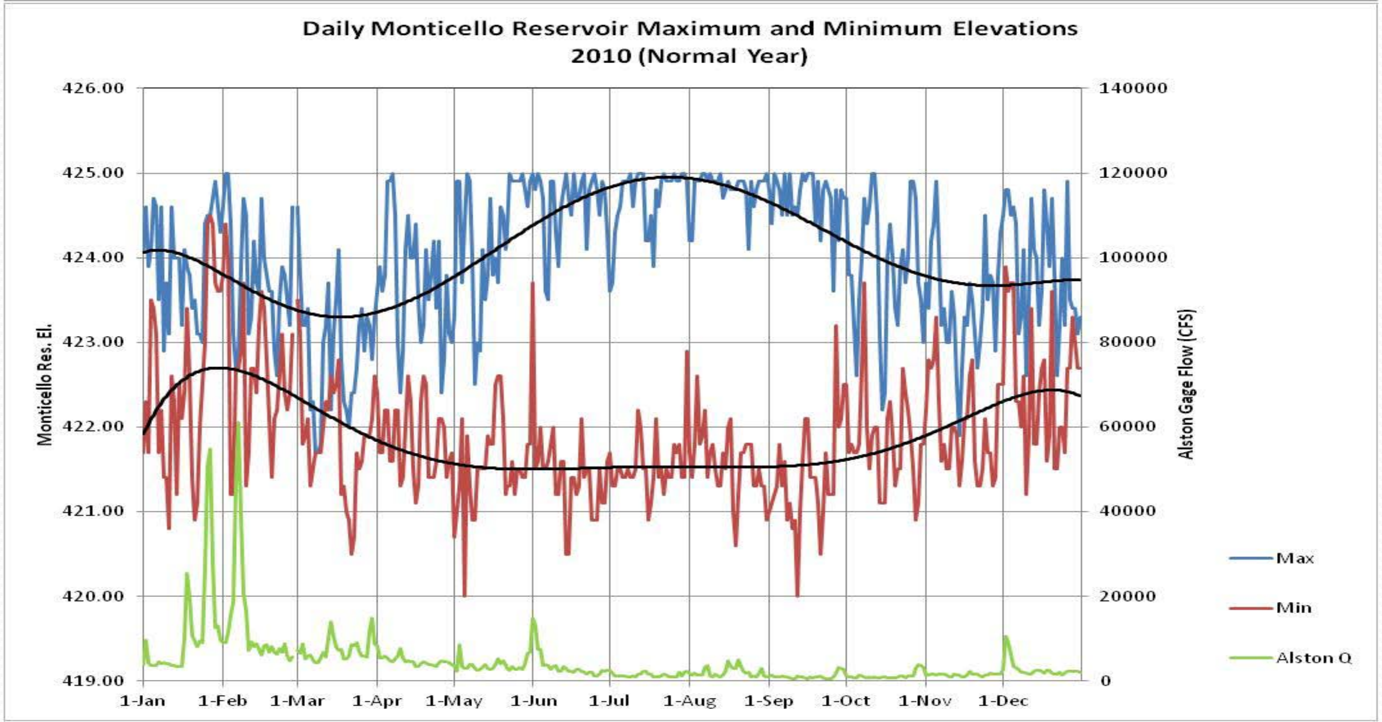
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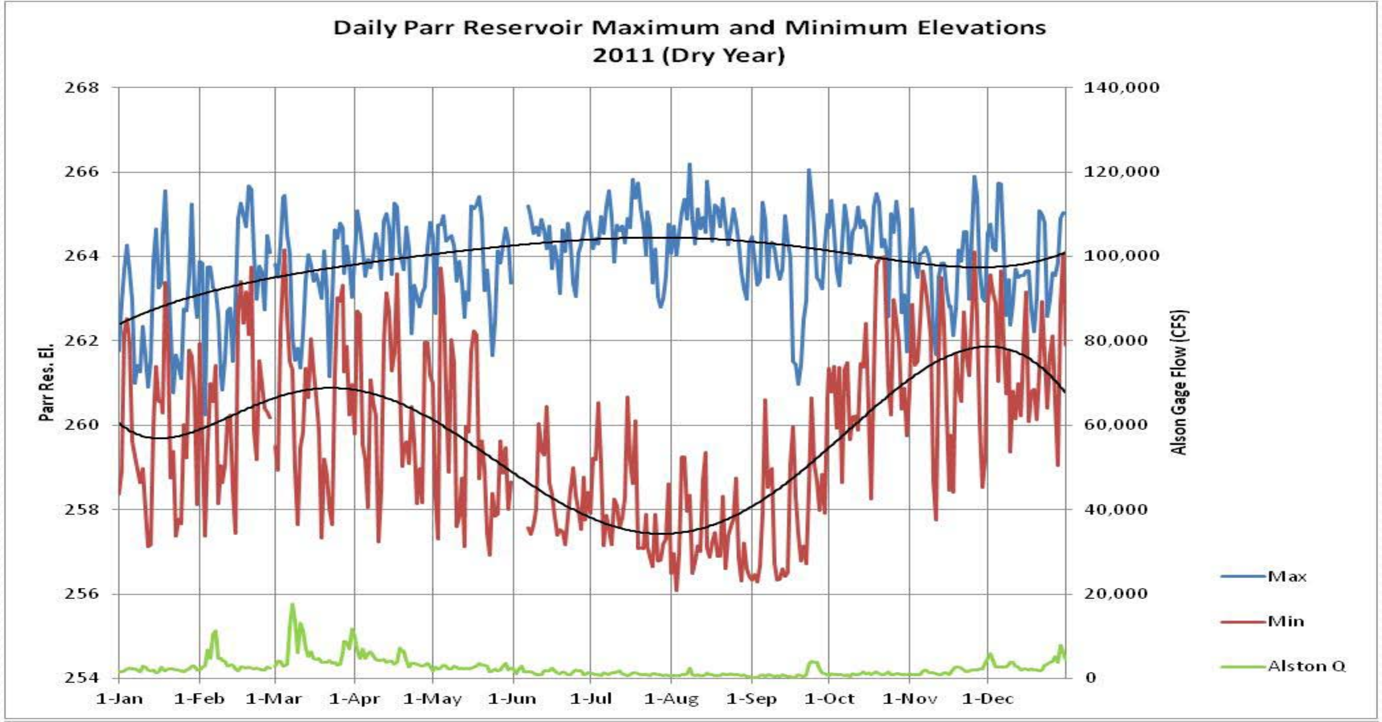

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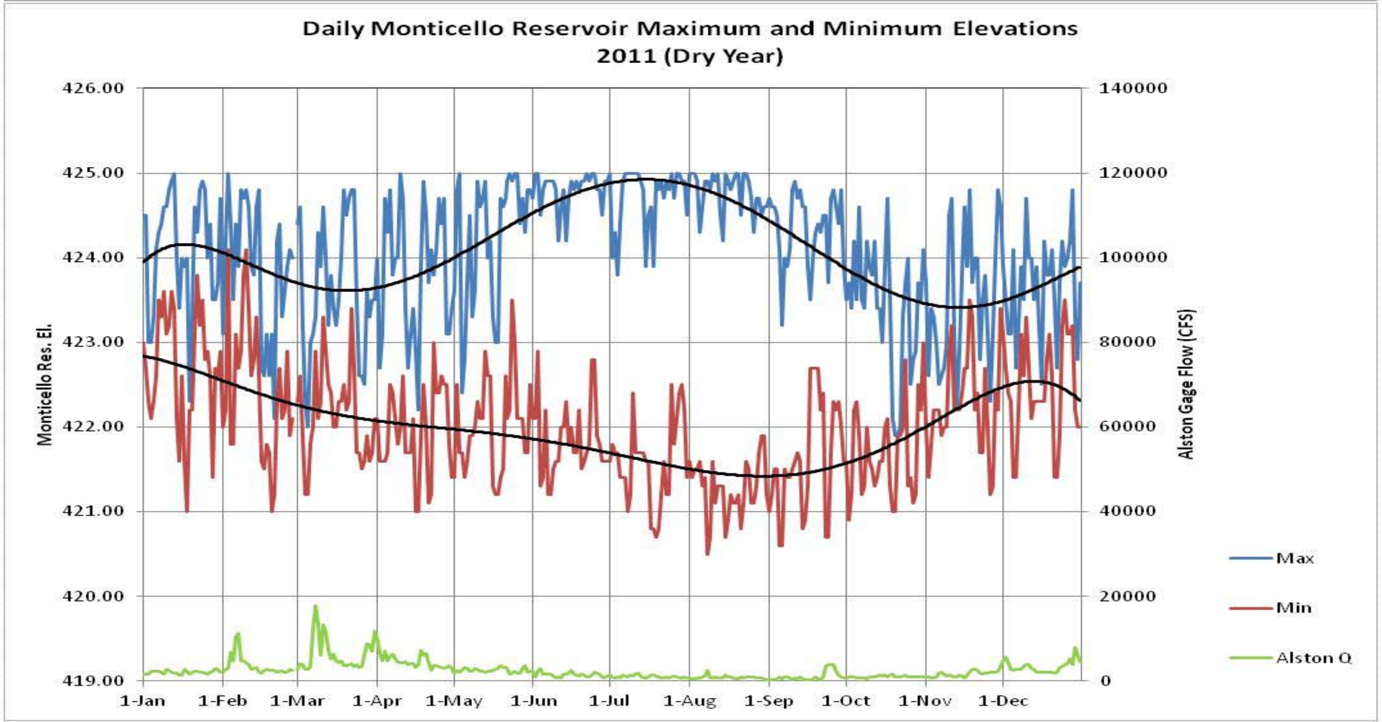

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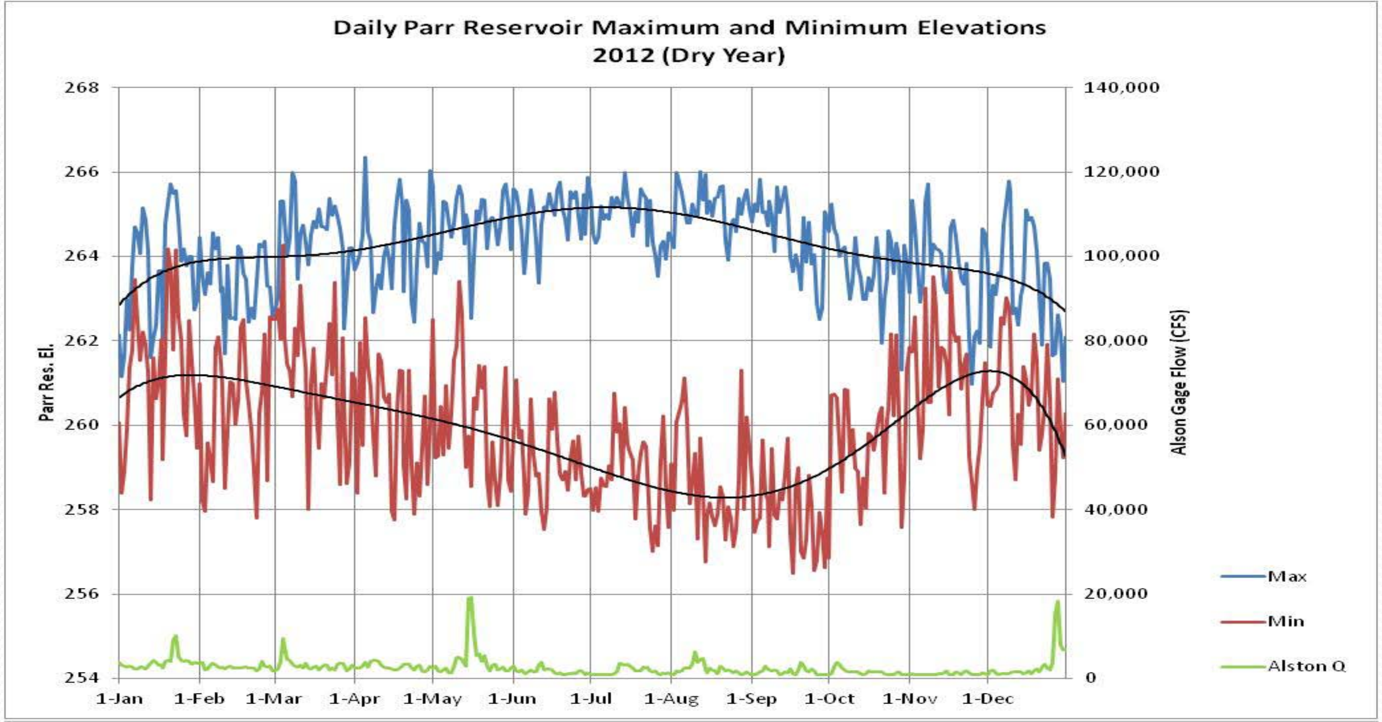

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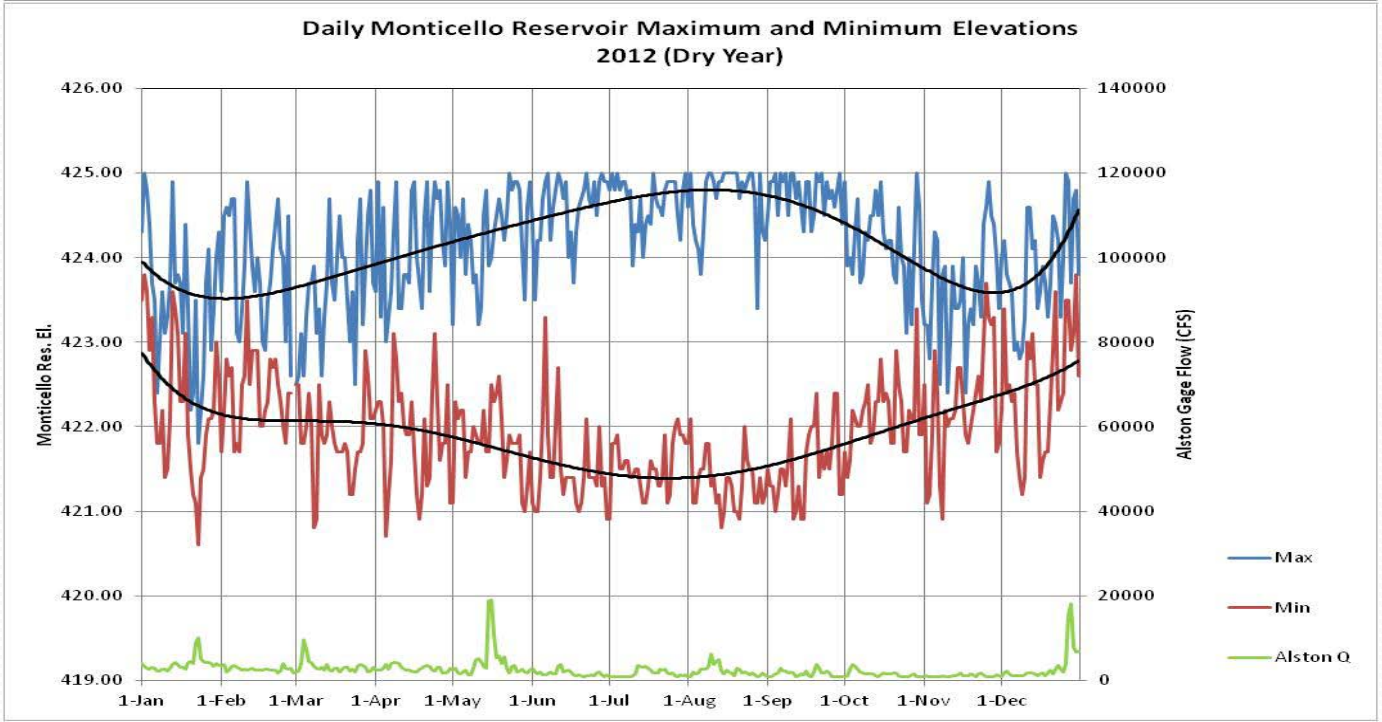

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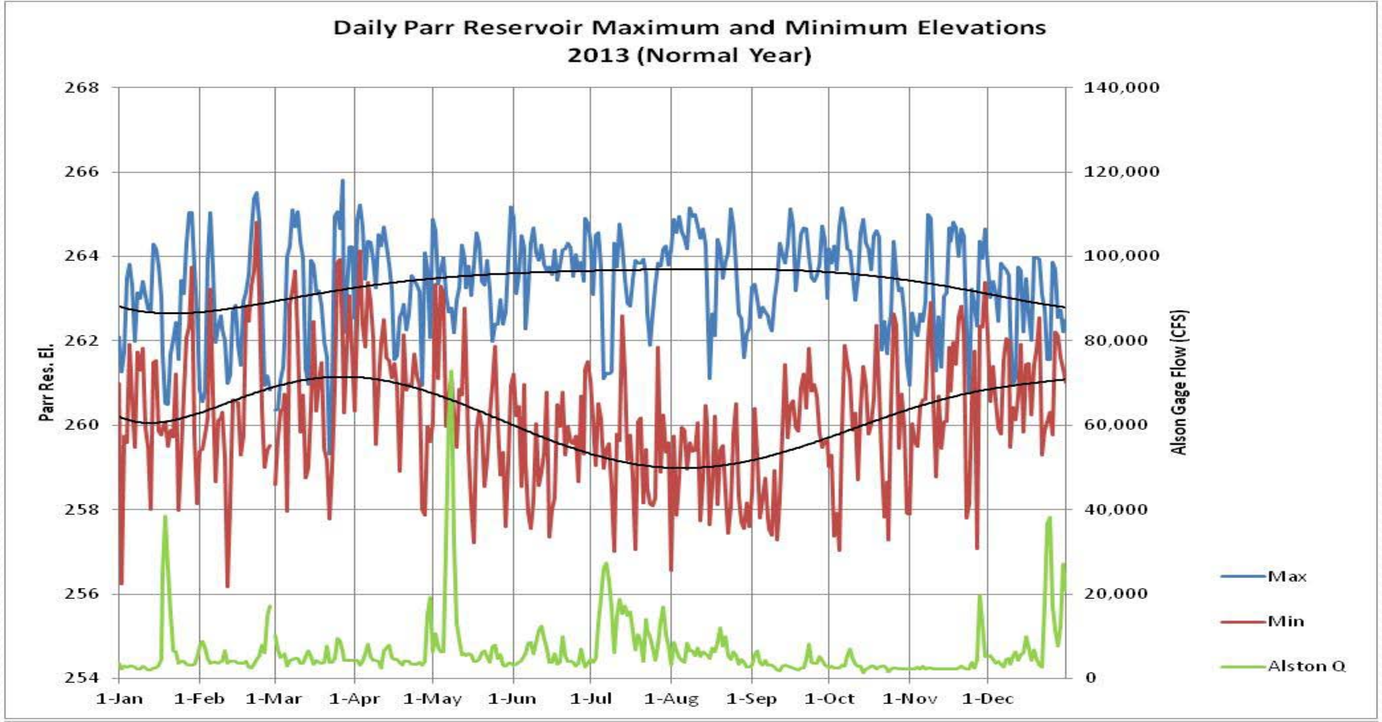

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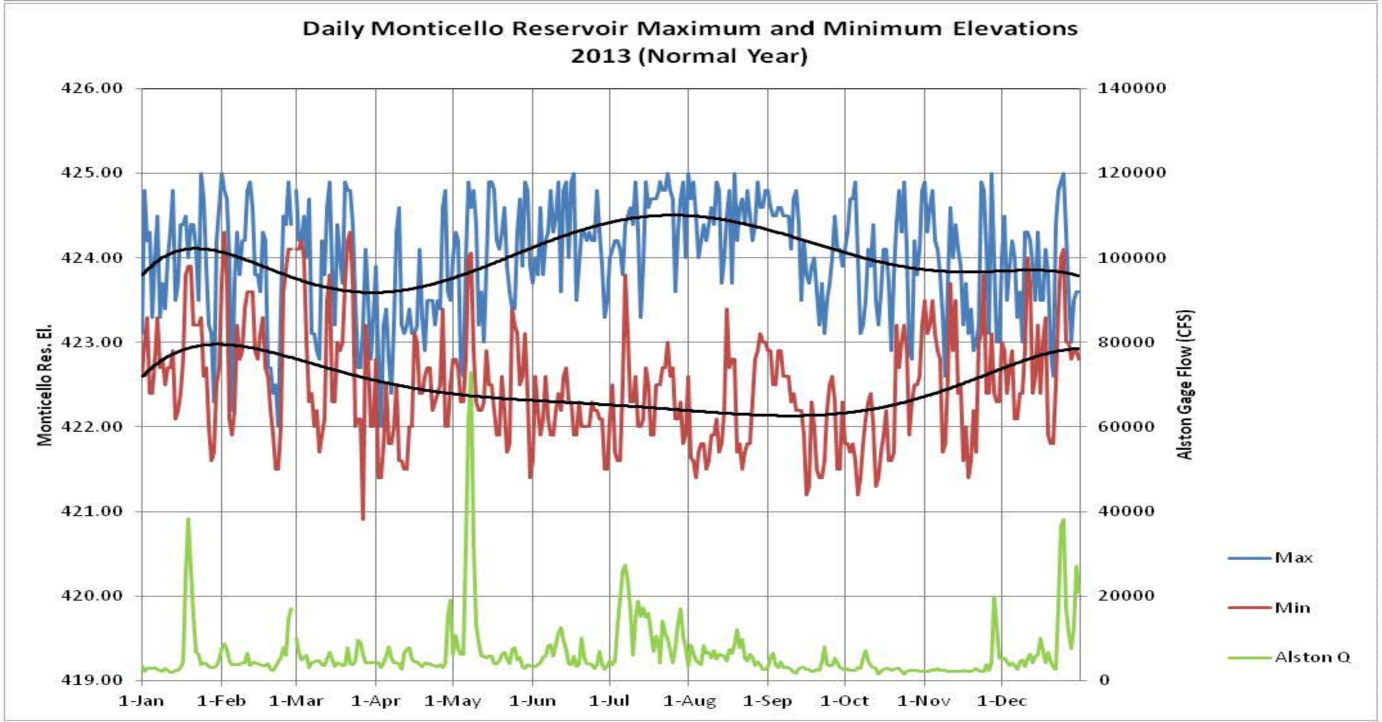

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Observations

- For both reservoirs, average annual fluctuation correlates closely with Fairfield generation and pumping MWHs, but not with flow at Alston gage site.
- Parr generation correlates closely with Alston flow.
- No obvious differences in pattern of fluctuation in wet vs. dry years.

DRAFT
RESERVOIR FLUCTUATION STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

February 2014

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DRAFT RESERVOIR FLUCTUATION
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

- During issues scoping, the Fisheries TWC identified the potential need for a Reservoir Fluctuation Study on the Parr and Monticello Reservoirs. The operating regime for the Project consists of a lowering and a refilling of the Project's two reservoirs on a daily basis. Although the amount at which the Project reservoirs fluctuate varies based on load demands and system needs, Monticello Reservoir is currently permitted by the FERC license to fluctuate up to 4.5 feet, while Parr Reservoir is permitted to fluctuate up to 10 feet. The magnitude of daily fluctuations varies seasonally in both impoundments. The largest daily fluctuations generally occur in June, July and August in both reservoirs (insert tables from Argentieri presentation). During February through April, when many fish species are spawning in shallow water habitat, average daily fluctuations range from

1.6-2.4 feet in Lake Monticello and from 2.9-4.2 feet in Parr Reservoir (Argentieri presentation 12-19-13). Resource agencies and stakeholders have expressed concerns of how these daily and seasonal fluctuations are affecting aquatic habitat along the shorelines of the reservoirs.

2.0 EXISTING INFORMATION

Fisheries

The Project area supports warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent survey work within the Project area documented 30 species of fish occurring in Parr Reservoir and 24 species in Monticello Reservoir. Although some seasonal variations in community structure have been documented, the fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch often being the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). Important game fish species such as largemouth bass, black crappie, and smallmouth bass (to a ~~lessor~~lesser extent) are also abundant in the two reservoirs. Life history and spawning preferences can influence the extent to which fish species are affected by reservoir fluctuations. Habitat and spawning preferences of the dominant fish species are briefly considered below.

Gizzard shad are a pelagic species that generally occupy the limnetic zone as well as feed along the littoral zone. Spawning typically occurs in the spring, associated with rapidly rising water levels. Gizzard shad typically spawn in shallow waters, 5 feet deep or less, and prefer recently inundated habitats, when available (Williams and Nelson, 1985). Blue and channel catfish typically occupy deep, protected areas, spawning at sites 6.5 to 13 ft deep (McMahon and Terrell, 1982). Bluegill typically inhabit and spawn within shallow, back-water habitats, at depths of 1-3 meters (Stuber et. al., 1982). White perch also spawn in relatively shallow habitat within reservoirs (0-5 feet). Adult white perch exhibit seasonal movements, utilizing both shallow and deep water habitat (Stanley and Danie, 1983). *Comment: Add language for largemouth bass, smallmouth bass and black crappie*

Small fishes, such as shiners, juvenile sunfish~~minnows~~, and small suckers serve as the food base for larger, piscivorous species. In general, these species typically have high fecundity rates and

Comment [WU1]: add table(s) of fish species for each reservoir

Comment [WU2]: - this section focuses on the effects of pool level fluctuations on the “dominant” fish species. Please include other fish species such as largemouth bass, bluegill, redear sunfish, redbreast sunfish, and black and white crappie.

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will utilize a variety of habitat types for spawning, cover, and resting. These species are typically ~~generalists; however, all of these species are generally~~ found within or in the vicinity of aquatic vegetation or other cover. When inundated, the shallow areas may be frequented by these species for forage and cover.

Pool Elevations

During the construction of Monticello Reservoir and the Fairfield Development in 1974, crest gates were added to Parr Shoals Dam, allowing for a full operating range of 266 ft to 256 ft at Parr Reservoir. Monticello Reservoir was constructed to allow for a full operating range of 425 ft to 420.5 ft.

SCE&G submitted surface area and capacity curves as part of the Final Environmental Impact Statement for Parr Hydroelectric Project, conducted in March 1974, after the crest gates were added to Parr Shoals Dam. In Monticello Reservoir, a change in elevation from 425 feet to 420.5 feet will reduce the surface area of the reservoir from 6,800 acres to 6,467 acres (95% of full pool surface area), resulting in a difference of 333 acres of shoreline exposed. The exposed shoreline is generally included in a narrow band that extends around the reservoir. A change in elevation on Parr reservoir from 266 ft to 256 ft will reduce the surface area of the reservoir from 4,369 acres to 1,375 acres (31.5% of the ~~normal~~ full pool surface area), resulting in a difference of 2,994 acres of exposed lake bottom~~shoreline~~. Prior to the construction of the crest gates and reservoir expansion, the approximately 3,000 acres was not inundated or available as aquatic habitat in Parr Reservoir.

3.0 STUDY OBJECTIVES

The primary objective of this study is to provide a qualitative assessment of the potential effects of operational reservoir fluctuations on aquatic habitat and navigation within the Project Area. As noted in Section 2.0, areas of shoreline are exposed during impoundment fluctuations, but the type and quality (mud flats, shoals, vegetated littoral zones? *(Comment: development of vegetated littoral zones is incumbent on stable pool elevations, therefore this measurement will surely be very low and not representative of project resources without pool fluctuations.* ~~*What would be more valuable is to use a reference lake such as the sub-impoundment to determine project impacts, although using the sub-impoundment might be problematic because it was recently stocked with grass carp)*~~, etc.) of those areas are currently unknown. This study will provide information to characterize habitats within areas exposed during lake-level fluctuations and identify areas with potential navigation issues caused by fluctuations. A secondary objective of this study is to identify appropriate Protection, Mitigation and Enhancement (PM&E)

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measures that might offset potential effects of daily fluctuations which could be considered as part of the Final License Application.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

The study will focus on Parr and Monticello Reservoirs during maximum normal pool and minimum normal pool. Several transects will be established at representative locations along Parr and Monticello Reservoirs, where information such as slope and elevation will be gathered. Members of the Fisheries TWC will select these transect locations prior to the study being performed, which will be no later than the summer of 2015. The study will commence after transect locations are selected.

After fluctuation data is collected and analyzed, the TWC will meet to discuss potential PM&E measures that could be considered for each reservoir.

5.0 METHODOLOGY

The study area will include both Parr and Monticello reservoirs. (~~*Comment: Need a transect in the sub-impoundment as a control for determining potential habitat without fluctuation. Lake Murray could be another option.)*~~ A maximum of four Priority Areas will be identified in Parr Reservoir by the Fisheries TWC members. Potential Priority Areas in Parr Reservoir have been identified and are depicted in Figure 1~~Figure 1~~ and Figure 2~~Figure 2~~. These Priority Areas will be representative locations within the reservoir that will best depict a variety of aquatic habitat types. Within each Priority Area, 3 to 5 transects will be identified across the wetted area. At each transect, elevations will be collected at full pool via GPS (GeoExplorer 6000 paired with an external Zephyr antenna) or survey methods, as well as at 1 foot increments as the reservoir level is lowered during a fluctuation cycle. Surveys will be performed during a low inflow and high energy demand period (August/September) so that as much of the full operating range of 10 ft as possible, from 266 ft to 256 ft can be observed. From this information an estimate of how much ~~bank~~ reservoir area is dewatered at each 1 foot contour will be estimated. At or near the minimum normal pool elevation (256 ft), slope and habitat type will also be photographed. Prior to the field study, locations that may present potential navigation issues during low fluctuations in Parr Reservoir will be identified (or included as a Priority Area). While aquatic habitat information is being collected in Parr Reservoir, field workers will also examine these areas during a fluctuation cycle. Any areas that appear to have navigation issues will be documented and photographed.

FIGURE 1 POTENTIAL PRIORITY AREAS IN UPPER PORTION OF PARR RESERVOIR

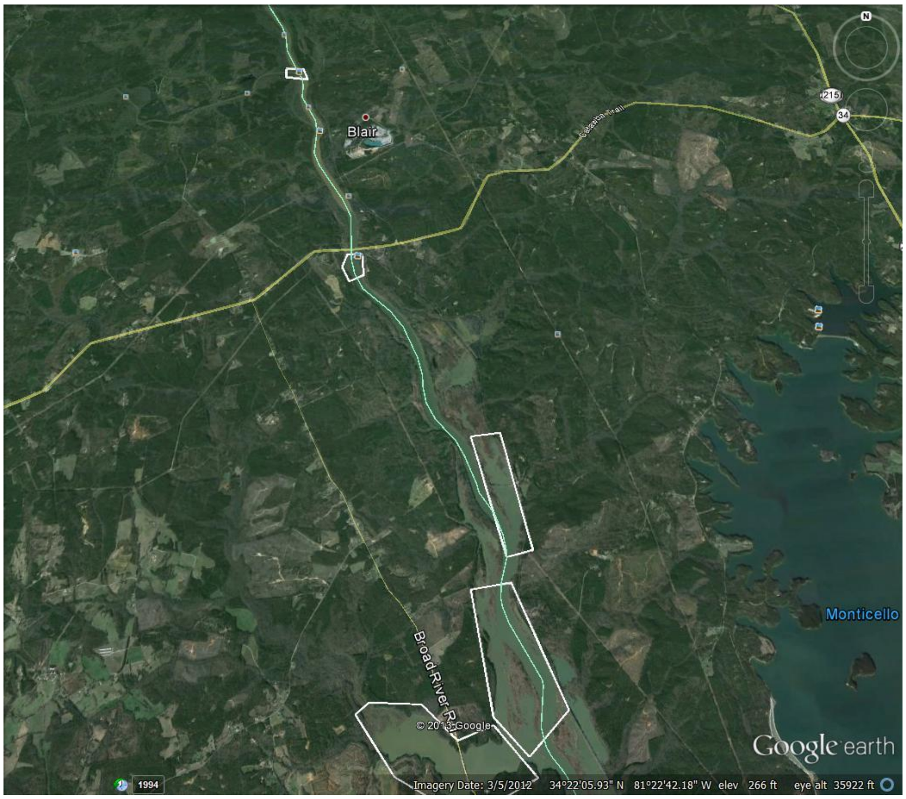

FIGURE 2 POTENTIAL PRIORITY AREAS IN LOWER PORTION OF PARR RESERVOIR

In Monticello Reservoir, a minimum of two Priority Areas will be identified that represent potential critical aquatic habitat areas. At each of these locations slope and habitat type will be measured and photographed at each 1 ft increment from 425 ft to approximately 420.5 ft.

The collected data will be consolidated into a report for the Fisheries TWC review and comment. This report will be the basis for the Fisheries TWC to determine potential PM&E measures that could be implemented at each reservoir. Typical PM&E measures may include aquatic habitat enhancements that could enhance fish spawning and/or recruitment.

6.0 SCHEDULE

Selection of Priority Areas will be completed no later than July of 2015. Field collections will be completed no later than the fall of 2015. After field data collection have been summarized in a report and distributed for review, the Fisheries TWC will meet to discuss PM&E measures that are appropriate for each reservoir. A final report summarizing the study findings and potential PM&E measures that could be considered as part of the Final License Application will be issued in or around July 2016. Study methodology, timing and duration may be adjusted based on weather and consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, Fisheries TWC, and other relicensing stakeholders.

8.0 REFERENCES

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MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Water Quality TWC Meeting

June 25, 2014

Final KDM 7-17-14

ATTENDEES:

Bill Marshall (SCDNR)
Milton Quattlebaum (SCANA)
Rusty Wenerick (SCDHEC)
Henry Mealing (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Ron Ahle (SCDNR)
Bill Argentieri (SCE&G)
Randy Mahan (SCANA)
Steve Summer (SCANA)
Byron Hamstead (USFWS)
Bill Stangler (Congaree Riverkeeper)
Vivianne Vejdani (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting by reviewing the agenda and action items from the Water Quality TWC meeting held on February 4, 2014. At that meeting, everyone agreed that Kleinschmidt and SCE&G would examine temperature and dissolved oxygen (DO) data from the USGS gages at Carlisle (02156500), Jenkinsville (02160991), Tyger River (02160105), and Enoree River (02160700); and flow data from the Alston gage (0216100) to determine potential project effects on low DO events. At the February 4th meeting, the group agreed that data from the gages listed above would be gathered from 2004 through 2013 and graphically compared to identify low DO events, determine how often, when, and how long those events occurred and to see if there are common events related to the low DO. Flow data would also be collected to determine if there is a correlation between low or high flows and low or high dissolved oxygen. These analyses were completed and summarized in an addendum to the Baseline Water Quality Report, which is attached to the end of these notes. CDs with the USGS data from the gages listed above were distributed to the TWC members attending the meeting, and are available upon request.

Henry discussed the results of the data review, as detailed in the Water Quality Report Addendum, which mainly focused on the data from the Jenkinsville gage and flow data from the Alston gage. Henry told the group that the data showed a trend of low DOs early in the morning, during periods of low generation, and during the summer months. Bill A. explained that he contacted USGS and found out that they replaced the monitoring probe located at Jenkinsville in 2011. Henry suggested that the gage may be located in a bad spot, where back flow may be occurring. If the units running are far away from the monitor the water near the monitor could become stagnant. To determine if this is true, SCE&G is planning to collect a series of water quality readings along the downstream side of Parr Shoals Dam and near the USGS gage. Milton will access the river through the windows in the powerhouse. Byron asked if flow data can also be collected. Henry said we can calculate the flow. Henry said that Milton can note which turbines are running when he is collecting the data to see if unit location is having an effect. While Milton is collecting data during July and August, he will request the operators to run different units to see if this affects the DO readings at the USGS gage.

Byron asked to look at specific DO excursions in the USGS data at Jenkinsville. From July 18-21, 2010, the DO at the Jenkinsville gage was below 4.0mg/L. The flow data at Alston shows that only one unit is running, which might possibly be the furthest unit from the gage. During the meeting, Bill checked the online operation records, but was unable to find records of which Unit was operating during that event. Bill will continue to look for historical unit operating data for Parr.

Ron suggested we look at the flows that are occurring during the low DO excursions to determine a pattern. Although there doesn't appear to be a pattern, the excursions could correlate to which units are running.

Rusty asked if the excursions could be related to the operation of Fairfield Pumped Storage Development. The group asked if Monticello stratifies and Steve explained how the reservoir acts as three separate reservoirs, with the upper portion of the reservoir stratifying. Rusty suggested that FPS operations (through higher water levels in the Parr Reservoir) are periodically pushing low DO water towards the dam.

Henry suggested that we collect data to verify the USGS gage first, since this seems to be the easiest next step toward identifying or ruling out the cause of the DO excursions. Bill S. asked what the next step would be if the gage is determined to be in a bad location. Henry said we will talk with USGS about relocating the gage.

Kelly told the group about the turbidity information that Kerry Castle with SCDNR sent following the February 4th Water Quality TWC meeting. The data shows how turbidity increases as one moves downstream in the Broad River. Kelly will send Kerry's data to the TWC.

Henry said that although there are occasional DO excursions, there is still high biodiversity downstream of Parr Shoals Dam. Henry stated that if low DO levels were a true problem below Parr Shoals Dam, the diversity and abundance of mussels and snails should not be as high.

Byron asked how difficult it would be to start keeping track of operations at Parr Hydro, such as which unit or units are running. Bill said that SCE&G can try to keep track of this information. Milton said he will take measurements as close to each unit as possible and as close to the USGS gage as possible.

Byron asked if there was a pattern for operating the units, or a first on, last off protocol. Steve said he thought that the operators most likely just rotate units to prevent wear on a particular unit. Bill spoke with an operator at Parr Hydro and found that there was no pattern or first on, last off protocol at the plant.

Steve asked if there is a gage that records the stage in Parr Reservoir. Bill said that stage data is collected at Parr Reservoir. Steve said this information would give us an indication of what is going on at Fairfield and if the operation of the development has any correlation to the USGS data. Rusty said that if Fairfield is transferring enough water from Monticello Reservoir to raise the level of Parr Reservoir, this action is having an effect on temperature in Parr Reservoir as well. The group examined stage data from Parr Reservoir and saw a possible correlation between low DO and stage.

Steve pointed out that we don't know if Fairfield is the cause of low DO occurrences, although they appear to be correlated. However, operation of Fairfield is related to system load which is in turn related to the sunrise and sunset.

Bill asked that if anyone sees a trend in the water quality data once they start looking at the data that was distributed during the meeting, to let the rest of the TWC know. The group will meet again once Milton has collected the data downstream of the Parr Shoals Dam – starting in July and extending into August if needed. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Milton and Kelly will collect water quality data below Parr Shoals Dam during July and August, making sure to record which units are operating while measurements are being taken. They will report their findings back to the TWC.

- Kelly will distribute Kerry Castle's turbidity data to the group.

- Kelly will finalize the Water Quality Report Addendum, send it to the TWC and post it to the website.

- Bill will look for historical unit operating data for Parr and FPS.

At the Water Quality TWC meeting on February 4, 2014, the TWC noted that the Parr Water Quality Report identified multiple dissolved oxygen (DO) levels below 4.0 mg/l in the Parr Shoals Dam tailrace. The TWC agreed that SCE&G would consolidate historic USGS data to examine those excursions and to provide any operations that might be associated with the data. SCE&G requested hourly DO, temperature and river flow data from 2004 through 2013 for the following USGS stations:

1. USGS 02160991 Broad River near Jenkinsville, SC
2. USGS 02156500 Broad River near Carlisle, SC
3. USGS 02160700 Enoree River at Whitmire, SC
4. USGS 02160105 Tyger River near Delta, SC

Our analysis of the data focused on the period from July through September of each year from 2004 through 2013. For this analysis, we plotted hourly readings of flow, temperature, and DO levels at each of the gage stations. Those plots and the raw data will be available to the TWC upon request. Included below are data from the Jenkinsville gage, located immediately downstream of the Parr Shoals Dam along the east bank of the tailrace (FIGURE 1 through FIGURE 10). Since flow data is not collected at the Jenkinsville gage, flow data from the Alston gage, USGS 02161000, was used.

FIGURE 1 2004 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000

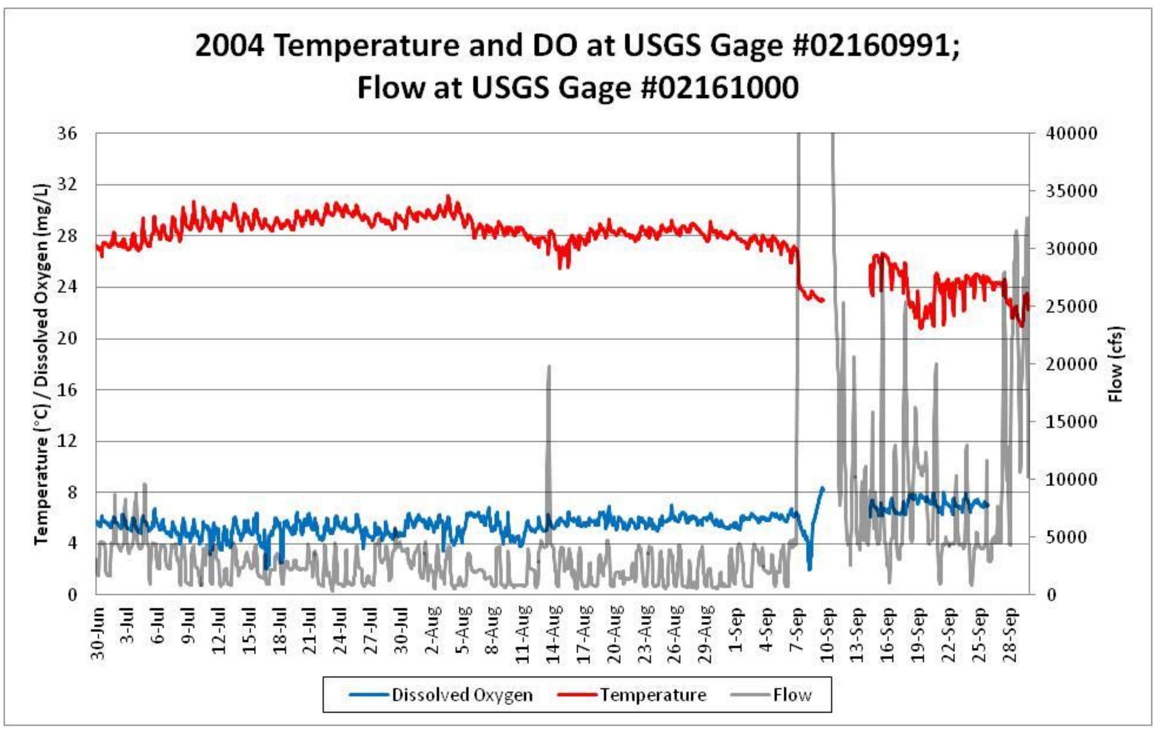


FIGURE 2 2005 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000

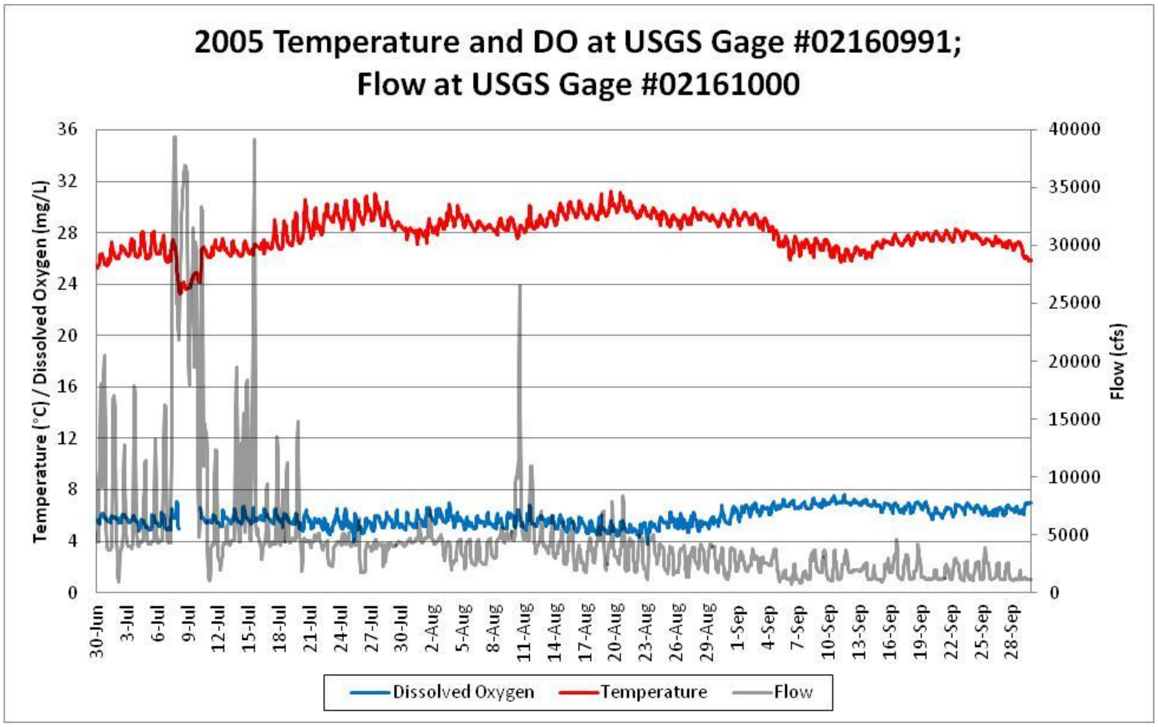


FIGURE 3 2006 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000

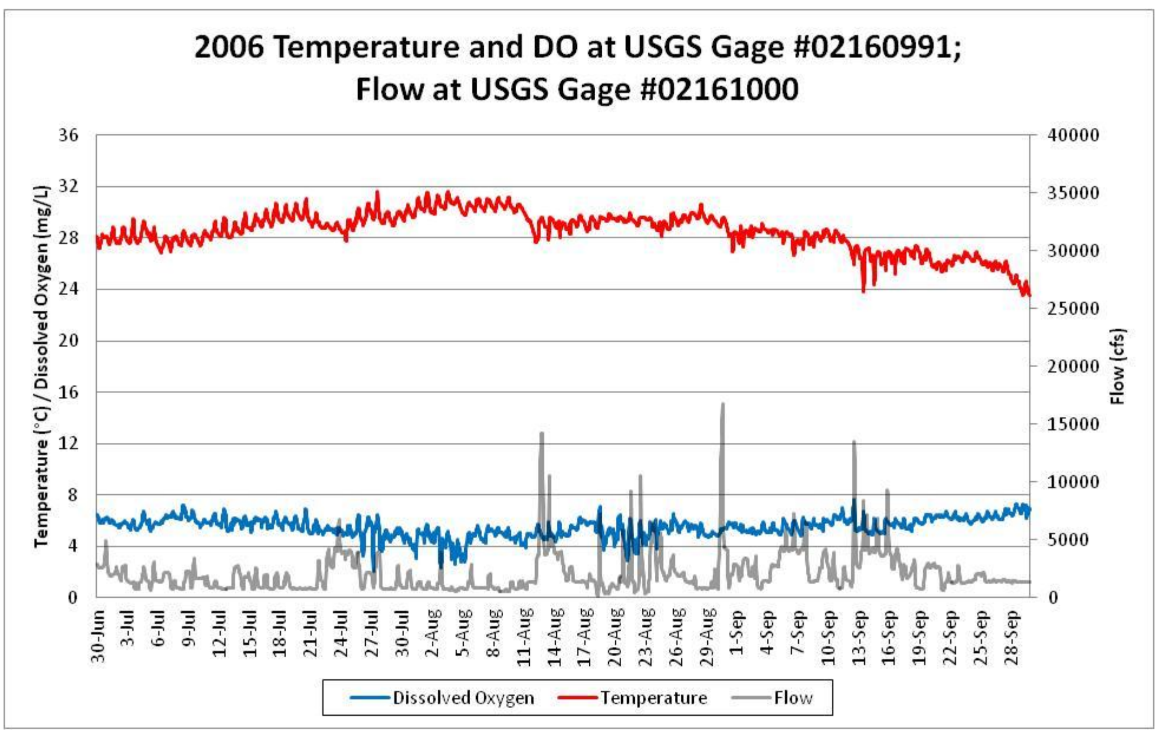


FIGURE 4 **2007 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

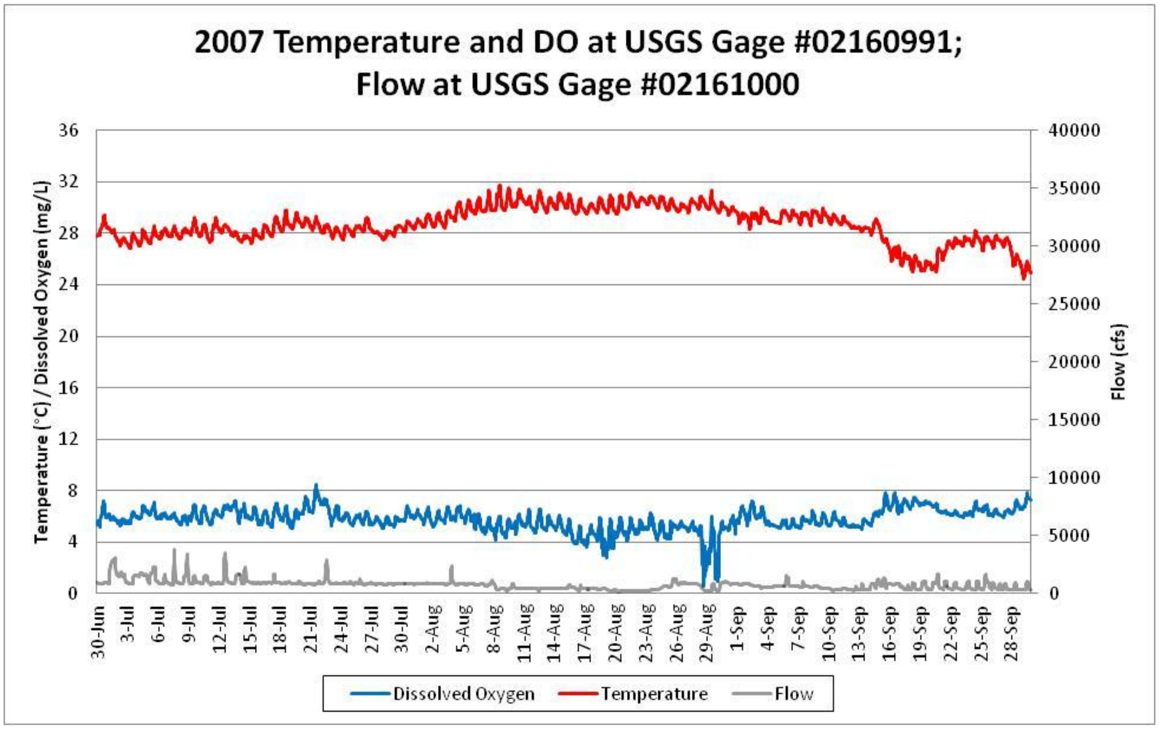


FIGURE 5 **2008 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

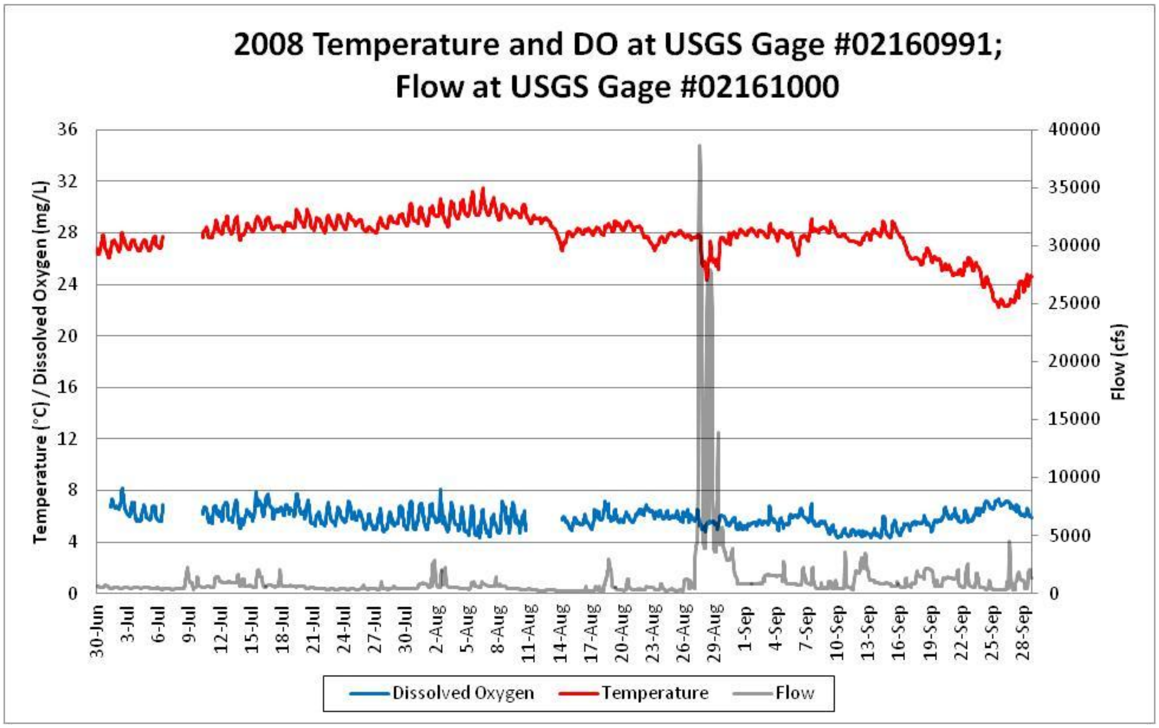


FIGURE 6 **2009 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

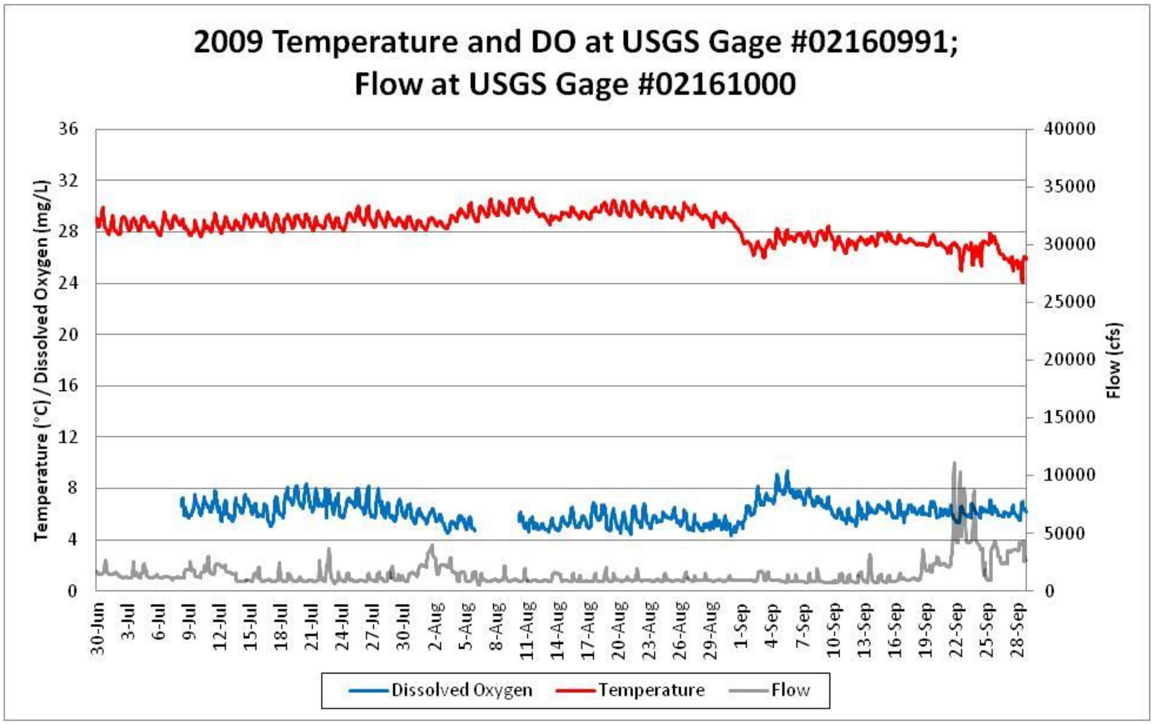


FIGURE 7 **2010 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

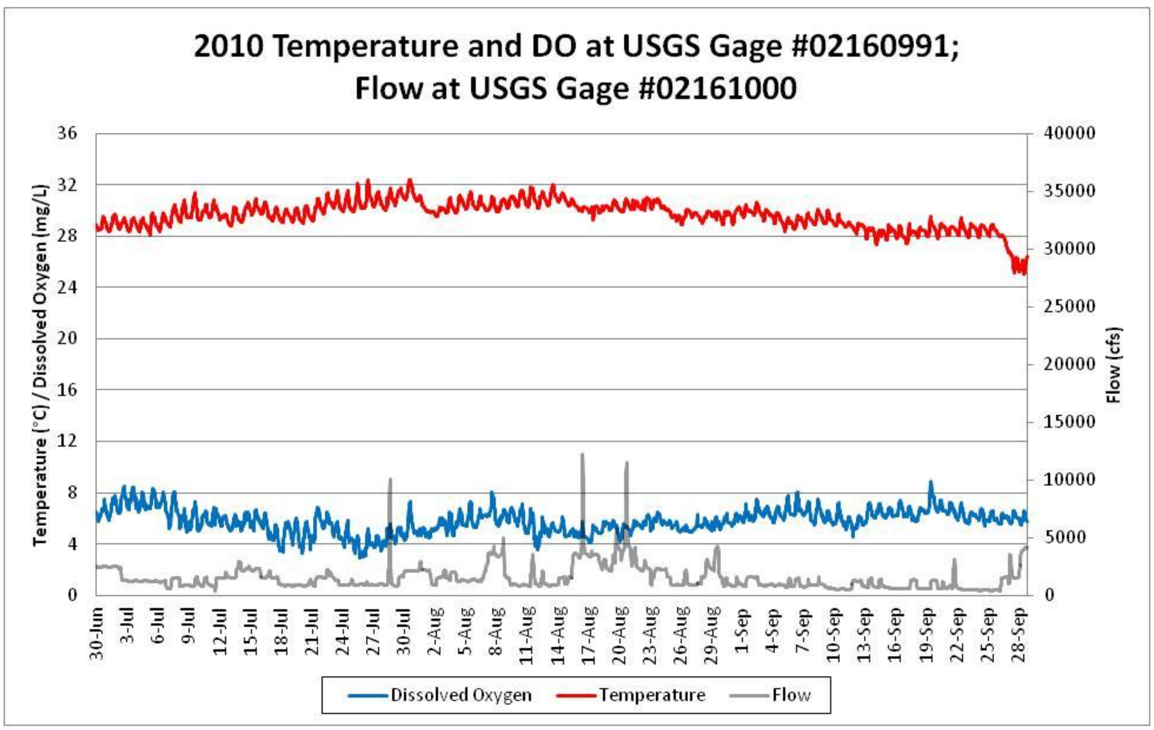


FIGURE 8 **2011 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

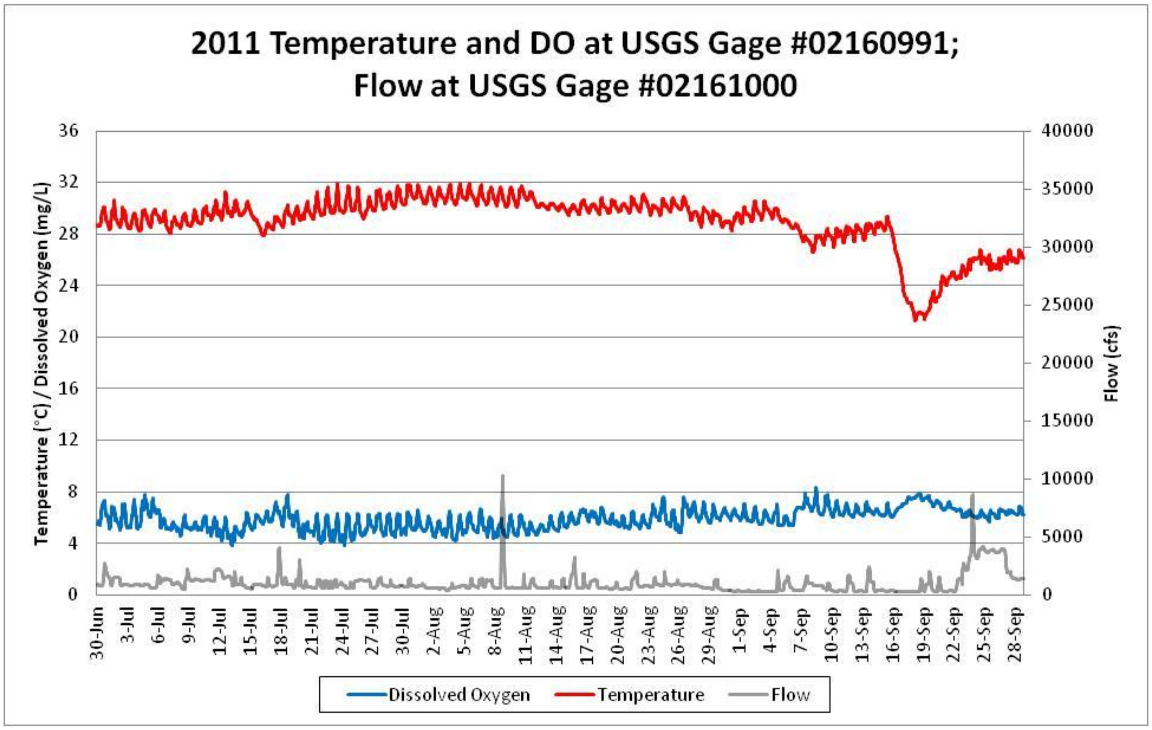


FIGURE 9 **2012 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

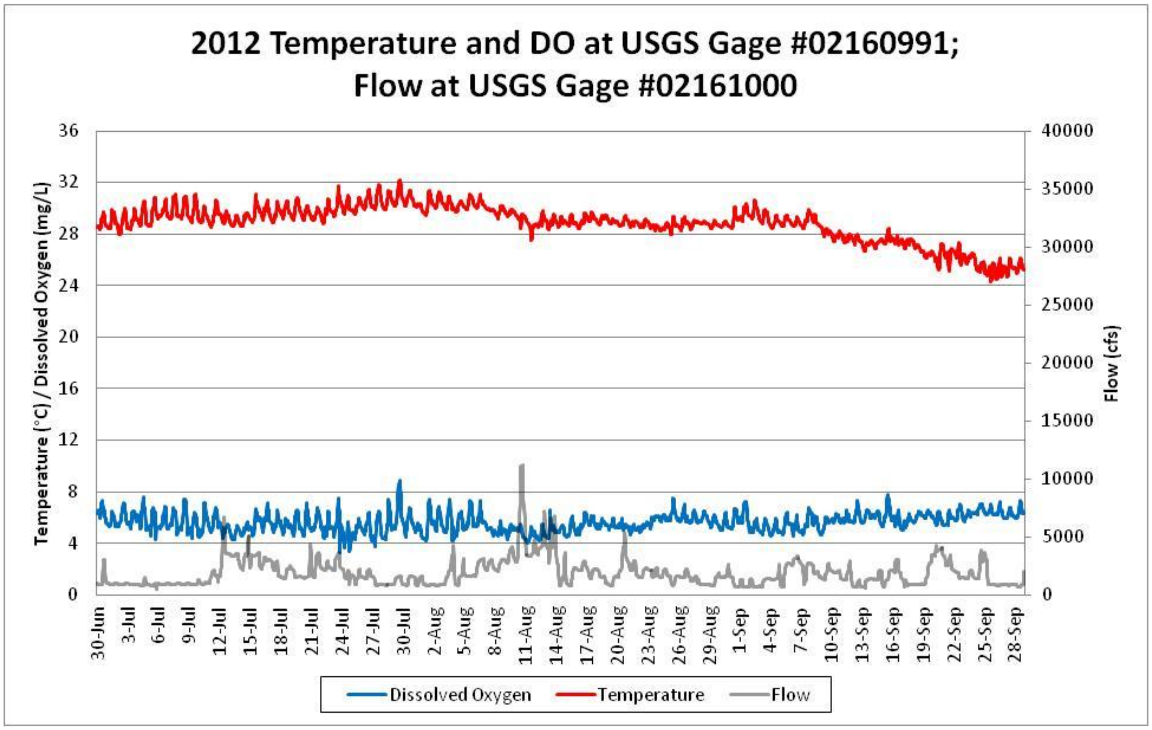
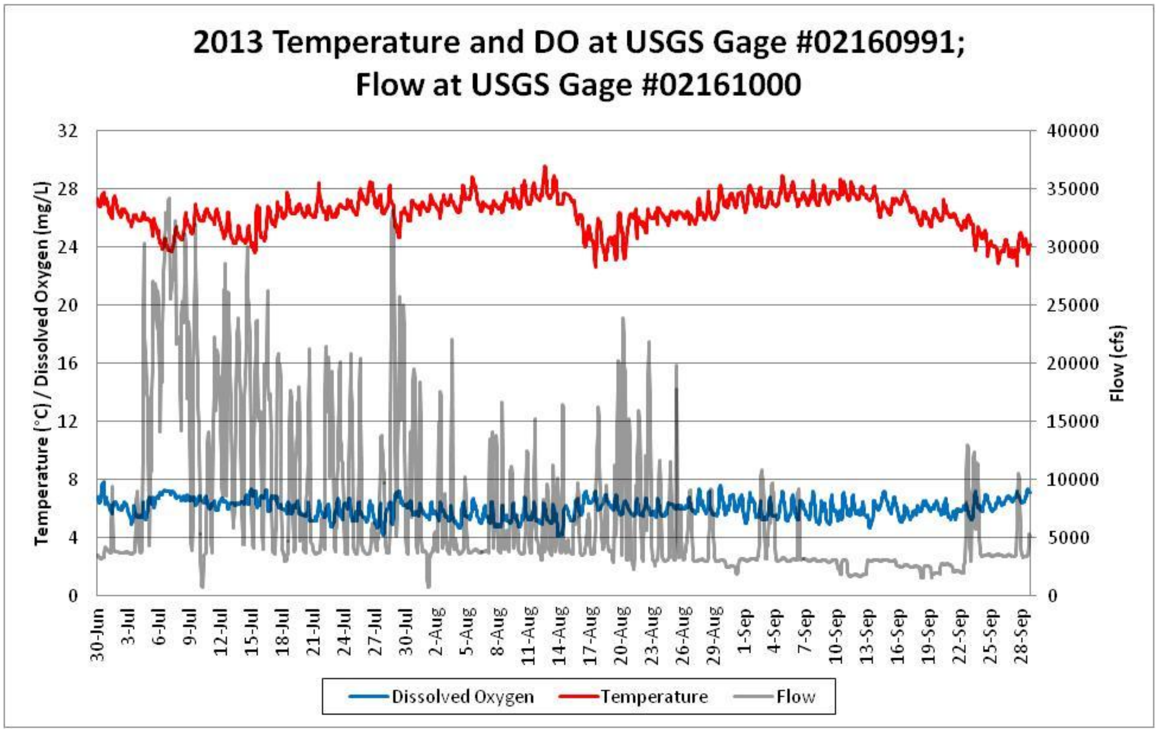


FIGURE 10 2013 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000



Review of the data verified that there are periodic excursions of DO levels less than 4.0 mg/l. These events are not consistent from year to year and do not typically have a long duration. We have presented representative excerpts of the raw data in TABLE 1 through TABLE 4 to demonstrate the month, flow, temperature, time of day, and DO level experienced.

TABLE 1 JULY 19-20, 2010: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/19/2010	9:00 pm	4.3	29.5	900.7
7/19/2010	10:00 pm	4.0	29.4	900.7
7/19/2010	11:00 pm	3.7	29.4	900.7
7/20/2010	12:00 am	3.9	29.3	900.7
7/20/2010	1:00 am	3.8	29.3	900.7
7/20/2010	2:00 am	3.8	29.2	888.0
7/20/2010	3:00 am	3.7	29.2	875.3
7/20/2010	4:00 am	3.6	29.1	862.7
7/20/2010	5:00 am	3.3	29.1	862.7
7/20/2010	6:00 am	3.7	29.0	837.7
7/20/2010	7:00 am	4.0	29.1	837.7
7/20/2010	8:00 am	4.5	29.2	825.3

TABLE 2 JULY 13, 2011: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/13/2011	5:00 am	4.6	29.7	1474.9
7/13/2011	6:00 am	3.9	29.3	1369.9
7/13/2011	7:00 am	3.8	29.3	939.3
7/13/2011	8:00 am	4.1	29.5	812.9

TABLE 3 JULY 24, 2012: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/24/2012	6:00 am	4.2	29.6	2107.6
7/24/2012	7:00 am	3.9	29.6	1789.4
7/24/2012	8:00 am	3.6	29.5	1536.0
7/24/2012	9:00 am	3.9	29.7	1459.7
7/24/2012	10:00 am	4.3	30.1	1429.5
7/24/2012	11:00 am	4.3	30.1	1429.5
7/24/2012	12:00 pm	4.4	30.2	1444.6
7/24/2012	1:00 pm	4.4	30.3	1444.6
7/24/2012	2:00 pm	4.7	30.6	1399.6
7/24/2012	3:00 pm	5.6	30.9	1444.6
7/24/2012	4:00 pm	5.7	31.0	1954.6
7/24/2012	5:00 pm	5.5	30.9	2124.8
7/24/2012	6:00 pm	4.8	30.8	1971.4
7/24/2012	7:00 pm	3.5	30.1	1154.4
7/24/2012	8:00 pm	3.4	29.9	875.3
7/24/2012	9:00 pm	3.6	29.9	1520.7
7/24/2012	10:00 pm	3.6	29.9	1676.9
7/24/2012	11:00 pm	4.1	29.9	1724.8

TABLE 4 JULY 27, 2012: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/27/2012	6:00 am	4.2	30.0	1490.1
7/27/2012	7:00 am	3.7	29.9	1196.5
7/27/2012	8:00 am	3.8	30.0	900.7
7/27/2012	9:00 am	4.3	30.0	837.7

Our review of this data lead us to the conclusion that the low DO levels frequently occur during the early morning hours when DO levels often begin to decline (diel fluctuation) and flows begin to decline. Based on this observation we reviewed the location of the USGS monitor which is located along the bank in a back eddy just downstream of the Parr Shoals Dam. We also asked the USGS to provide any information they had on the type of monitoring equipment used and how it had changed over time. The following is a consolidation of email excerpts that we received from Michael Hall of the USGS:

> The current DO probe that the USGS uses at the Parr Dam monitoring site is a YSI 6150 ROX, which is an optical DO probe with a self cleaning wiper system. Looking back over the last year and a half, there have been no corrections needed to the sensor data for fouling or calibration drift. The sensors and sonde are cleaned at least monthly, but sometimes more often in the summer months if needed. The DO membrane itself rarely has any visible fouling because of the wiper system. Calibration is checked monthly and readings are also verified at each visit with a separate calibrated field meter. YSI states that the accuracy of the ROX DO is +/- 0.1 mg/L or 1% of reading, whichever is greater. The USGS applies corrections to the data if the combined fouling and drift differences exceed +/- 0.3 mg/L.
>
> [USGS hasn't] noticed any issues with the quality of the readings and can't ever recall the water being stagnant where the sonde housing is placed. The flow at the sonde is mostly negative due to a swirling motion, but any debris or other trash that is floating in the pool gets "flushed" fairly quickly, so I would assume the water is constantly being refreshed. If you would like, we can arrange to be on site during different unit releases to better determine if there is a stagnant issue.
>
> Prior to the ROX sensor [installation – June 2011], [USGS] used a YSI 5739 and YSI Rapid Pulse DO Probes. All three sensors have the same accuracy according to YSI. [USGS doesn't] have the exact dates that the ROX was installed, but [they] believe it was in the 2011 water year. The frequency of cleaning for the older probes was 2 to 4 weeks depending on season and flow events. Those probes didn't self clean, so during the summer months they usually needed more attention"

It is our suspicion that some, if not all, of these low DO events are related to low flows in the tailrace and backflow or stagnant flows at the USGS monitor. To test this theory, we have planned to collect additional data in the tailrace during July and August of 2014 and compare it with USGS data collected at the same time. We will focus on these warmer summer months when flows are lower and more likely for us to observe any deviations.

DO readings will be collected along a transect starting at the furthest turbine discharge on the west end of the Parr Shoals powerhouse and proceed to the east towards the USGS monitor using a Hydrolab Surveyor 4a with a Hydrolab MS 5 sonde or similar equipment. DO readings will be collected at the mid-depth of the water column from a maximum of 10 sample locations along the transect. Collections will be performed at one hour before sunrise, at sunrise, and one hour after sunrise. Collections will also be coordinated with lower flow events – possibly scheduled for each sampling. We will perform up to eight collections during July and August of 2014 to detect any differences in the transect DO measurements and the USGS data measurements.

The transect data will be compared to the USGS data. We will use figures and tables to display the collected data and patterns in the DO level will be described based on time, flow, and distance from the USGS monitor. We will consolidate this information into a letter report to share with the TWC for review and discussion.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Operations RCG Meeting

June 26, 2014

Final KDM 08-26-14

ATTENDEES:

Vivianne Vejdani (SCDNR)
Dick Christie (SCDNR)
Scott Harder (SCDNR)
Steve Summer (SCANA)
Gerrit Jobsis (American Rivers)
Bill Marshall (SCDNR)
Bret Hoffman (Kleinschmidt)
Randy Mahan (SCANA)
Malcolm Leaphart (Congaree Riverkeeper)
Bill Argentieri (SCE&G)
Ray Ammarell (SCE&G)
Kelly Miller (Kleinschmidt)
Henry Mealing (Kleinschmidt)
Byron Hamstead (USFWS)
Bruce Halverson (Kleinschmidt) via Conf. Call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting by reviewing the agenda and then he turned the meeting over to Bret. Bret stated that the meeting goal was to explain the methodology included in the study plan used to develop the inflow dataset and explain the methodology for determining the correlation coefficient. Bret noted that many of the comments submitted by the RCG on the Inflow Dataset Methodology Memo were related to the use of monthly data. Bret explained that the dataset will actually be daily or hourly data. Monthly data was used only to determine the correlation coefficient.

Bret then led the group through the comments and questions submitted by the RCG, beginning with those submitted by Scott Harder. (The questions submitted by the RCG on the Inflow Dataset Methodology Memo and corresponding answers are attached to the end of these notes.) Scott asked for clarification on how the dataset would be used. Bret agreed that language can be added to the memo to clarify this. Bret explained that daily data could be used to develop the coefficients, but because it is a mass balance evaluation, it makes more sense to use a monthly dataset due to daily mass variance which can result from the pumped storage operation. Gerrit asked how using a monthly dataset can capture daily variances. Bret explained that the monthly data was used only to determine the coefficients for pro-rating upstream gages, which will then be applied to the daily dataset. Bret reiterated that daily data could be used to determine the coefficients, but the coefficients would generally be the same as using monthly data, and it would increase inaccuracy into the regression analysis.

Scott stated that he compared the method explained in the dataset methodology memo to the straight area proration method, and he is comfortable with the method chosen. Bret said that the method was chosen because it more accurately predicted low flows than other methods considered.

Bret asked the group if there was a real need to use hourly data, since it has a more limited period of record than daily data, which could be substituted as hourly for corresponding hourly model runs. Ray said the model can be routed for high flow events, using hourly data during these events only, instead of for the whole period of record. Gerrit said that his interests are in the amount of water coming in to the Project, how the Project manipulates it, and how the water leaves the Project. He is interested in low flows, not particularly high flow events. He doesn't want the model to be smoothed over during the low flow events because monthly data was used. Ray said that monthly data was only used to create the coefficients, and those coefficients can be applied to anything, including daily or hourly flows. The model and its output are not governed by the input of the inflow dataset. Hourly inflow data will only have significant impacts on the project during high inflows from storm events, which can be routed. Ray said these specific events can be modeled at any time using hourly data, thus in effect "zooming in" to a particular event in time.

Byron asked if the model accounts for geologic factors. Bruce said that this is done mathematically, based on the slope of the channel. The speed of the flood wave moving downstream is dictated by the width and slope of the channel. Ray explained there is a series of coefficients for each reach of the river and these coefficients are entered into the model, which relates each coefficient to a different set of coefficients. You then examine the resulting hydrograph to determine if it looks reasonable. Ray explained that it is typical to estimate inflows. All applications of these models are approximations. Ray noted that a reservoir curve can be created, which is then compared to the reservoir stage data as water flows in to determine if the hydrograph is reasonable. Hydrographs can also be compared to observations for calibration. Real operations data and real reservoir stage data is used to calibrate the hydrographs. If the model compares closely to the actual data, you can conclude that the model is accurate and can be used to predict future operations. However, modeling is always an approximation and assumptions must be understood. Models are a tool, to which judgment must be applied.

Bret reminded the group that the method explained in the memo is only used for developing the inflow datasets, not the actual dataset used in the model. The actual dataset used in the model will be circulated to the RCG for their information. Bret told the group to consider whether they want to use routed hourly inflows with the shorter period of record versus daily inflow data in the model.

Scott's second comment submitted on the methodology memo was regarding the normalized flows graph. Bruce explained that only two consecutive years were included in the memo, which showed two years of extremes. However, he did graph all years and showed this to the group. The normalized flows show that all gages provide similar contributions, validating the use of a single alpha and a single lambda coefficient for the entire dataset. Byron asked if it would be more statistically accurate to create an individual alpha and lambda for each basin. Bret said that it would be more accurate but on such a minute level that it wouldn't make a difference in the final product. Byron said that if we could account for the subtle differences in the hydrology of contributed drainage areas, we could determine how different Carlisle is from the other basins, thus accounting for subtle geologic differences between the areas. Bret stated that the differences would not reduce the variability to a noticeable degree. Each basin has different characteristics, including some isolated storm events, regulated projects, geologic differences, and land use differences. Carlisle contributes more on a mass basis, however on a per square mile basis, it is very similar geologically to the other basins. Scott said that it doesn't matter if there are slight differences in the basins. We are trying to represent the ungaged areas by using proration, which are relatively similar. Scott said he believes the regional coefficient is sufficient to accurately represent the ungaged areas. Scott said he doesn't believe we have the data to accurately make a coefficient for each basin.

Byron asked how the lambda for the two Enoree gages was determined. He asked if Riverdale should be considered. Bret said that the Riverdale Project is not in operation, hasn't been in operation for 10 or more years, and is so small (8 to 10 acre ft of storage) that it wouldn't have a real effect, especially since monthly data was used.

Henry asked the group if there were any further comments. The memo will be edited based on the comments submitted. The edits will be included in track changes (attached to the end of these notes) and sent to the RCG for final approval. The questions and comments received, along with answers, will be included as an appendix to the Final Inflow Dataset Methodology Memo. The proposed daily dataset will be calculated using the coefficients, and sent out to the RCG following the meeting.

The next steps include creating the reservoir routing model (HEC-Res Sim model) and the hydraulic model of the downstream reach (HEC RAS model). Data used will include the two active gages on the river, the old Richtex gage data, and data being collected for the IFIM study. Steve asked if the evaporation from the two new nuclear units will be included in the model. Bret said that evaporation losses will be deducted from the hydrology dataset by the model.

Henry reminded the RCG that at the last meeting there was discussion about future water use and future water consumption, with Duke Energy's *Broad River Water Supply Study* from 2007 specifically being referenced. Are there future water allocations that need to be considered in the model? Dick said that the numbers tend to be greatly exaggerated in these studies. We have an opportunity to test the first ten years of the Duke study now. He doesn't know if we should be worried about these numbers because he thinks they are way too high, but we can look into it. Vivianne added that these numbers may have been exaggerated so that higher water withdrawal permits can be requested in the future. Dick said that everyone pads their numbers to make sure they have enough approval to meet their needs. Scott said maybe we should consider some of the bigger water needs in the area, such as Spartanburg withdrawals or any new nuclear plants such as Lee Nuclear Station. The agencies agreed to look at the estimated numbers in the Duke study and see if they are accurate for the present.

Bret said that the reservoir model is separate from the river model and should be considered as independent. The reservoir model is designed around the following parameters: the two reservoirs transferring water back and forth, the turbines' hydraulic capacities at Parr and Fairfield, and the operation of the spillway gates. Parameters like how SCE&G operates their system will also be included. Seasonal variation in pumping and outages will also be considered.

Scenarios won't be run for another year. The models will be developed and calibrated to historical operations, but no scenarios will be run until information is gathered from other studies. Scenarios will begin to be developed in late 2015. The model demonstration is planned for early September 2014.

The meeting was adjourned. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Kleinschmidt will edit the Inflow Dataset Methodology Memo based on comments and distribute to the RCG for final approval. The memo will then be finalized with the submitted comments and questions/answers included as an appendix.
- Kleinschmidt will distribute the proposed daily dataset to the RCG.
- Kleinschmidt will complete the HEC-Res Sim model and the HEC RAS model and schedule a meeting for the model demonstration in September 2014.
- The Agencies (SCDNR and USFWS) will evaluate the estimated numbers in the Duke Broad River study and see if they are accurate for the present.

INFLOW DATASET DEVELOPMENT: STATISTICAL METHODOLOGY

PARR HYDROELECTRIC PROJECT

FERC NO. 1894

Prepared for:

South Carolina Electric & Gas Co.
Columbia, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

~~May~~ July 2014

INFLOW DATASET DEVELOPMENT:
STATISTICAL METHODOLOGY

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~~May~~ July 2014

INFLOW DATASET DEVELOPMENT:
STATISTICAL METHODOLOGY

PARR HYDROELECTRIC PROJECT

FERC NO. 1894

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INFLOW DATASET DEVELOPMENT:
STATISTICAL METHODOLOGY

PARR HYDROELECTRIC PROJECT

FERC NO. 1894

1.0 PARR RESERVOIR INFLOW DATA DEVELOPMENT

1.1 INTRODUCTION

An inflow hydrology dataset is being developed in support of developing operations models and to satisfy the Final Parr Fairfield Operations Model Study Plan (Study Plan). As discussed in the Study Plan, the ~~existence~~ operation of the pumped storage development and lack of long-term operational records prevents the back-calculation of a sufficient inflow dataset. For this reason, the inflow to Parr Reservoir was calculated using upstream flow data adjusted by statistically-derived parameters. The inflow time series datasets for Parr Reservoir were developed using statistical algorithms based on flow data records from the USGS gages upstream and downstream of the Parr Dam.

The inflow dataset developed by this process will be used for two distinctly different simulation processes. The utilization of Parr Reservoir inflows for power generation by the Fairfield Pumped Storage development and the Parr Hydro development, and corresponding upper and lower reservoir fluctuations will be simulated using the USACE modeling package HEC-ResSim; this software's primary requirement is daily inflow values. The flows released from the Parr development will be used as upstream boundary conditions in the USACE model HEC-RAS, which will simulate the downstream flow and stage regimes. The HEC-RAS model requires flow values in increments of one-hour or less.

1.2 HYDROLOGIC DATA

Data used in the statistical analyses were obtained via the USGS web portal (http://waterdata.usgs.gov/nwis). The data were processed using spreadsheets and the USACE database program HEC-DSSVue. The USGS gage sites used in the analysis are listed in Table 1. Additional flow and stage data were obtained from the USGS server for use in other phases of this study, and will be fully cited and described in the applicable summary reports.

TABLE 1 USGS GAGE SITES

DATA SOURCE	USGS #	DRAINAGE AREA (SQ. MI.)	PERIOD OF RECORD	DATA TYPE
Enoree River at Whitmire	02160700	444	10-1-1973 to Current	Stage & Discharge
Enoree River near Woodruff	02160390	249	2-9-1993 to Current	Stage & Discharge
Tyger River near Delta	02160105	759	10-1-1973 to Current	Stage & Discharge
Broad River near Carlisle	02156500	2790	10-1-1938 to Current	Stage & Discharge
Broad River at Alston	02161000	4790	10-1-1896 to 12-1-1907, 10-1-1980 to Current	Stage & Discharge

1.3 PARR RESERVOIR INFLOW DATA SYNTHESIS

Prior to the statistical analyses, Kleinschmidt Associates performed a review of relevant hydrologic studies published by the USGS. These included:

- Low-Flow Frequency and Flow Duration of Selected South Carolina Streams in the Broad River Basin through 2008 (USGS Open-File Report 2010-1305);
- Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina (USGS Scientific Investigations Report 2009-5156); and
- Techniques for Estimating the Magnitude and Frequency of Floods in Rural Basins of South Carolina, 1999 (Water-Resources Investigations Report 02-4140)

Although these studies included hydrologic analyses of the Parr watershed, their focus was primarily on the development of statistically-based estimates of extreme events as opposed to typical hydrology. These studies were reviewed as background information regarding the physiographic nature of the watershed, which could provide insight on the hydrologic behavior of the Broad River and its tributaries upstream and downstream of Parr Reservoir.

The synthesis of streamflow data using a proration of upstream gages typically uses a statistical regression technique based on drainage area ratios. Gages were selected for summing prorated inflows with the intention of maximizing the relevant, overlapping periods of record, as well as drainage area coverage. Periods of record that are relevant represent the current development of the waterway, which would be subsequent to the commissioning of the pumped storage project (December 1978) to current day. Three gages were selected that measure contributing flows for 84% of the project's total drainage area and compared with the corresponding period of record with the Alston gage downstream of the Parr dam[1].

In order to develop the inflow data set for Parr Reservoir, various statistical methods were assessed to determine the optimal estimate. These methods included statistical regressions to determine the weighting factors for scaling the measured upstream flows (see Figure 1) to estimate the inflow to Parr Reservoir. These methods are described in the following sections.

The statistical analyses will use monthly and annual flow data rather than daily average flows. The daily data are affected by reservoir operations, which introduce a significant degree of variability due to the cyclic transfer of up to 29,000 acre-feet between the upper and lower reservoirs. Flow releases from the project may be vastly different at any given hour from the inflows to the Parr reservoir. The monthly and annual flow data statistics are much less affected by day-to-day operations.

[1] It is worth noting that the Parr dam drainage area is 4,750 square miles compared to the slightly larger Alston gage drainage area of 4,790 square miles (about 0.8% less). However, the USGS cites the Alston gage as synonymous with reservoir outflow. No adjustment was made, as the difference is statistically insignificant.

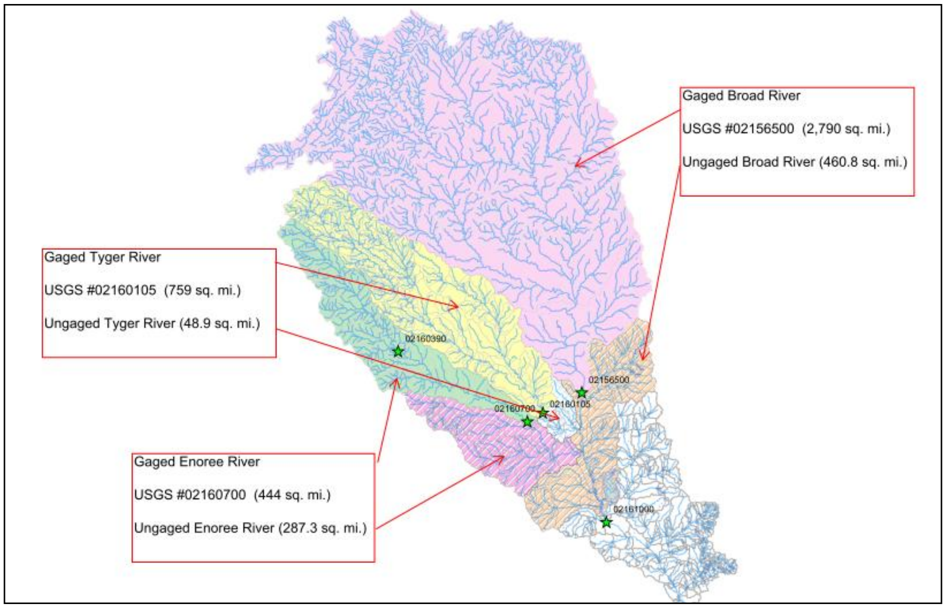
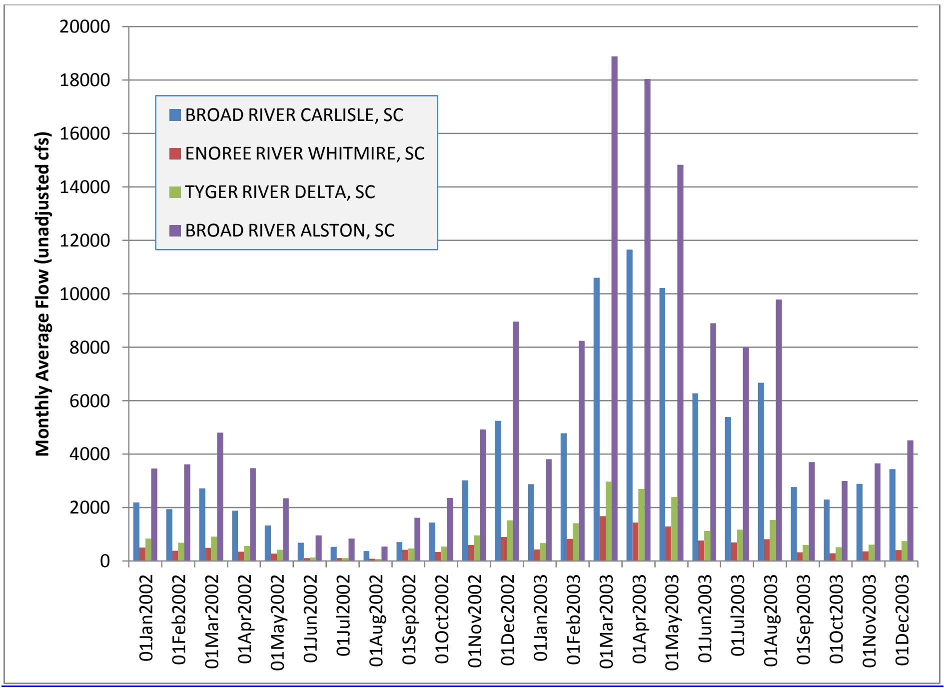


FIGURE 1 GAGED AND UNGAGED BROAD RIVER SUBWATERSHEDS

1.3.1 PRELIMINARY HYDROLOGIC REVIEW

Prior to the statistical regression analyses, a cursory review was performed to assess the hydrologic response of the subwatersheds that contribute to the Parr Reservoir inflows. The review consisted of a comparison of a sampling of monthly average flows from the upstream gages on the Broad, Tyger, and Enoree rivers to the flows at the Alston gage (see Figure 2). The purpose of the review was to determine the degree of hydrologic similarity between the three contributing subwatersheds. A high degree of hydrologic similarity indicates that the soils, topography, and land use over the entire watershed are homogeneous. The subsequent analyses, which are predicated on this assumed homogeneity, provide a basis for developing a statistical relationship between the gaged and ungaged portions of the subwatersheds.

The first comparison was the unadjusted monthly average flows from the upstream gages with the Alston gage. This comparison illustrates the relative contribution of the upstream gaged areas. For the given period, the monthly average flow at Carlisle was approximately 2/3 of the flow average at Alston.



Monthly Average Flow (unadjusted cfs)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
BROAD RIVER CARLISLE, SC
ENOREE RIVER WHITMIRE, SC
TYGER RIVER DELTA, SC
BROAD RIVER ALSTON, SC
01Jan2002
01Feb2002
01Mar2002
01Apr2002
01May2002
01Jun2002
01Jul2002
01Aug2002
01Sep2002
01Oct2002
01Nov2002
01Dec2002
01Jan2003
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01Oct2003
01Nov2003
01Dec2003

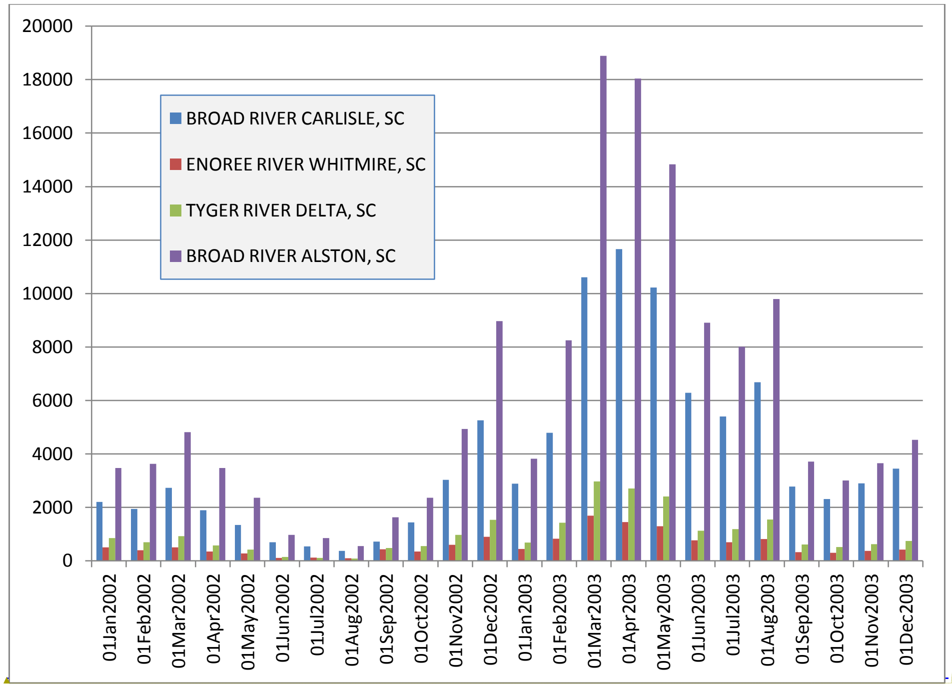

FIGURE 2 MONTHLY AVERAGE FLOWS, UNADJUSTED

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The second portion of the review was a comparison of the runoff from the gaged upstream subwatersheds. The monthly average flows from the previous step were normalized by drainage area, resulting in the average flow per 100 square miles of drainage area. This comparison was performed to determine the similarity in runoff characteristics between the three gaged areas. The comparison (see Figure 3) illustrates that the range of the monthly averages (per 100 sq. mi.) was visually close to the aggregate average through a variety of flow ranges; this indicates the hydrologic similarity of the three subbasins.

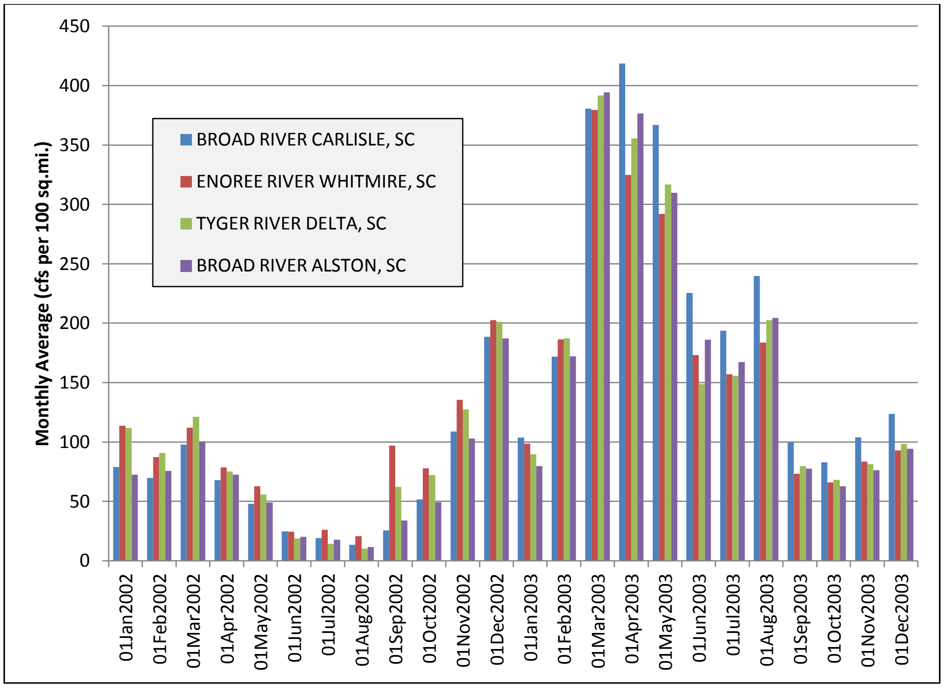


FIGURE 3 NORMALIZED MONTHLY AVERAGE FLOWS

1.3.2 MULTIVARIATE REGRESSION ANALYSIS

A multivariate regression was performed to determine the parameters of a generalized equation for estimating the inflow to Parr Reservoir. The flow estimate is based on the flows measured at three gage sites upstream of the impoundment. The two parameters include a fitted regional exponent (γ), and a fitted regional coefficient (α). The equation, shown below, is a summation of the three upstream flow values multiplied by scaling factors, which include the ratio of the total drainage area represented by each to that gage's actual drainage area.

Equation 1: $ParrInflow = \langle \alpha * BRC \left(\frac{3250.8}{2790}\right)^{\gamma} \rangle + \langle \alpha * TRD \left(\frac{807.9}{759}\right)^{\gamma} \rangle + \langle \alpha * ERW \left(\frac{731.3}{444}\right)^{\gamma} \rangle$

where,

BRC – Broad River at Carlisle
TRD – Tyger River near Delta
ERW – Enoree River at Whitmire
α – Fitted Regional Coefficient
γ – Fitted Regional Exponent

The regional exponent was developed by quantifying the relationship between monthly streamflow averages and drainage area using two unregulated stream gages on the same river with overlapping records. The only gages that meet this in the immediate Parr Dam watershed are on the Enoree River. The regional exponent was developed by performing a regression on monthly flow averages from the Woodruff gage (drainage area = 249 sq. mi.) and the Whitmire gage (drainage area = 444 sq. mi.). These two gages were selected because they have the longest overlapping (current) periods of record. The result of this regression produced the drainage area regional exponent (γ) of 0.599.

This proration exponent was used to normalize the monthly flow averages, prior to performing the second regression to develop the drainage area coefficient (α). The regression used monthly flow averages for the period 1/1/1981 through 12/31/2013, a total of 396 months. The target data used in the regression is the monthly average flow at the Alston gage, which was adjusted by adding the estimated evaporation from both the Monticello and Parr reservoirs. Evaporation estimates were based upon monthly losses in inches[2] applied to the average surface area of both reservoirs, plus estimated increased evaporation caused by the V.C. Summer Nuclear Station thermal plume in Monticello Reservoir. This adjustment ranged in value from 37.5 cfs in January to 103.5 cfs for July.

The results of this regression, using all 396 months, produced a value of $\alpha = 1.041$, an R^2 of 0.9828, and a standard error of 495.4. The scatter plot of Alston monthly flow vs. predicted flow, including a 1:1 reference line, is shown in Figure 4. The modeling residuals were also calculated and are shown graphically in Figure 5. The modeling residual values are the difference between the target value and the predicted value. In this case, a negative modeling residual indicates that the predicted value is greater than the target value. The plot of the modeling residuals indicates that the statistical model tends to overpredict flows during months for which the average flow was less than 7,700 cfs (the y-intercept shown on Figure 5) and tends to underpredict during months with flow averages greater than 7,700 cfs.

[2] Evaporative rates from "Pan Evaporation Records for the South Carolina Area," John C. Purvis, SC State Climatology Office, with FWS evaporation taken as 75% based on Discussions in "NOAA Technical Report NWS 33: Evaporation Atlas for the 48 Contiguous States," June 1982.

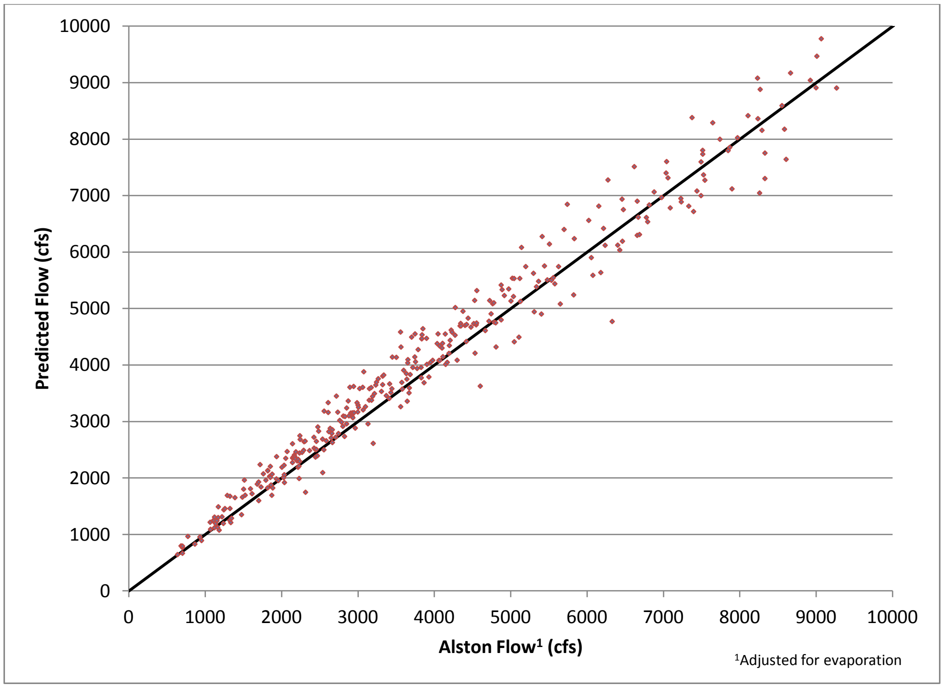


FIGURE 4 ALSTON FLOW VS. PREDICTED MONTHLY AVERAGES (33 YEARS) – REGRESSION BASED ON ALL MONTHS

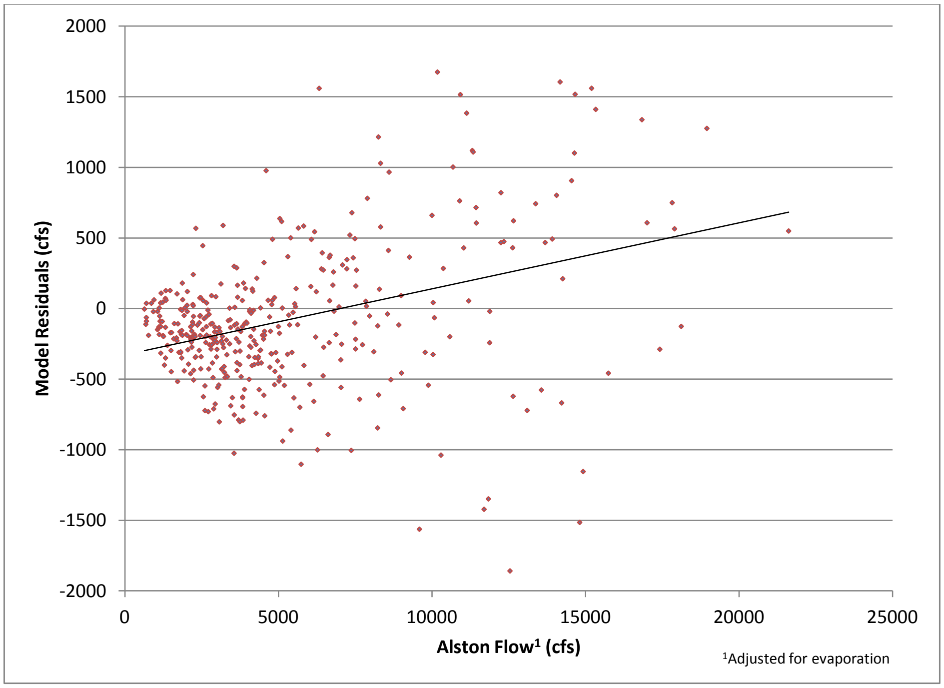


FIGURE 5 MODEL RESIDUALS – REGRESSION BASED ON CONCURRENT PERIOD OF RECORD

1.3.3 MODIFIED REGRESSION (ADJUSTED FLOW RANGE)

Due to the results of the first regression attempt, which indicated a tendency to overpredict during months with less than 7,700 cfs average flow, a second regression was developed. Because balancing the hydrologic resource is imperative during lower inflow conditions, this modified regression was performed to more accurately predict flows in the lower range. The second analysis used the lowest 75% of monthly average flows (289 out of 396 months) as a basis for the regression and then applied the resulting coefficients on the entire dataset to quantify the statistical performance.

The results of the second regression, using 289 of the 396 months, produced a value of α = 0.988, an R^2 of 0.9828, and a standard error of 469.6. Compared to the first regression, the reduced α-value did not change the R^2 value, but reduced the standard error. The most significant change was the modeling residuals. The y-intercept for the residual plot for the second regression is approximately 3,900 cfs. This indicates that the second regression has a lower statistical bias in the range of the most typical flows than the first regression. The scatter plot of Alston monthly flow vs. predicted flow is shown in Figure 6, and the modeling residuals are shown in Figure7.

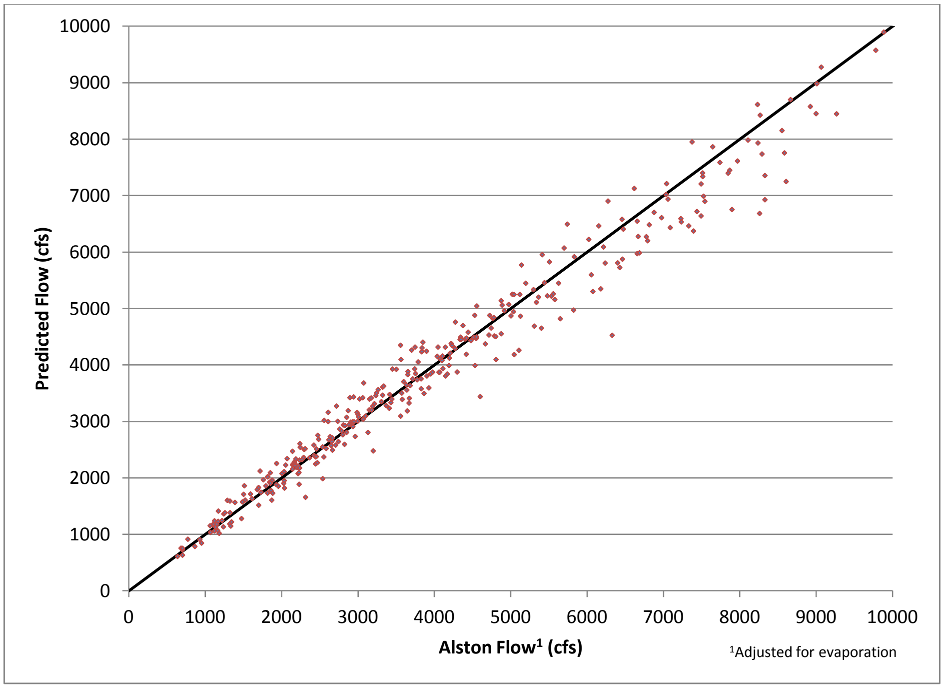


FIGURE 6 ALSTON FLOW (ADJUSTED) VS. PREDICTED MONTHLY AVERAGES (33 YEARS) - REGRESSION BASED ON DRIEST 75% MONTHS

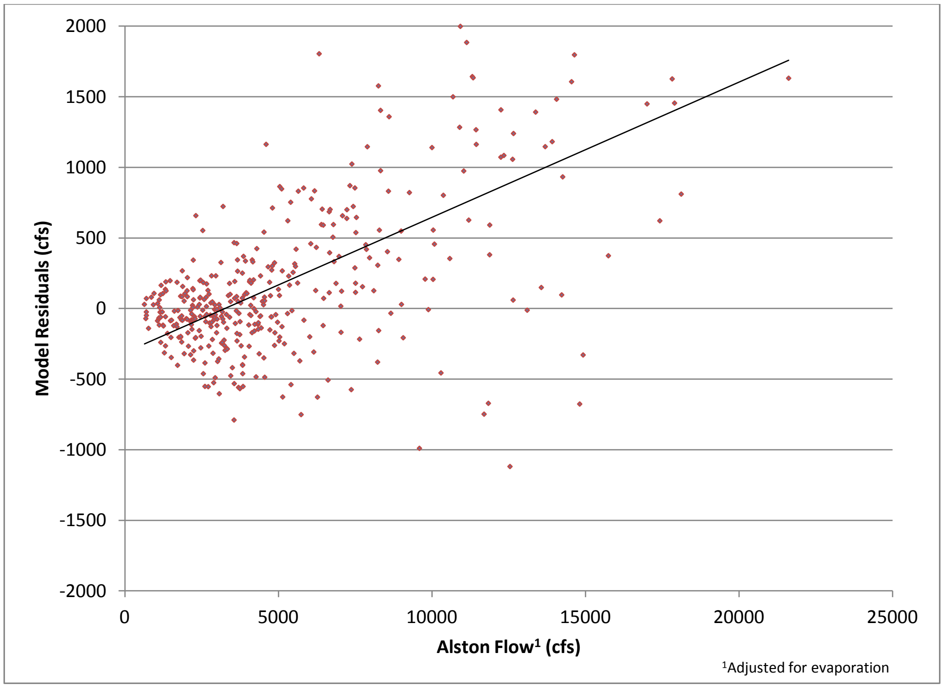


FIGURE 7 MODEL RESIDUALS - REGRESSION BASED ON 75% LOWEST FLOW AVERAGE MONTHS

1.3.4 MODEL VERIFICATION

The verification of the model results was performed by comparing the predicted flows vs. the target flows for three year periods, including statistically wet and dry periods (see Figures 8 and 9). The dry period was from January 2006 to December 2008, inclusive. The wet period was from January 1993 to December 1995, inclusive. These periods were selected on the basis of the average flow of the three years and of the 33-year period for which there was a complete flow dataset for the gages, which spanned January 1981 to December 2013.

These comparisons indicate that the estimated values have a slight overprediction bias during prolonged low-flow periods. During higher flow periods, such as 1993 - 1995, there is very little bias on the lower flows and a slight underprediction bias on the higher flows.

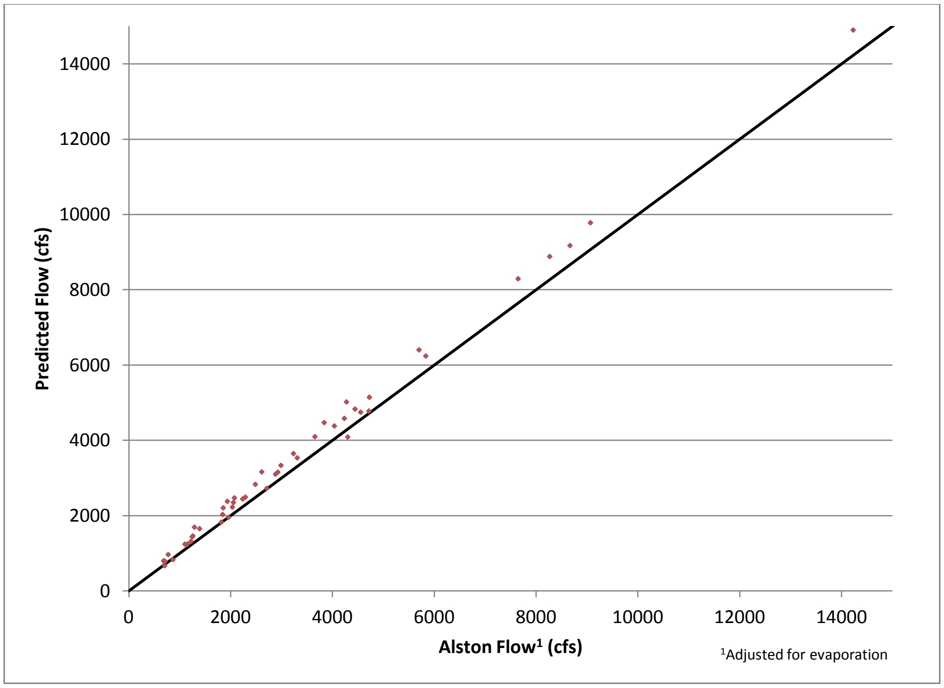


FIGURE 8 ALSTON FLOW (ADJUSTED) VS. PREDICTED MONTHLY AVERAGES (DRY 3-YEAR PERIOD) - REGRESSION BASED ON DRIEST 75% MONTHS

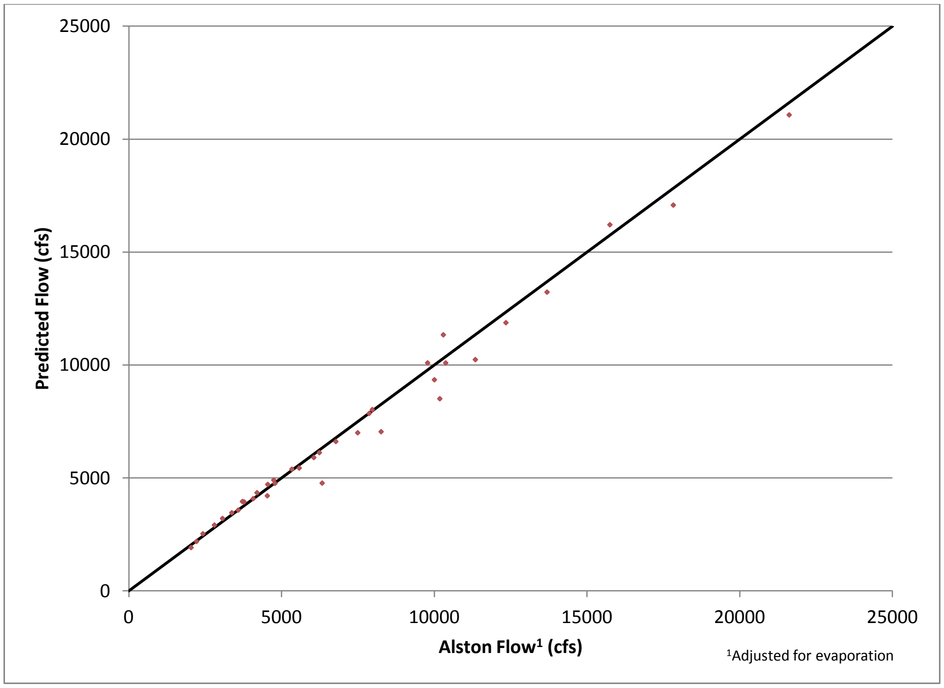


FIGURE 9 ALSTON FLOW (ADJUSTED) VS. PREDICTED MONTHLY AVERAGES (WET 3-YEAR PERIOD) - REGRESSION BASED ON DRIEST 75% MONTHS

1.4 SUMMARY

Two statistical regressions were performed to develop the coefficients used in Equation 1 (see Section 1.3.2). The first regression, using all of the monthly flow averages, resulted in a trend of negative modeling residuals (overprediction) for months with flow averages less than 7,700 cfs. A subsequent regression, using monthly flow averages less than 6,000 cfs (approximately 75% of the data values) produced a better balance between negative and positive modeling residuals. This regression performed statistically better in the range of the most frequent values of monthly average flows, with flows nearest 3,900 cfs predicted most accurately. As this lower flow range is of greater importance than the entire historic range for balancing the hydrologic resource, the coefficient and exponent determined through the second regression are preferred for the development of the inflow dataset (see Table 2).

TABLE 2 STATISTICAL MODEL RESULTS SUMMARY

MODEL NAME	REGRESSION DATASET OF ALL MONTHLY AVERAGES (396 VALUES)	REGRESSION DATASET OF LOWEST 75% MONTHLY AVERAGES (289 VALUES)
α – Coefficient	1.041	0.988
γ – Exponent	0.599	0.599
Standard Error	495.0	469.6
R^2	0.9828	0.9828

Scott Harder

Hydrologist, LWC Division, SCDNR

5/30/14

Comments regarding Kleinschmidt's "Inflow Dataset Development: Statistical Methodology" for the Parr Hydroelectric project (FERC No. 1894).

1. The methodology pertaining to how the monthly statistical analysis will used to develop daily (or hourly) Parr inflow dataset needs to be clarified in the report. Also, will time of travel be factored in when moving to a daily or hourly time step?

We propose to edit the report during the meeting so the clarifications are agreed to and understood by the RCG. Preliminary clarification follows: The statistical analyses were performed on data points that were monthly average flow values for each of the gages, for the common gaged periods of record (1981 – 2013). The regional coefficients derived from these analyses will be applied to recorded data for each of the three upstream gages. The resulting sum of these inflows will serve as the dataset input to the HEC reservoir and downstream river models. The reservoir and downstream models will use hourly (or longer) time steps for evaluating operations. The downstream river model will include travel time on an hourly basis.

Hourly inflows can use mean daily data as a substitution, or they can be calculated from hourly gage data. If done on an hourly basis, the flows will be routed from the upstream gages using one of several routing algorithms (such as Muskingum, Muskingum-Cunge and Modified Puls), the selection of which will be based on the stream hydraulics. The routing of hourly data would include travel time, whereas mean daily data would not be adjusted for travel time because the gages are only hours away from the project.

Hourly inflows are not expected to have noticeable affects on the project model runs due to the magnitude of the usable storage, except during high inflow hydrographs. The RCG should consider the benefit of developing hourly inflow data versus capturing a longer period of record with daily data. If the daily data is used, hourly model runs will assume the mean daily inflow is occurring for that 24-hour period. If the hourly data is used, the gages are limited to October 1, 1987; daily data is available back to October 1, 1980 (although monthly values used to determine the regional coefficients were truncated for complete calendar years, 1981-2013).

2. Regarding the technique to compare the hydrologic similarity between the three gages area (Tyger, Enoree and Broad in section 1.3.1:

a. Only two years were used for comparison (2002 and 2003) in Figure 3. Was there an attempt to include more years? These two years represent extremes, or close to it, for dry and wet years back to back and the comparison would be more robust if it included more normal periods as well or if a comparison was made for a longer period of time (see below also).

The comparison of normalized flows for evaluating hydrologic similarity was performed using the monthly average flows for the period 1/1/1981 to 12/31/2013, a thirty-two year period. Only two years were charted for the document for visibility, selected to illustrate consistent gaged contributions across a range of hydrologic conditions: extreme drought conditions during the summer of 2002, and high inflows the following spring. We can present additional years for comparison, and propose to include them in appendices. Our conclusions apply to the entire period of record and range of flows.

The statistical regressions were performed using several variations of inflow subsets including the entire 32-year period, as well as using an abridged dataset that included only the lowest 75% of the flow values. The abridged version used an equivalent of 24 years of monthly average flows.

b. Please rewrite or elaborate on the following statement at the end of page 6: "The comparison (see Figure 3) illustrates that the range of the monthly averages (per 100 sq. mi.) was visually close to the aggregate average through a variety of flow ranges; this indicates the hydrologic similarity of the three subbasins." Please consider summarizing the point you are trying to make here quantitatively in a table and not just visually from a plot. In Figure 3, normalized monthly average runoff is consistently higher for the Broad basin in 2003 than for the Tyger and Enoree, which maybe isn't surprising given that the Broad is a much larger basin that extends up into the North Carolina mountains. It would be instructive to see if this was observed for other years besides 2003 (my own preliminary analysis shows that it does). The higher runoff suggests that the assumption of homogeneity for the gaged portion of Broad basin (as a whole) at Carlisle as compared to the Enoree and Tyger basins may not be valid. As a result, it may be problematic to use the Broad River gage at Carlisle to develop a regional coefficient. However, I think that the assumption that the *ungaged* parts of the three basins (Tyger, Enoree, and Broad) are very nearly homogeneous is likely valid, but the question remains on how to best account for the additional flow from these ungaged areas (but see 4 below).

Visual examination of the normalized flows was done to check for consistent, significant discrepancies between gaged areas under a range of hydrologic conditions. The comparison of any single normalized gage with the aggregate average was visibly within the same order of magnitude for all months across a large range of inflow conditions, and was the basis for concluding the similarity. The Carlisle gage does appear to contribute more flow more often, but to a nominal degree compared to the aggregate. In the interest of simplicity, consistent regional coefficients were used for the analysis.

The desired end product is a dataset that consists of six time series of flow data, three of which are USGS flow records measured at the gage sites for the three rivers, and the other three time series are estimates of ungaged flows from the three rivers. Several statistical models were evaluated in an attempt to determine the most effective regression, using statistical metrics such as r-square and standard error values. The selected statistical model produced r-squared values above 95%, suggesting a strong correlation using consistent fitted regional coefficients.

Although not documented in the report, the initial screening of statistical models included many variations of regressions that were attempted in order to determine if the ungaged flows appeared to be more similar to one or two of the upstream gages as opposed to all three. A regression model was evaluated, using 1) all data, 2) three consecutive dry years, and 3) three consecutive wet years. This regression model included alpha values for each of the streamgages. The statistical regression results indicated that the ungaged flows were more similar to the Tyger River than the Broad or Enoree, but the relationship shifted between wet and dry periods. The statistical model used in this initial screening was dropped from consideration and not documented in the report.

3. In section 1.3.2, please make sure that the x and y axes scales are set to display all data points in Figures 4 and 5. For example, in figure 4, average flows at Alston extend well beyond 10,000 cfs for some months, but the maximum flow is cutoff somewhere between 9000-9500 cfs.

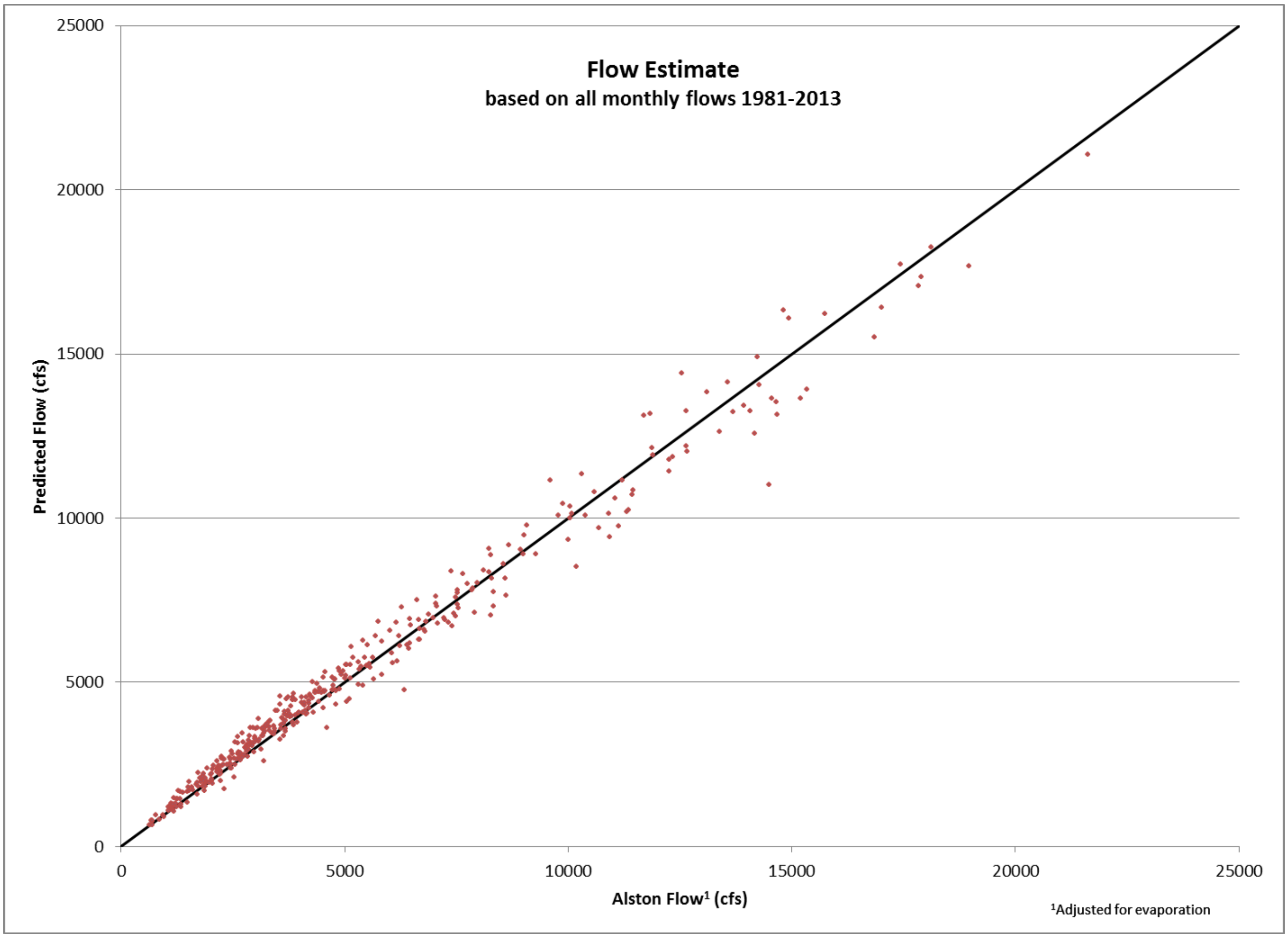


FIGURE 1 (EXPANDED) ALSTON FLOW VS. PREDICTED MONTHLY AVERAGES (33 YEARS) – REGRESSION BASED ON ALL MONTHS

4. I initially had some strong reservations with applying a regression using monthly average flows at the Alston gage as a driver for computing daily inflows to Parr. Part of the reason (maybe the whole reason) for using an alternative method for estimating daily inflow is that the straight area proration method likely overestimates daily inflow during low inflow periods. I at first was not convinced that the method presented here would provide the best estimate of low flows on daily to weekly time scales due to the reliance on statistics from monthly averages which tends to smooth out the daily variations. After comparing hydrographs for several low flow years (2002, 2007, etc.) using the method presented in this report with a hydrograph developed using the area proration method (and with a hydrograph using just the sum of the 3 gages) the resulting daily inflow dataset seems reasonable (and thus, the concern over

homogeneity above may not be an issue) for low to moderate flows. I did not look at high flows in detail since I am not too concerned at that end.

Daily data evaluation for the development of the regional coefficients is a noted concern due to the potential short-term mass balance impacts associated with the significant usable storage. Even under low flow conditions, a mass balance approach for determining the regional coefficients should have good correlation. Using the entire range of flows for developing the regional coefficients has more effect on the accuracy at the upper and lower ends, as prorating coefficients are widely acknowledged to vary with flows. Observation of the initial regression results, with coefficients derived using the entire range of flows, indicated a tendency for the model to over-predict lower flows. This inflection was noted in section 1.3.2 to be around 7,700 cfs, above which the model tended to under-predict flows. Concern for low-end accuracy led to the regression based upon flows at or below the Parr Hydro capacity, which was approximately 75% of the inflow months. This reduced the tendency of the model to over-predict lower flows, at the expense of higher flow predicted accuracy.

5. As has been suggested by others, a meeting is probably necessary to further discuss and clarify the inflow methodology.

Responses to Byron Hamstead, USFWS Fish and Wildlife Biologist

Email:

Hi Kelly,

Please see attached for the USFWS's comments/questions in track changes regarding the Parr inflow dataset statistical methodology.

Thank you,

Byron

Requested edit: "As discussed in the Study Plan, the ~~existence~~ operation of the pumped storage development and lack of long-term operational records prevents the back-calculation of a sufficient inflow dataset." [Replace existence with operation].

> Answer: Agreed, edit incorporated.

Comment: *Y axis label = unadjusted Q* (regarding the Figure 2 Monthly Average Flows column chart)

> Answer: Agreed, Label Added to Chart in final version.

Comment:

"The comparison (see Figure 3) illustrates that the range of the monthly averages (per 100 sq. mi.) was visually close to the aggregate average through a variety of flow ranges; this indicates the hydrologic similarity of the three subbasins."

BH: Is there a benefit of normalizing discharge by 100 sq. mi. versus normalizing by 1 sq. mi.?

> Answer: The scale for normalizing was selected to match the order of magnitude of the contributing (smallest) drainage area. Examining the three gages on a cfs per unit square mile would not change the results or the relative contribution of any gage area, but only the scale. The lower flows would change from around 10 cfs/100 square miles to 0.1 cfs/square mile, while the higher 420 cfs/100 square miles would reduce to 4.2 cfs/square mile.

BH: I think it is necessary to quantify statistical differences between gages in terms of Q/square mile since subbasin hydrologic homogeneity is an important assumption included in the model. Accounting for these differences might further reduce the variance in the model, making it more accurate at lower flows.

> Answer: Visual examination of the normalized flows was done to check for consistent, significant discrepancies between gaged areas under a range of hydrologic conditions. The comparison of any single normalized gage with the aggregate average was visibly within the same order of magnitude for all months across a large range of inflow conditions, and was the basis for concluding the similarity. While any given month may show one gaged area has a

noticeably higher contribution, no general trend indicates a consistent bias across the range of hydrologic conditions. Significant differences in runoff characteristics would be indicated by one or more normalized areas consistently contributing more or less than the aggregate average. In the absence of significant consistent contribution by any single gage, consistent fitted regional coefficients (alpha and lambda) were selected for all three gaged areas. Variances observed for individual months, where one gaged area contributes more or less than others, is attributable to precipitation that was inconsistent for the entire drainage area, rather than differences in runoff characteristics.

BH: Was this the sole period of record [referring to Figure 3, Normalized Monthly Average Flows, which shows 2002 – 2003 calendar years] used to infer similarity of runoff characteristics among subwatersheds? According to table 1 there are overlapping discharge data for all of these gages since 1973.

There appear to be potentially significant differences in mean monthly discharge between gages even when the data is normalized by drainage area.

Answer: The period of record used to infer similarity was 1981 – 2013, the longest concurrent period for the four gages available (in complete calendar years); the Alston Gage period of record has a gap in the dataset from 1907 through 1980. We will correct the current period or record in Table 1 in the final version. Only two years were charted for the document for visibility, selected to illustrate consistent gaged contributions across a range of hydrologic conditions: extreme drought conditions during the summer of 2002, and high inflows the following spring.

Comment:

"These two gages [Woodruff and Whitmire gages on the Enoree River] were selected because they have the longest overlapping (current) periods of record."

BH: What is the period of record for discharge here?

The proposed Riverdale Project (formerly Inman Mills) was licensed in 1982, but became inoperable 12-years ago. Since this calculation assumes that the hydrologic characteristics of the Enoree River apply throughout the Broad River subwatershed, I want to make sure that the regional exponent/model is not confounded by a period of record that includes river regulation activity.

Answer: The overlapping period of record for the Whitmire and Woodruff gages is indicated in Table 1 as 2-9-1993 to present, limited by the Woodruff gage. The use of monthly flow averages to establish the pro-rating coefficient would eliminate any effects of short-term regulation upstream of the Parr dam. FERC documentation (correspondence from project licensee) indicates the Riverdale project has not operated since August 2001.

With respect to daily average flows that will be prorated to create the dataset, the project has insignificant storage and re-regulating capacity with respect to the Parr Reservoir (9 acre pond with a gross storage of 22 gross acre-feet, compared to 4,400 acres and 32,000 acre-feet).

Comment:

TABLE 1 STATISTICAL MODEL RESULTS SUMMARY

MODEL NAME	REGRESSION DATASET OF ALL MONTHLY AVERAGES (396 VALUES)	REGRESSION DATASET OF LOWEST 75% MONTHLY AVERAGES (289 VALUES)
α – Coefficient	1.041	0.988
γ – Exponent	0.599	0.599
Standard Error	495.0	469.6
R^2	0.9828	0.9828

BH: The standard error [469.6] for this model may be too high considering that annual daily flows are often below 3,000, and approach 2,000 cfs in late Summer/ early Fall.

Figure 6 shows a few stray data points that may be driving up SE. Were any statistical outliers omitted from analysis?

Answer:

The Standard Error represents the standard deviation across the entire range of flows. The Standard Error on the left and right columns are based on the associated regional coefficient and exponent, which were established according to the conditions of the headings (all flows vs. lower 75% flows, approximately 6,000 cfs limit). The Standard Error for only low-flow scenarios would have lower values. The Standard Error calculated for flows up to 6,000 cfs is 321 for the left column, and 304 for the right column. The Relative Standard Error of the entire dataset more accurately explains the error versus the total range of flows. For both regressions, the RSE is calculated at 9.3%.

No statistical outliers were omitted from the analysis, as the good correlation between the predicted and measured flows across the range of data did not suggest that data points needed eliminated.

Responses to Gerrit Jobsis, American Rivers Sr. Director:

Email:

Kelly,

Please find attached American Rivers comments on the inflow data plan. It is intended to support the Final Parr Fairfield Operations Model Study Plan. That study plan says "The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies." As my comments in the document state, I do not agree that this inflow data set will be usable to evaluate the effects of project operations on habitat and recreation. Project operations via inflow alterations and reservoir fluctuations affect habitat and recreation values *on a real time basis (hourly or less) that cannot be estimated using monthly average inflow estimates. Smoothing the data with regression equations removes the hourly and sub-hourly variation that is essential to understanding project effects.*

I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.

Gerrit

Answer:

The inflow dataset is a model input that is independent of the project operations. This effort is to determine accurate coefficients for prorating the gaged inflows for summing the total dataset. They are being determined on a monthly basis because mass balance between the upstream gages and the Alston gage can be significantly affected by project operations. Daily analysis could be performed, but would introduce a significant level of inaccuracy in determining the coefficients. The inflow dataset will be developed as mean daily flows, using the coefficients determined through the mass balance effort. Hourly inflows are proposed to be the same as daily average, as the travel time between gages under varying flows would introduce high potential for inaccuracy. The model outputs will evaluate the hourly and daily impacts on the areas within the PBL and the reach downstream of the Parr Shoals dam.

Comment:

"The statistical analyses will use monthly and annual flow data rather than daily average flows."

GJ: I don't agree with this for evaluating a project effects on stream flow (inflow versus outflow) and reservoir fluctuations. Project effects occur on an hourly or shorter time frame. Analysis of project effects should be done similarly. The issue for habitat and recreation is not how Parr/Fairfield affects monthly or annually, but within the day and hour.

Answer:

Project effects will be evaluated via modeling efforts on time steps of an hourly basis, in addition to any longer periods requested.

Comment:

"Flow releases from the project may be vastly different at any given hour from the inflows to the Parr reservoir."

GJ: This is exactly what we need to understand

Answer:

This statement is alluding to the inherent error associated with calibrating the inflows with the Alston gage on a daily basis, due to the storage of the project. The model will facilitate the understanding of these releases. The inflow dataset will not be affected by project operations, but is an independent input.

Comment:

" A multivariate regression was performed to determine the parameters of a generalized equation for estimating the inflow to Parr Reservoir."

GJ: Again, this may be good for the operations models and energy models but I don't understand how this will help answer the question of how the project affects streamflow and reservoir fluctuations. Smoothing things out with a regression takes away the variability of inflow that is essential to understanding project effects on habitat and recreation.

Answer:

This regression is performed only to determine the regional prorating coefficients. Project effects on streamflow and fluctuations are addressed in the Res and RAS models. The regression is not intended to smooth out the extreme high and low flows, but rather best establish the prorating coefficients to most accurately represent the inflow. Inflows will still be highly variable, based on mean daily records.

Comment on graph:

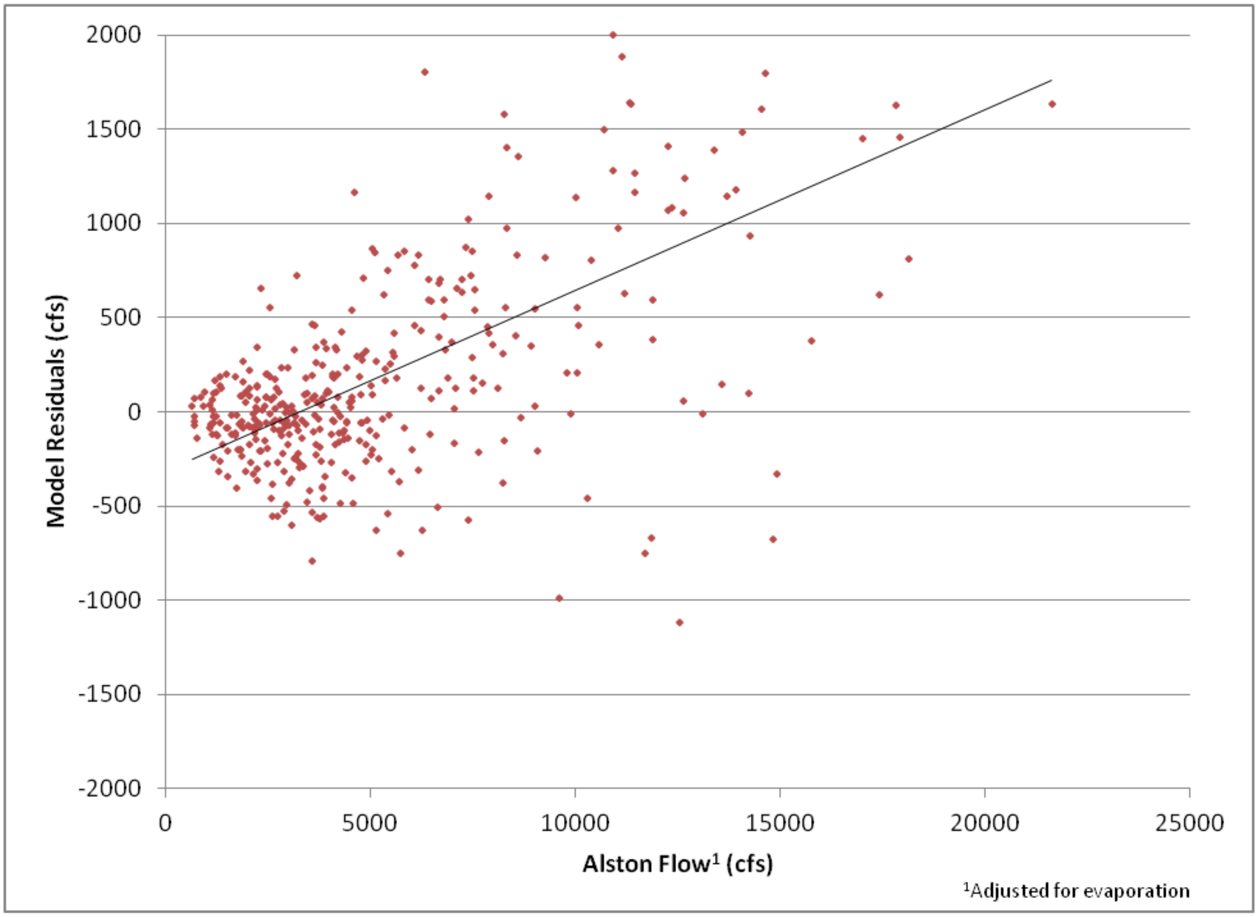
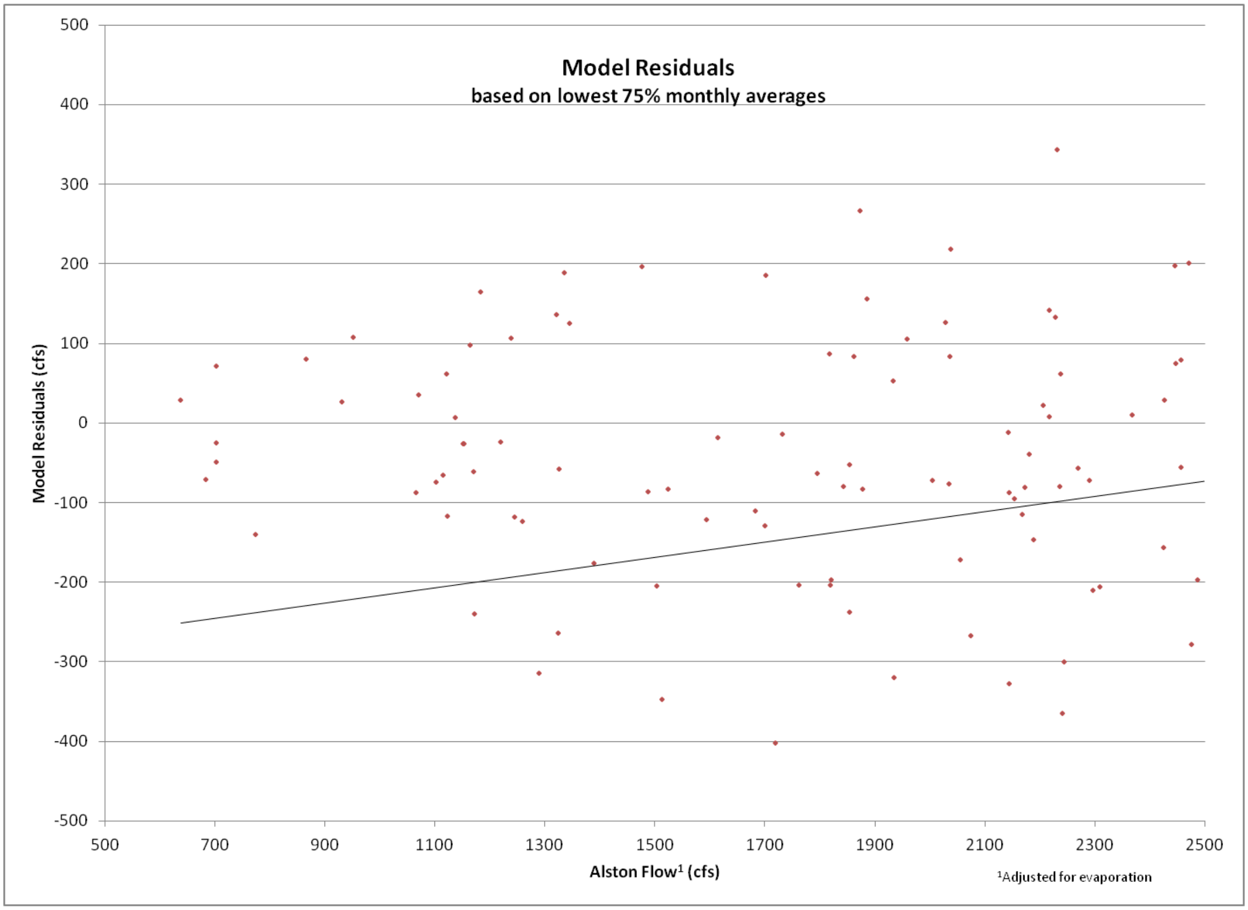


FIGURE 1 MODEL RESIDUALS - REGRESSION BASED ON 75% LOWEST FLOW AVERAGE MONTHS

GJ: Poor fit at lower end of flow range affects the reliability of the model

Answer:

The residuals diminish in magnitude as flows decrease, are appear evenly distributed about the zero value. While the inflow dataset will have calculated values both higher and lower than the Alston readings, no significant bias is evident under low flow conditions. A closer examination of the low-end flows can be made with the graph below, scaled to flows below 2500 cfs. (The trendline is a linear average across all flows for the 75% lower inflow months, and does not represent the trend of the lower flow residuals alone.)



Comment:

TABLE 2 STATISTICAL MODEL RESULTS SUMMARY

MODEL NAME	REGRESSION DATASET OF ALL MONTHLY AVERAGES (396 VALUES)	REGRESSION DATASET OF LOWEST 75% MONTHLY AVERAGES (289 VALUES)
α – Coefficient	1.041	0.988
γ – Exponent	0.599	0.599
Standard Error	495.0	469.6
R^2	0.9828	0.9828

GJ: This [referring to the 469.6 standard error value] seems significantly high when evaluating low flow periods and could represent 20% to 25% of the average flow

Answer:

The Standard Error represents the standard deviation across the entire range of monthly average flows (up to 20,000 cfs). The Standard Error on the left and right columns are based on the associated regional coefficient and exponent, which were established according to the conditions of the headings (all flows vs. lower 75% flows, approximately 6,000 cfs limit). The Standard Error calculated for low-flow conditions has lower values. For example, the calculated Standard Error for the two columns limited to flows up to 6,000 cfs are 320 and 304 (left and right respectively). For flows up to 2,000 cfs, they are 155 and 147. If considered from a percentage perspective, as the Relative Standard Error, it would more accurately explain the error versus the total range of flows. For both regressions, the RSE is calculated at 9.3%.

Response to Pace Wilber, NOAA National Marine Fisheries Service Atlantic Branch Supervisor

Hi Kelly. I agree with the comments from FWS and American Rivers that short-term variation important for assessing project effects on fishes and riverine habitat may be masked by using monthly average flows as model inputs. I also agree there are much better ways to judge the similarity of flows between subwatersheds than "eyeballing" the histograms in figures 2 and 3. A correlation matrix may be a more rigorous way to make the comparisons. Pace

Answer: Short-term variation will still be performed using daily mean inflows. Monthly average flows are only being used to determine regional pro-rating coefficients for daily inflow calculations, due to the mass balance errors associated with daily operations.

Visual examination of the normalized flows was done to check for consistent, significant discrepancies between gaged areas under a range of hydrologic conditions. The comparison of any single normalized gage with the aggregate average was visibly within the same order of magnitude for all months across a large range of inflow conditions, and was the basis for concluding the similarity. Due to the good overall correlation, it is unlikely that altering one set of regional coefficients to more accurately represent the contributing ungaged area will offer significant improvement to the model. Lower homogeneity in runoff characteristics may be inferred from metrics when the contributing factor is actual weather event(s) specific to a single subbasin within a given month.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Operations RCG Meeting

September 17, 2014

Final KDM 10-30-14

ATTENDEES:

Dick Christie (SCDNR)	Bill Argentieri (SCE&G)
Scott Harder (SCDNR)	Ray Ammarell (SCE&G)
Steve Summer (SCANA)	Kelly Miller (Kleinschmidt)
Henry Mealing (Kleinschmidt)	Byron Hamstead (USFWS)
Bret Hoffman (Kleinschmidt)	Bruce Halverson (Kleinschmidt)
Randy Mahan (SCANA)	Amy Bresnahan (SCE&G)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry gave a brief overview on the purpose of the meeting and then turned the floor over to Bret. Bret gave a PowerPoint presentation on the Operations Model, including the three different components; the river routing model (HEC-RAS); the reservoir routing model (HEC-ResSim); and the model database (HEC-DSS). The presentation is attached to the end of these notes.

Byron asked if the HEC-DSS was used to manipulate variables of the HEC-RAS and HEC-ResSim. Bret said that changes are made in the rules of these two programs, but the HEC-DSS allows the user to see how those changes affected the model output. Datasets, such as the input and results datasets, are easily stored in HEC-DSS versus Excel spreadsheets.

Bret then discussed the HEC-RAS model and the SCDNR terrain data that was used. Bret explained that the LiDAR data doesn’t show what is going on beneath the water, so Bruce developed an approximate equivalent trapezoid underneath the water level that is large enough to pass the flows for that particular day. The IFIM study will give better definition of the bathymetry at specific transects along the Broad River.

Scott asked how the HEC-RAS applies to the IFIM study. Bret said that the IFIM is targeting habitat qualities and the amount of water and flow needed to support a particular species. Henry explained that low flows are examined in the IFIM study to determine how minimum flows affect the quality and amount of fish habitat available at adjustment range of flows.

Scott asked if there was a point identified downstream that could cause a problem during high flows. Ray said that there is an area of private property downstream that could be inundated during high flows. Ray also mentioned that the current license does not allow the Project to add to a flood event.

Scott asked if the HEC-RAS model was a tool that SCE&G wanted to use, or was it requested by the agencies. Ray explained that it is important for studying wave attenuation, navigation, etc downstream of Parr Shoals Dam. Also, stakeholders expressed interest in determining how fluctuations might be affecting the downstream reach, including striped bass spawning in the river.

Bruce then began the demonstration of the HEC-ResSim model. Scott asked if the model was set up to use the maximum amount of fluctuation. Ray said that the model currently represents the full capability of the Project, even if it isn't used to the maximum every day. Ray said that in the future the Project will be used to its full capacity more often. The group disagreed as to whether the "baseline" model should be set up to demonstrate how the Project is currently being utilized or to demonstrate the full capabilities of the Project. Ray said that every day the Project is operated differently based on conditions, so the "baseline" model should demonstrate full operational abilities. Dick said that baseline seems to him to be current or daily operating conditions, which typically does not include full fluctuation potential. A scenario can then be created to demonstrate the full capabilities of the Project.

Bruce said that a scenario can be created to show what has happened in the past, but the model must be developed first to include the full operating range of the Project. Once the full range has been accounted for, the model operator can hone in on specific daily variations.

Scott said that while it is impossible to recreate the past in the model, there needs to be a check completed to demonstrate that the model is accurate. Ray said that there is a lot more that goes into operating the Project on a daily basis than just the if/then constraints that Bruce used to create the model. If the generation (MWH) for a particular day is entered into the model, it should yield reservoir levels and flows that were recorded for that day by the USGS. The group then discussed running a load curve. Ray said that if the group decides on a representative load curve for the Project, the MWH demands can be entered into the model. Flows that the model produces can be compared to the inflow and downstream flow recorded by USGS for that time period. This is one way to check the accuracy of the model.

Ray noted that it is important to ensure the Project works in the future with the addition of the new nuclear units. This is why it is important to make sure the model will mimic a load curve. Bruce and Ray will identify a two week period when all data needed to perform a load curve check is available. This information will be included in an appendix to the Operations Model Report.

Scott asked how the nuclear units will affect the operation of the Project and downstream flows, and if this is accounted for in the model. Scott said it was the DNR's understanding that when there is less water in the system, due to low inflow, withdrawals from the new nuclear units would be removed from the 29,000 acre-feet of usable storage and Monticello would reach the low pool limit quicker.

Currently the existing nuclear unit evaporation is deducted from inflows for minimum flow release requirements. Bruce created a flow diversion in the model that accounts for this. However, the two new nuclear units are permitted withdrawals and not deducted from inflows for minimum flow requirements. The current model does not include future diversions. Bruce will update the model with a placeholder for future diversions.

The group agreed that the model needs to include license constraints. The group also agreed that it would be helpful if the RCG members would create a list of issues that will be examined during relicensing, such as spring spawning flows, reservoir constrictions, recreation flows, and continuous minimum flows. These would be provided to Bruce so that he can develop an Output Format that will interpret model outputs into to more easily understandable results.

During the discussion of the HEC-ResSim model, Scott asked that a glossary be added to the Operations Model Report for datasets of primary interest. Bruce then demonstrated the HEC-RAS model to the group.

Following the meeting, Scott submitted a list of comments regarding the Operations Modeling System and the Operations Model Report. These comments are appended to the end of these notes.

ACTION ITEMS:

- Bruce will refine the HEC-ResSim model to remove diversions for withdrawals associated with the new nuclear units.
- Bruce will add a glossary to Operations Model Report for datasets of primary interest.
- RCG members will provide a list of possible scenarios to be run in the future. These scenarios should cover a range of issues that the RCG anticipate could arise.
    - Examples:
        - continuous min-flow of XXX,
        - spawning flow of XXX cfs during (Feb – April),
        - recreation flow on the weekends of XXX for 6 hours (10am-4pm) during June – Oct

Kleinschmidt

Scott Harder

Hydrologist, SCDNR

9/18/14

Re: Comments on the Parr-Fairfield Operations Modeling System report and the 9/17/14 Model demonstration meeting.

1. A "baseline scenario" should be developed that uses a monthly or seasonal load shape curve that approximates historic or current generation patterns. The baseline scenario would also not include the two new nuclear units at VC Summer.

2. A methodology for model verification needs to be developed to show that the model is approximating reality or current operations (for baseline scenario). One approach is to look for time periods (weeks to months) where there were few to no complicating operational considerations and compare model outflows with data from the Alston gage. Another approach is to perform some tests on mass conservation over longer periods of times (years) to ensure that the model is not losing or gaining (unlikely) water over time and serve as a check on evaporation estimates. I would recommend attempting both approaches but certainly welcome other suggestions as well. A section should be added to the "Parr-Fairfield Operations Modeling System" report on model verification.

3. From previous discussions associated with the nuclear licensing of the two new units at VC Summer, my understanding was that the evaporative losses from these units would not be subtracted from the inflow to determine outflow during low flow conditions. Instead, the volume of water pumped between Monticello and Parr would be reduced during these low flow periods. In other words, the operation of the new units would have little to no impact on downstream flows during low flow periods. The version of the model introduced at the meeting on 9/17/14 should be modified to reflect this rule. Future scenarios should generally reflect this rule unless a scenario(s) is proposed that specifically addresses the rule.

Parr-Fairfield Operations Modeling System

Bret Hoffman, PE

Bruce Halverson, PE

Introduction

- FERC Licensing of Parr Hydroelectric Project
- Operations Resource Conservation Group
- Study Plan – Methodology and Objectives

Study Objectives

- Historic Inflow Hydrograph Development
- Hydraulic Modeling
- Operations Model
- Next steps: Scenario Modeling

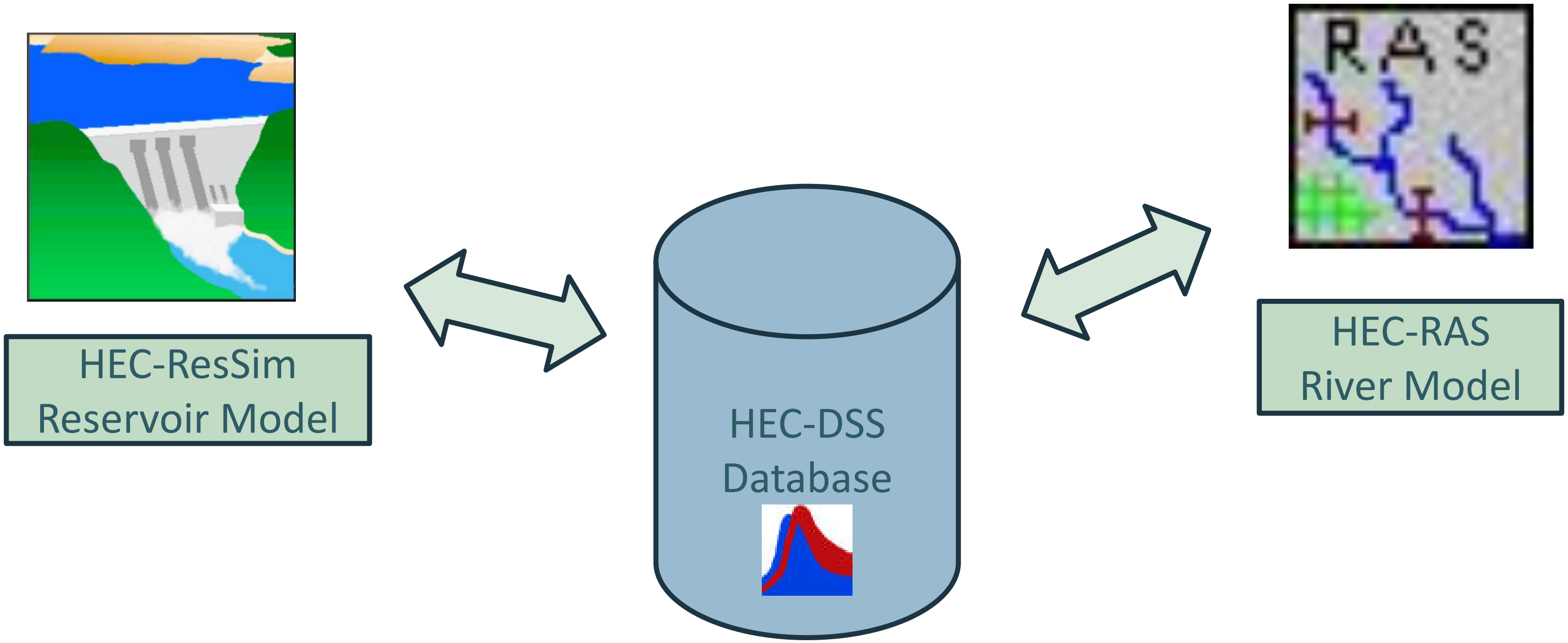
PROJECT SCOPE

- Develop an Operations Model
  - Identify pre-defined constraints
  - Simulate baseline conditions
  - Capable of evaluating stake-holder requested changes to existing operating parameters
- Develop Draft Operations Model Report
- Provide Model Demonstration
- Finalize Baseline Operations Model Report

Modeling System Components

- River Routing Model (HEC-RAS)
- Reservoir Routing Model (HEC-ResSim)
- Model Database (HEC-DSS)

Modeling System Schematic



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Modeling Database Files

- HEC-DSS files
- Direct access database file structure
- Primarily for time series and paired-data, such as rating tables
- No manual handling of data required

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Modeling Database Files

- File #1 > Input data for HEC-ResSim (inflow)
- File #2 > Output data from HEC-ResSim, used as input to HEC-RAS
- File #3 > Output data from HEC-RAS

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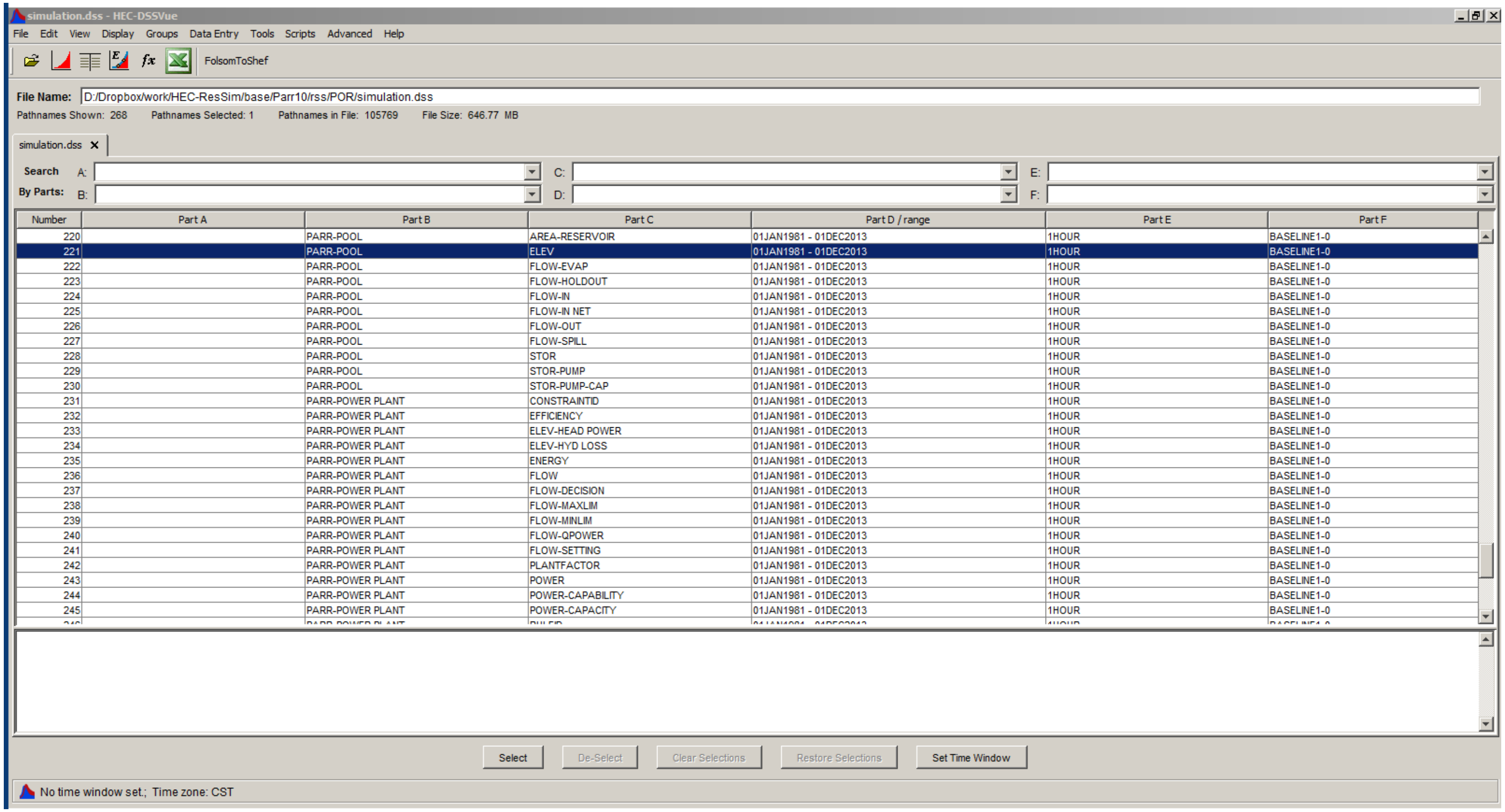
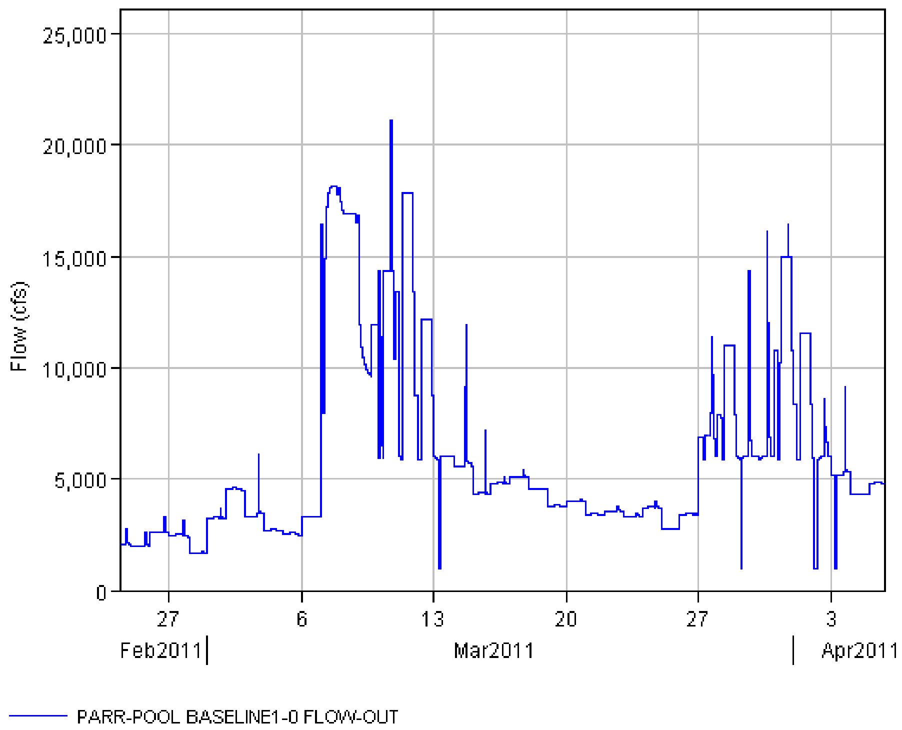
HEC-DSSVue - Point/click GUI



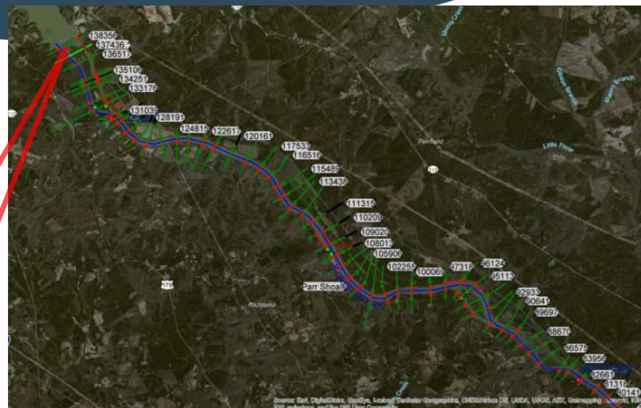
Number	Part A	Part B	Part C	Part D / range	Part E	Part F
220		PARR-POOL	AREA-RESERVOIR	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
221		PARR-POOL	ELEV	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
222		PARR-POOL	FLOW-EVAP	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
223		PARR-POOL	FLOW-HOLDOUT	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
224		PARR-POOL	FLOW-IN	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
225		PARR-POOL	FLOW-IN NET	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
226		PARR-POOL	FLOW-OUT	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
227		PARR-POOL	FLOW-SPILL	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
228		PARR-POOL	STOR	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
229		PARR-POOL	STOR-PUMP	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
230		PARR-POOL	STOR-PUMP-CAP	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
231		PARR-POWER PLANT	CONSTRAINTID	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
232		PARR-POWER PLANT	EFFICIENCY	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
233		PARR-POWER PLANT	ELEV-HEAD POWER	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
234		PARR-POWER PLANT	ELEV-HYD LOSS	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
235		PARR-POWER PLANT	ENERGY	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
236		PARR-POWER PLANT	FLOW	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
237		PARR-POWER PLANT	FLOW-DECISION	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
238		PARR-POWER PLANT	FLOW-MAXLIM	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
239		PARR-POWER PLANT	FLOW-MINLIM	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
240		PARR-POWER PLANT	FLOW-QPOWER	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
241		PARR-POWER PLANT	FLOW-SETTING	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
242		PARR-POWER PLANT	PLANTFACTOR	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
243		PARR-POWER PLANT	POWER	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
244		PARR-POWER PLANT	POWER-CAPABILITY	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0
245		PARR-POWER PLANT	POWER-CAPACITY	01JAN1981 - 01DEC2013	1HOUR	BASELINE1-0

HEC-DSSVue - Point/click GUI

- View
- Print
- Export to Excel
- Several others



HEC-RAS Model



Parr Dam

Columbia Dam

- Total of 111 transects
- Covers approximately 23.8 river miles

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Data Requirements

- Physical Geometric / Terrain data
- Satellite Imagery (visual aid)
- Boundary conditions & calibration data
- Inflow data

Terrain Data

- Downloaded from SCDNR web server
- LiDAR data – 10’ (approx.) grid
- Vertical datum = NAVD88
- Note > HEC-RAS is NAVD88

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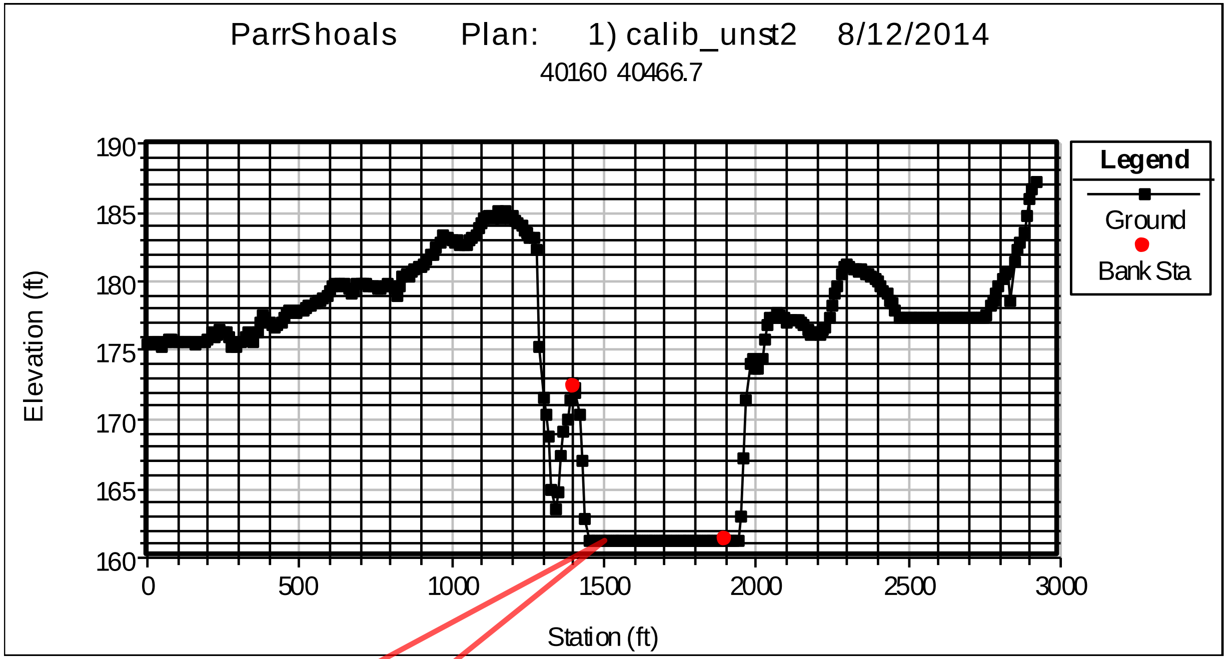
Cross-section – Unedited LiDAR

- Lacking bathymetric definition
- Requires manual editing



LiDAR elevation indicates water level

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Imagery Data

- Primarily ESRI non-proprietary aerial images
- Georeferenced
- Not used by the model – used by the model**er**
- Used to determine landforms and channel characteristics

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Imagery example

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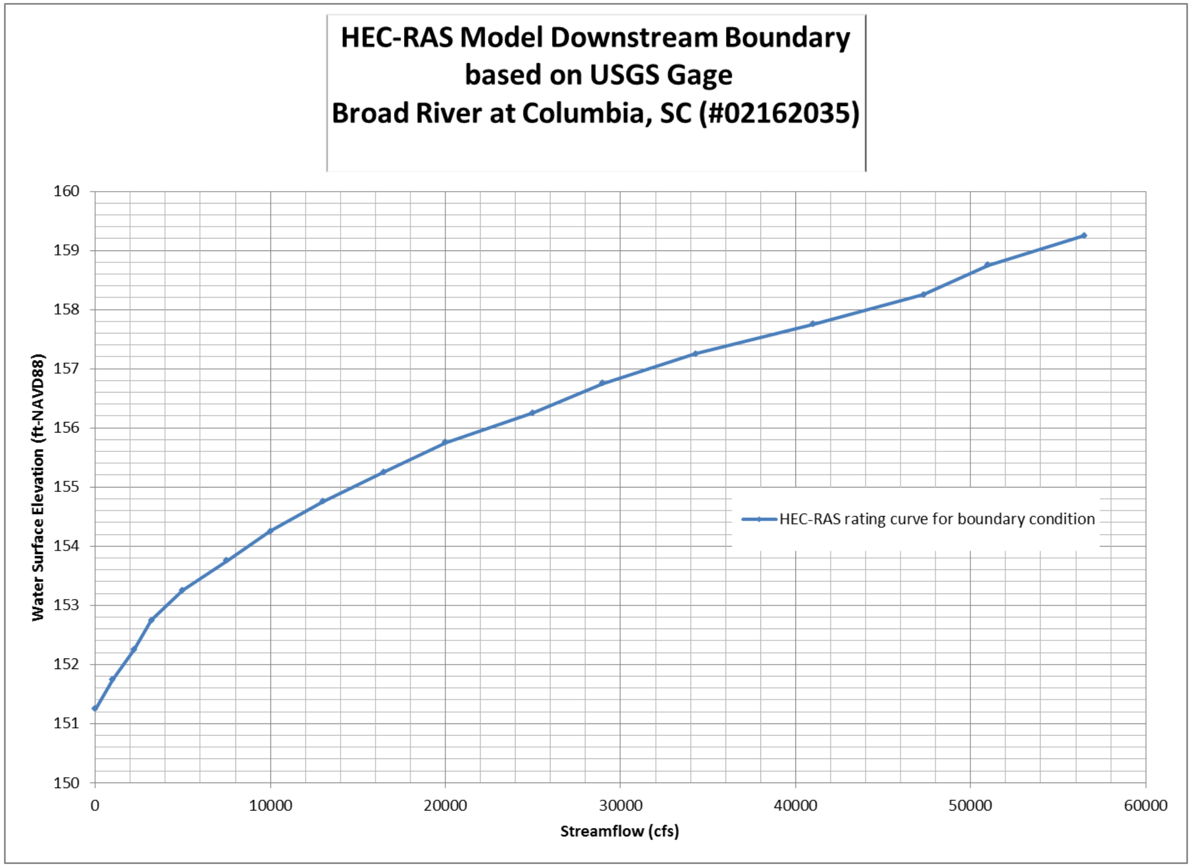
Boundary Conditions & Calibration Data

- USGS flow and stage data
- USGS gage rating tables
- Downstream boundary – Columbia Dam
- Monitoring data - 2014

Downstream Boundary Condition

- Includes observed data for normal flows
- High flows – computed
- Affects downstream-most 5 miles

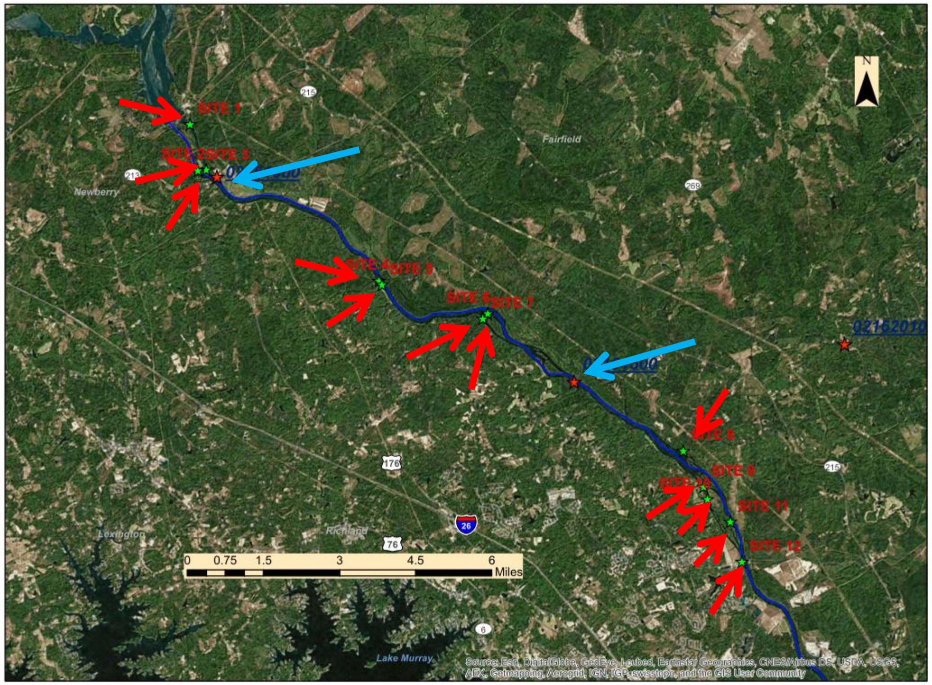


Model Calibration

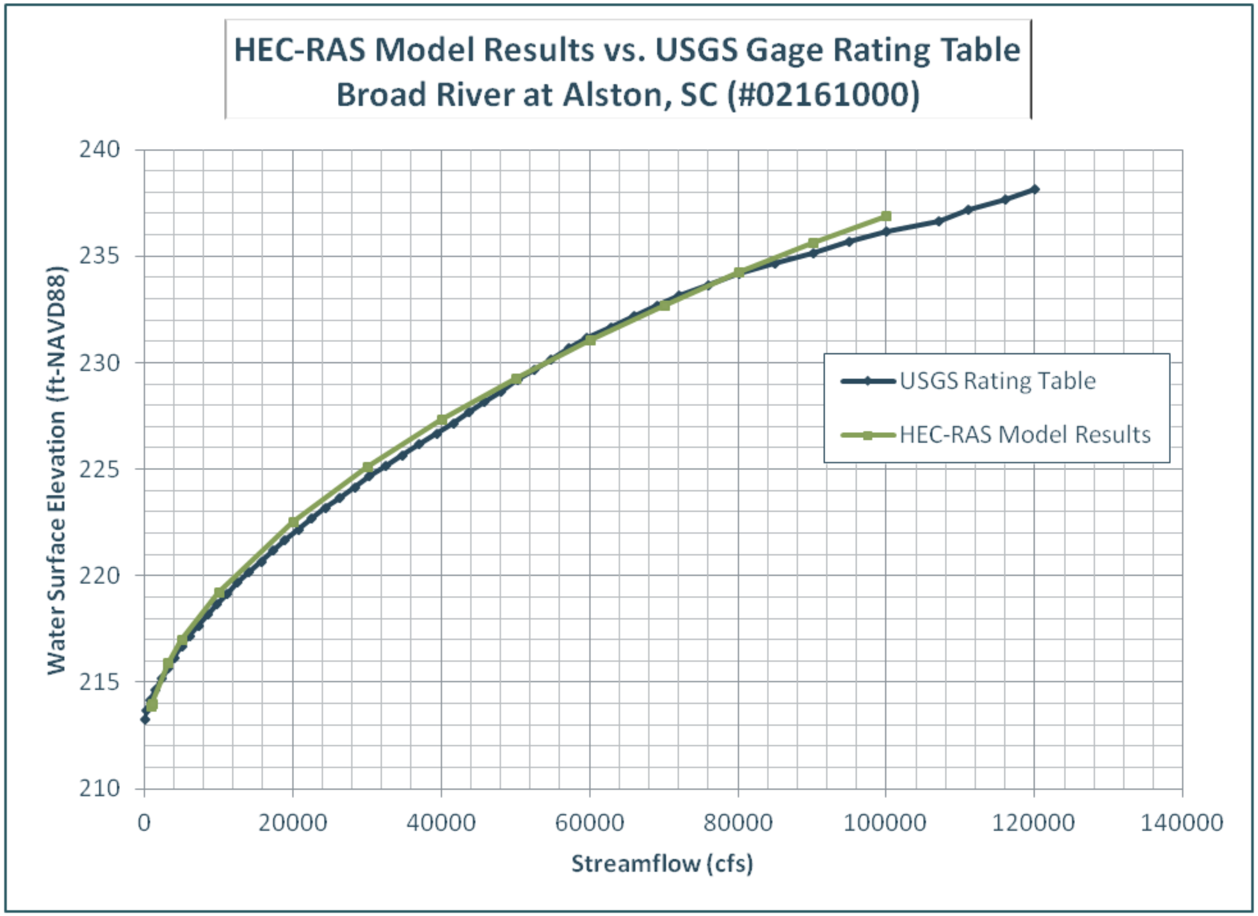
- Iterative process to adjust cross-section data and channel roughness

- **USGS gage sites (2)**
- **Monitoring sites (12)**

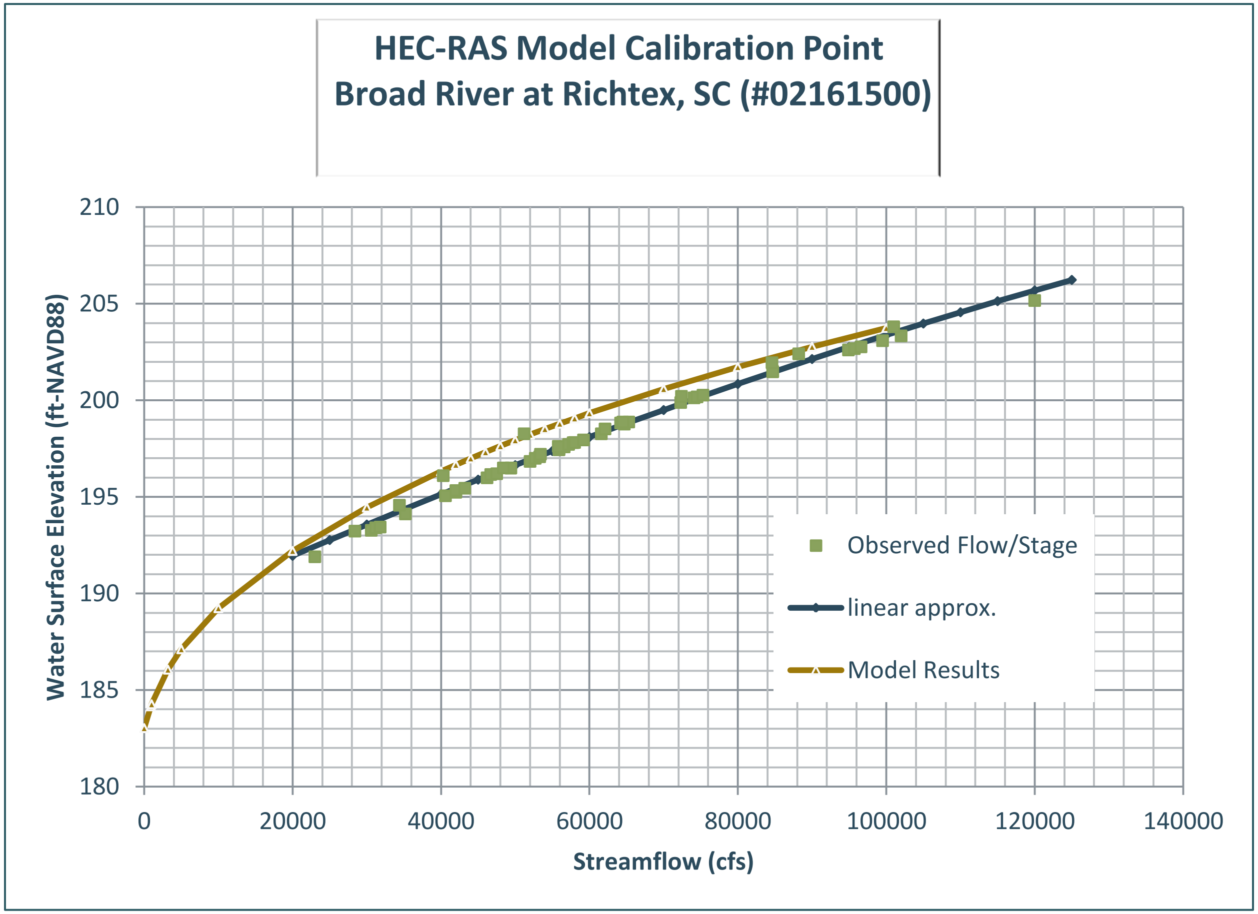
Broad River - Datalogger Sites / USGS Gage Sites



Calibration example: Alston gage



Calibration example: Richtex gage site



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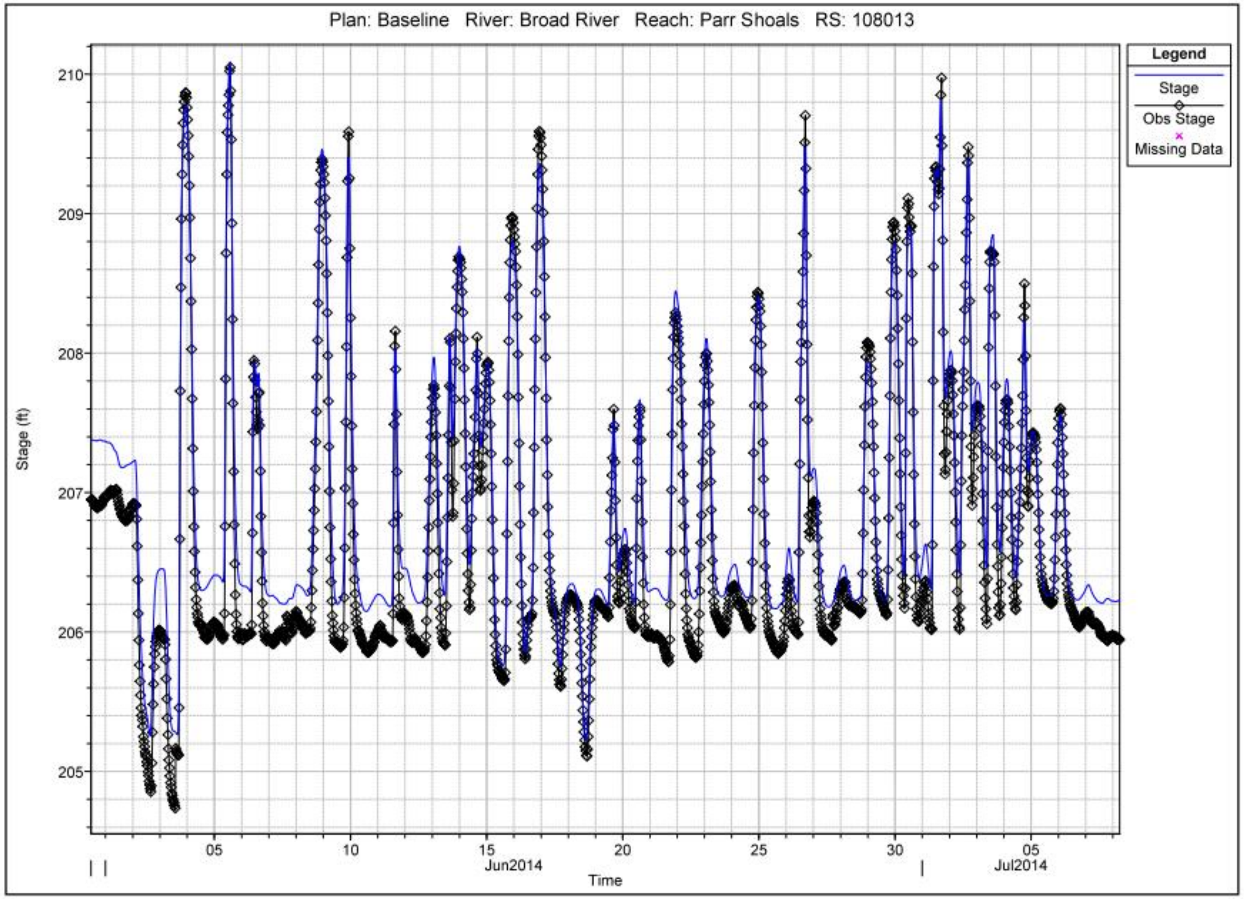
Calibration example: Site 5



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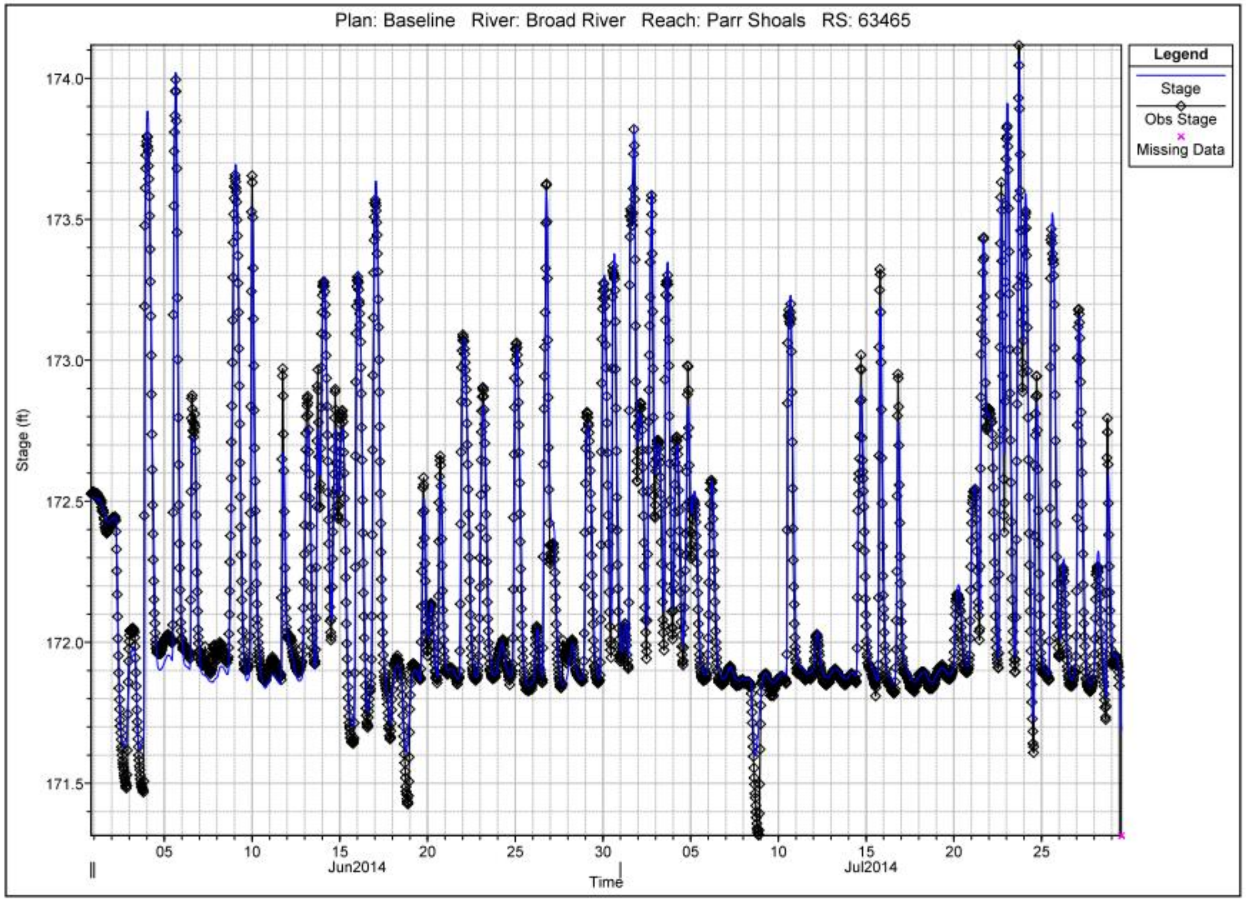
Calibration example: Site 10



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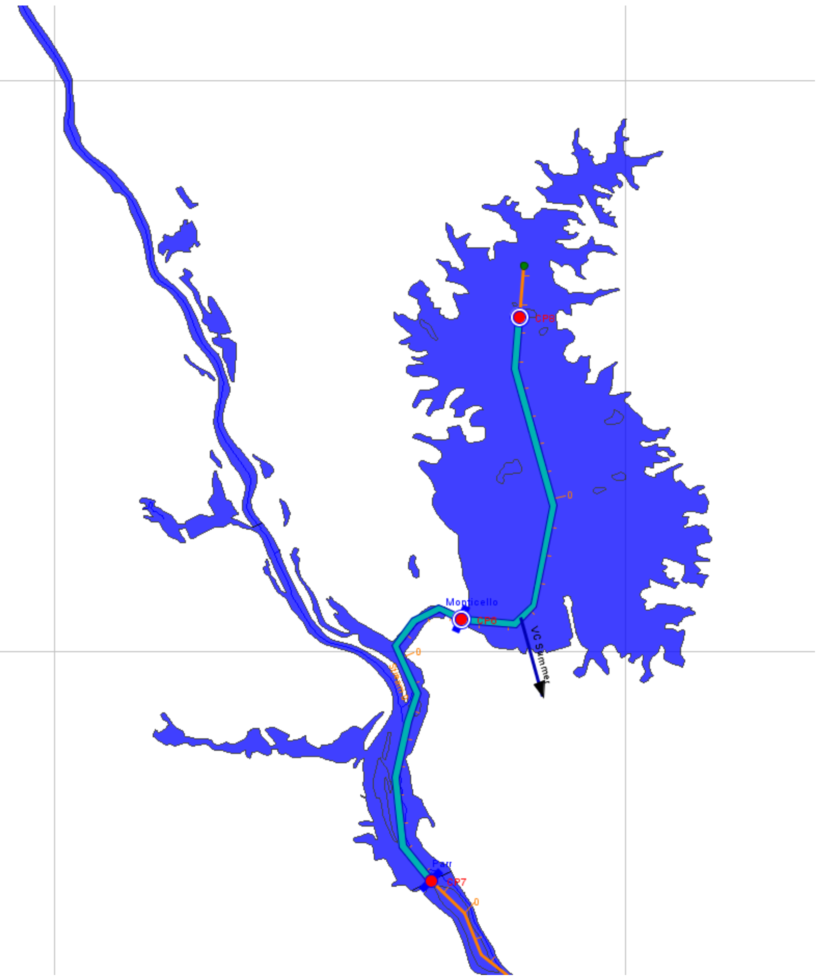
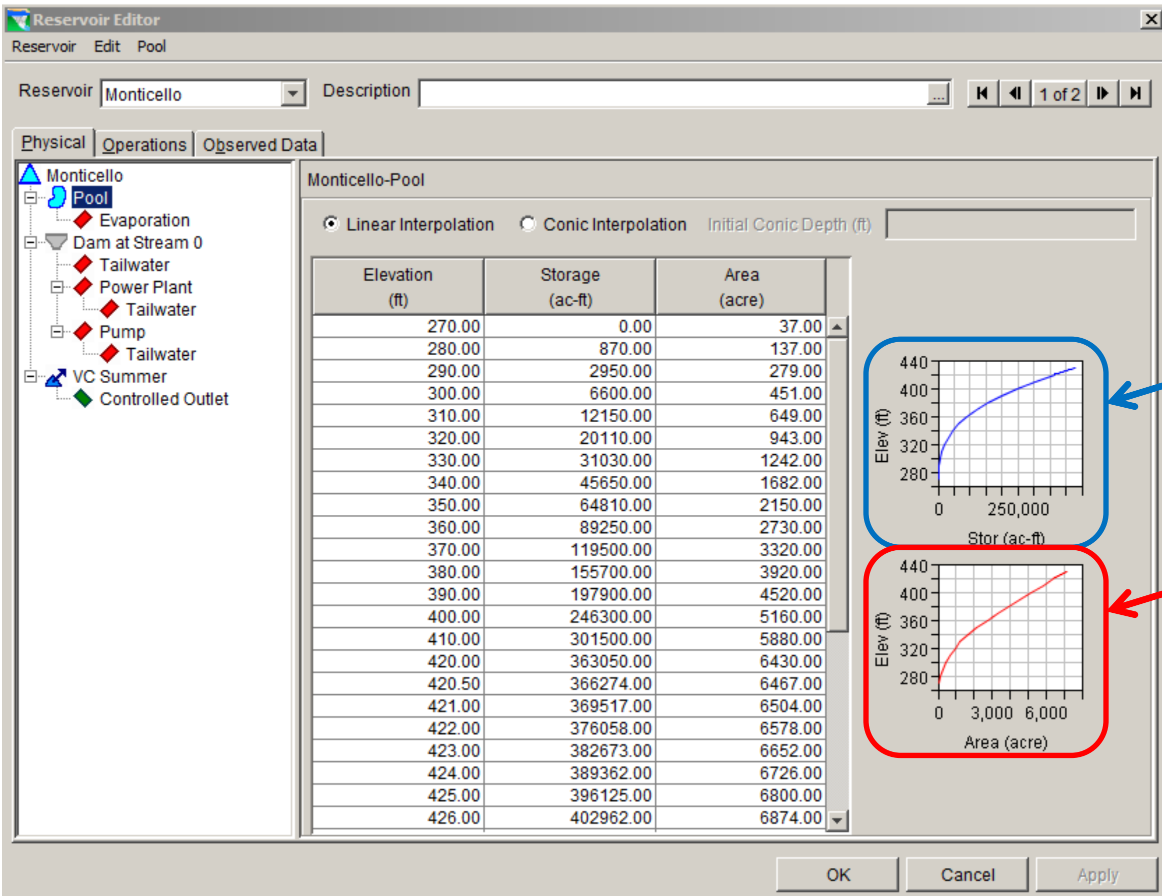
HEC-ResSim Model



Data Requirements:

- Static model inputs
- Temporal / time series data
- Operational Rules

Static Model Inputs



Elevation (ft)	Storage (ac-ft)	Area (acre)
270.00	0.00	37.00
280.00	870.00	137.00
290.00	2950.00	279.00
300.00	6600.00	451.00
310.00	12150.00	649.00
320.00	20110.00	943.00
330.00	31030.00	1242.00
340.00	45650.00	1682.00
350.00	64810.00	2150.00
360.00	89250.00	2730.00
370.00	119500.00	3320.00
380.00	155700.00	3920.00
390.00	197900.00	4520.00
400.00	246300.00	5160.00
410.00	301500.00	5880.00
420.00	363050.00	6430.00
420.50	366274.00	6467.00
421.00	369517.00	6504.00
422.00	376058.00	6578.00
423.00	382673.00	6652.00
424.00	389362.00	6726.00
425.00	396125.00	6800.00
426.00	402962.00	6874.00

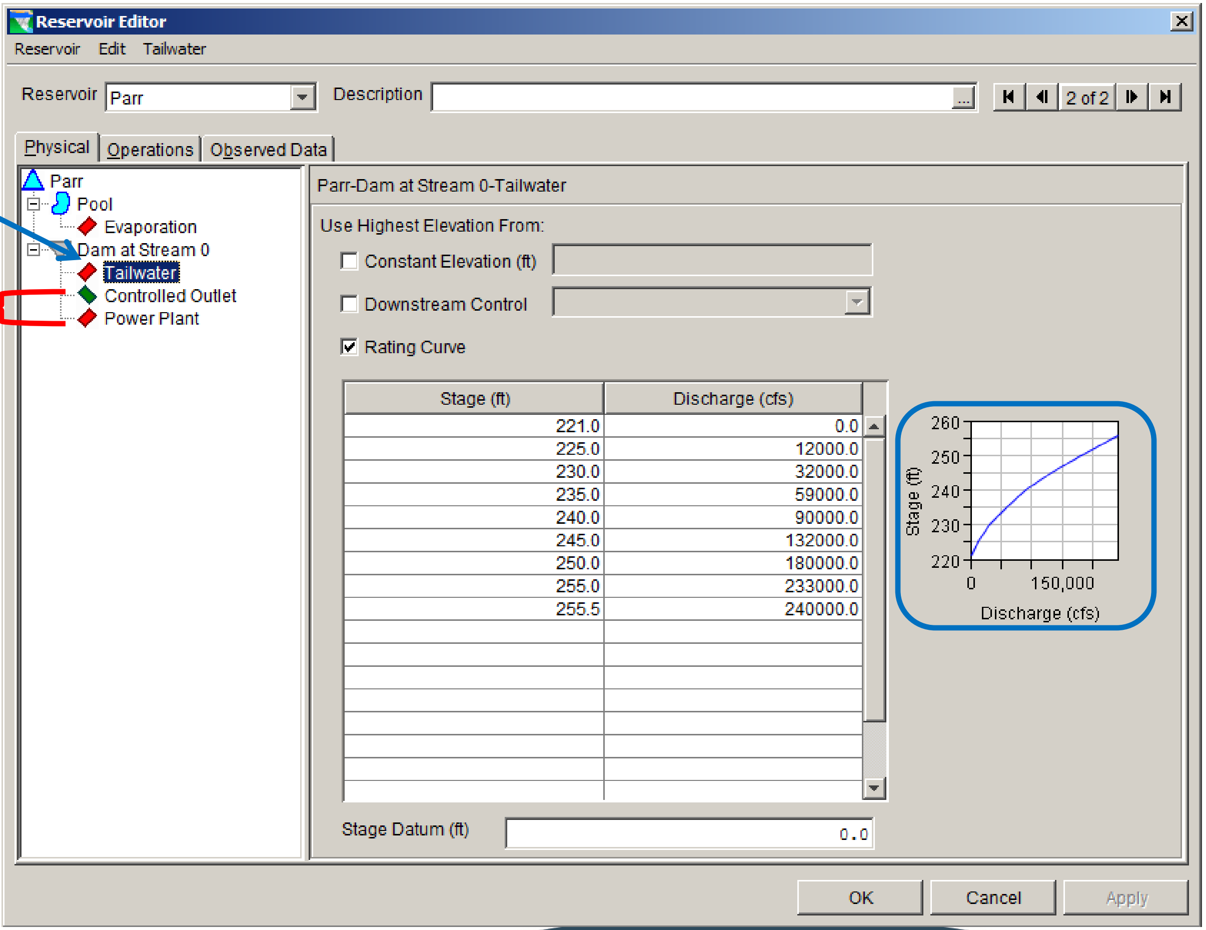
Stage vs Volume

Stage vs Area

Static Model Inputs

Tailwater rating curves

Outflow rating curves



Temporal Model Inputs

- Inflow Dataset

- Evaporation rates
  - losses computed as function of pan evaporation

Operational Rules

- Minimum flow
- Drought constraints
- Min / max pool levels
- Pumping Rules
- Generation constraints

Operational Rules

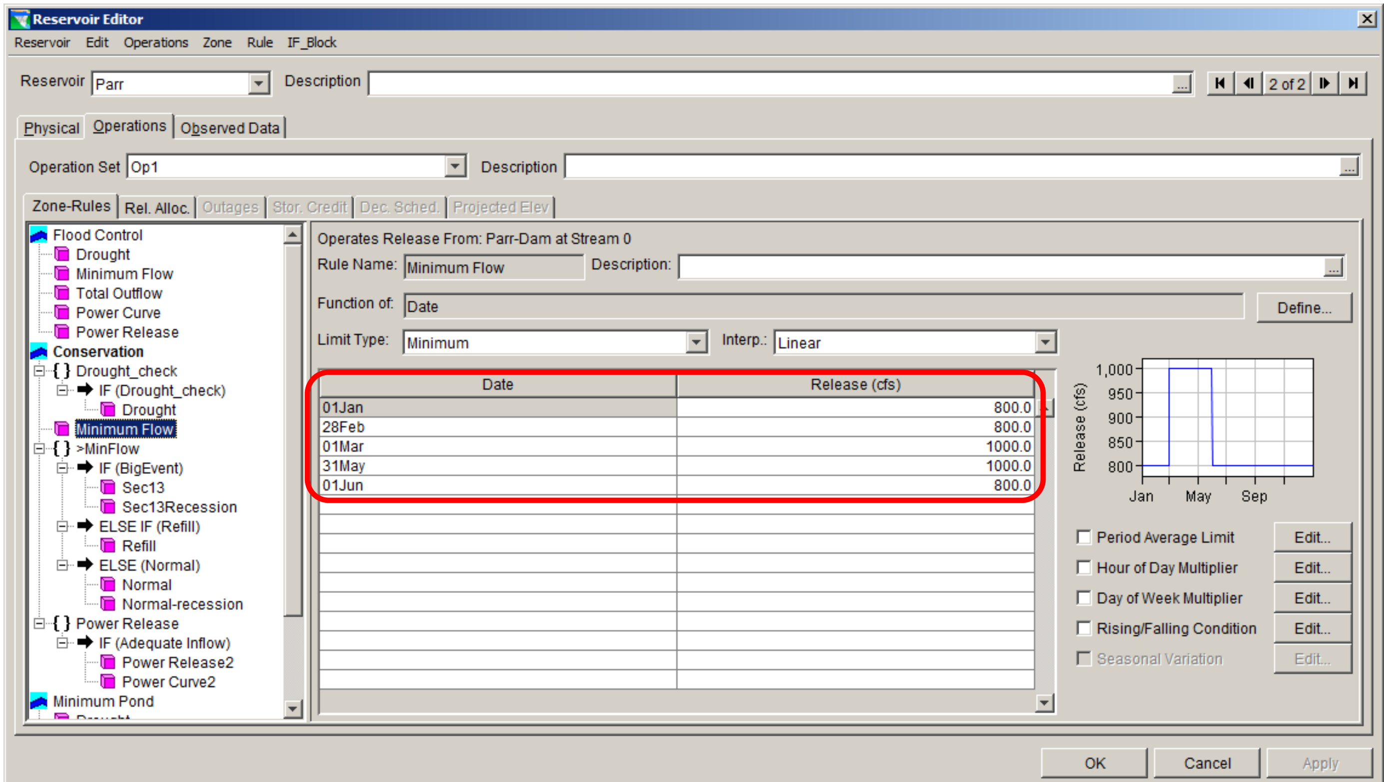
- Coded in model using if-then logic
- Constrained by variety of factors
  a. Date
  b. Inflow
  c. Reservoir level

Baseline vs. Scenario Rules

- Baseline operational rules are superseded in scenario simulations
- Prioritizations and thresholds can be adjusted

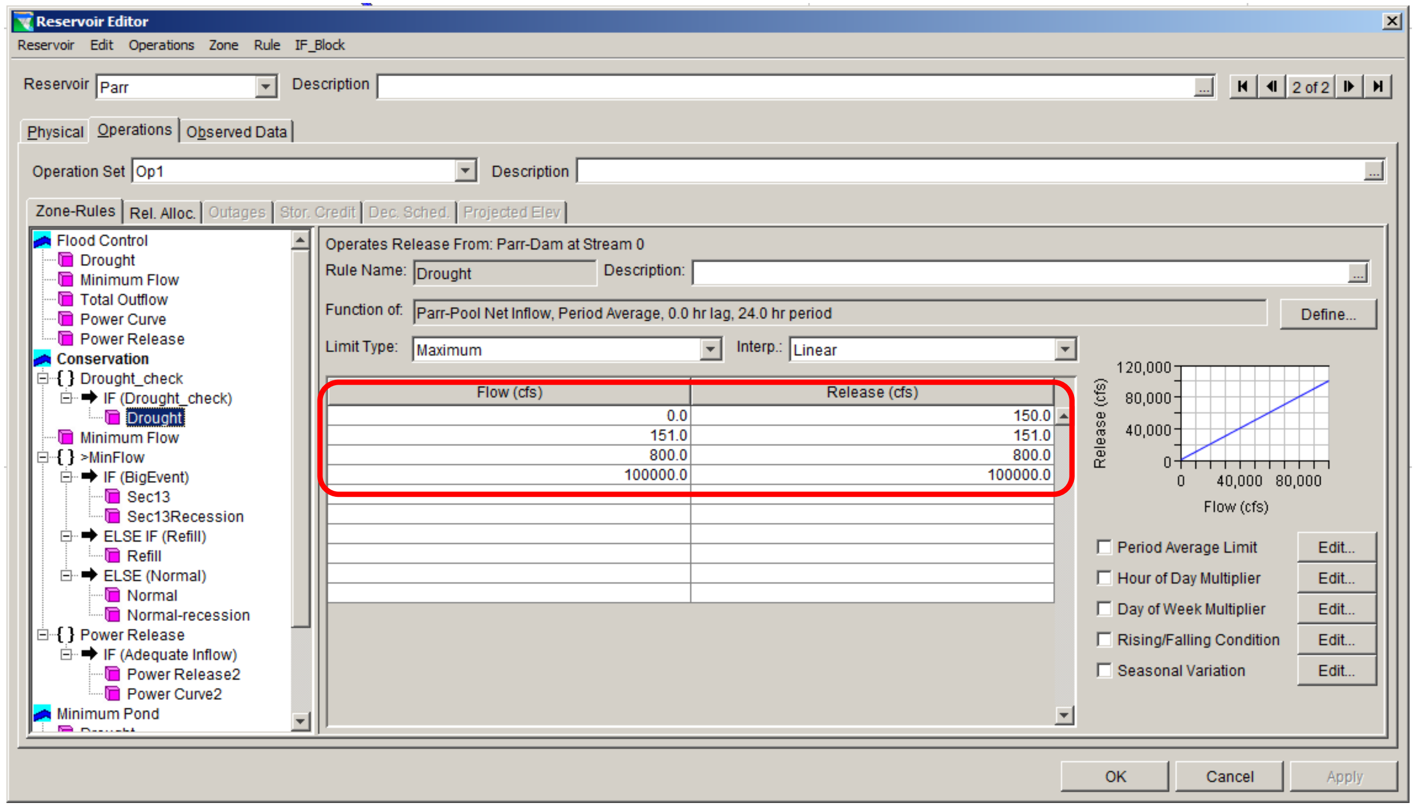
Operational Rules – Minimum Flow

Coded as function of date



Operational Rules – Drought

Coded as function of net inflow (Upstream flow minus evaporative losses)



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Other Operational Rules

- Curtail generation at Fairfield to avoid contributing to high flow releases (> 40k cfs)
- Decrease max pond level at Parr during high inflows to prevent upstream flooding
- Pumping to Monticello during evening, Fairfield generation during day

Next Steps

- Finalize Baseline Model & Report (Current Project, 2014)
- Define Metrics to be Evaluated (2015)
- Develop Output Summary Format (2015)
- Final Report of Model Simulations (2016)

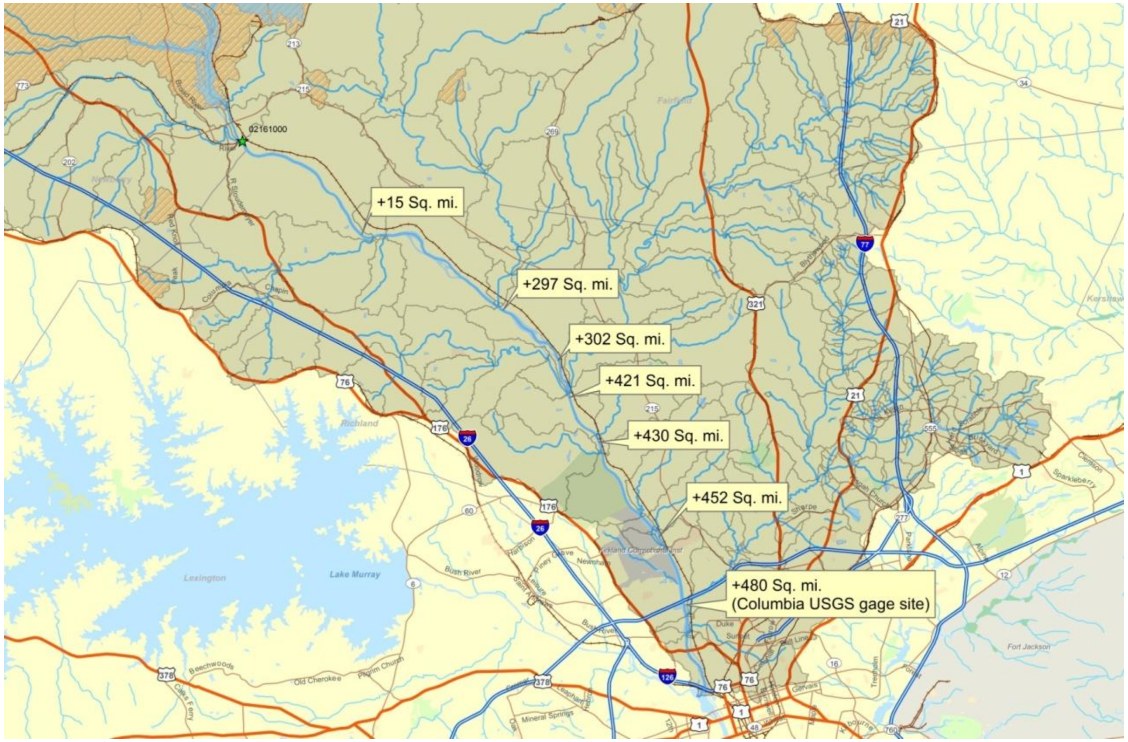
QUESTIONS?

Bruce Halverson, PE

Bruce.Halverson@KleinschmidtGroup.com

Thank you

Broad River Hydrology – Parr to Columbia



<u>Drainage Area Comparison</u>:

- at Parr – 4,750 sq. mi.
- at Columbia gage – 5,230 sq. mi.

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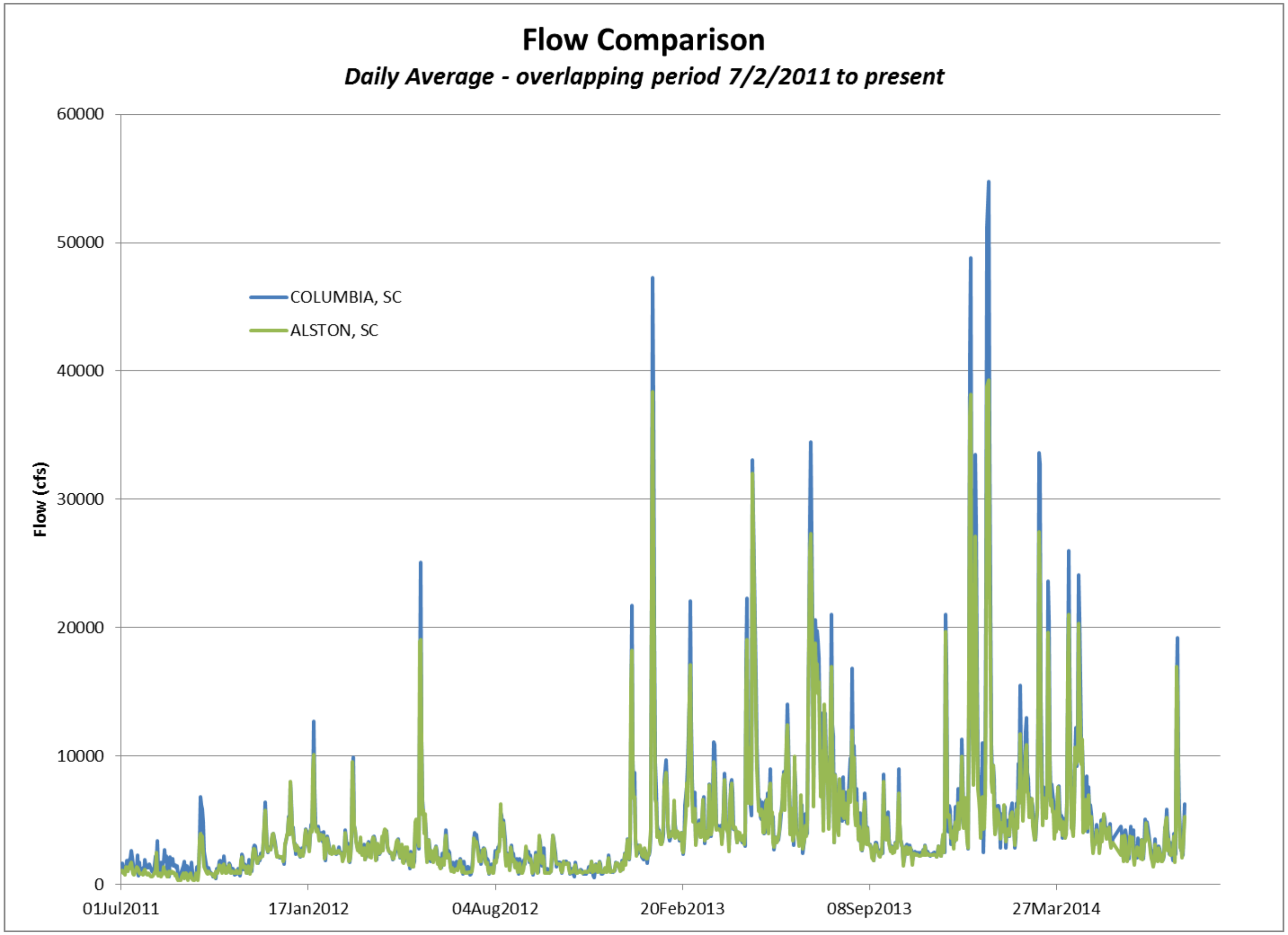

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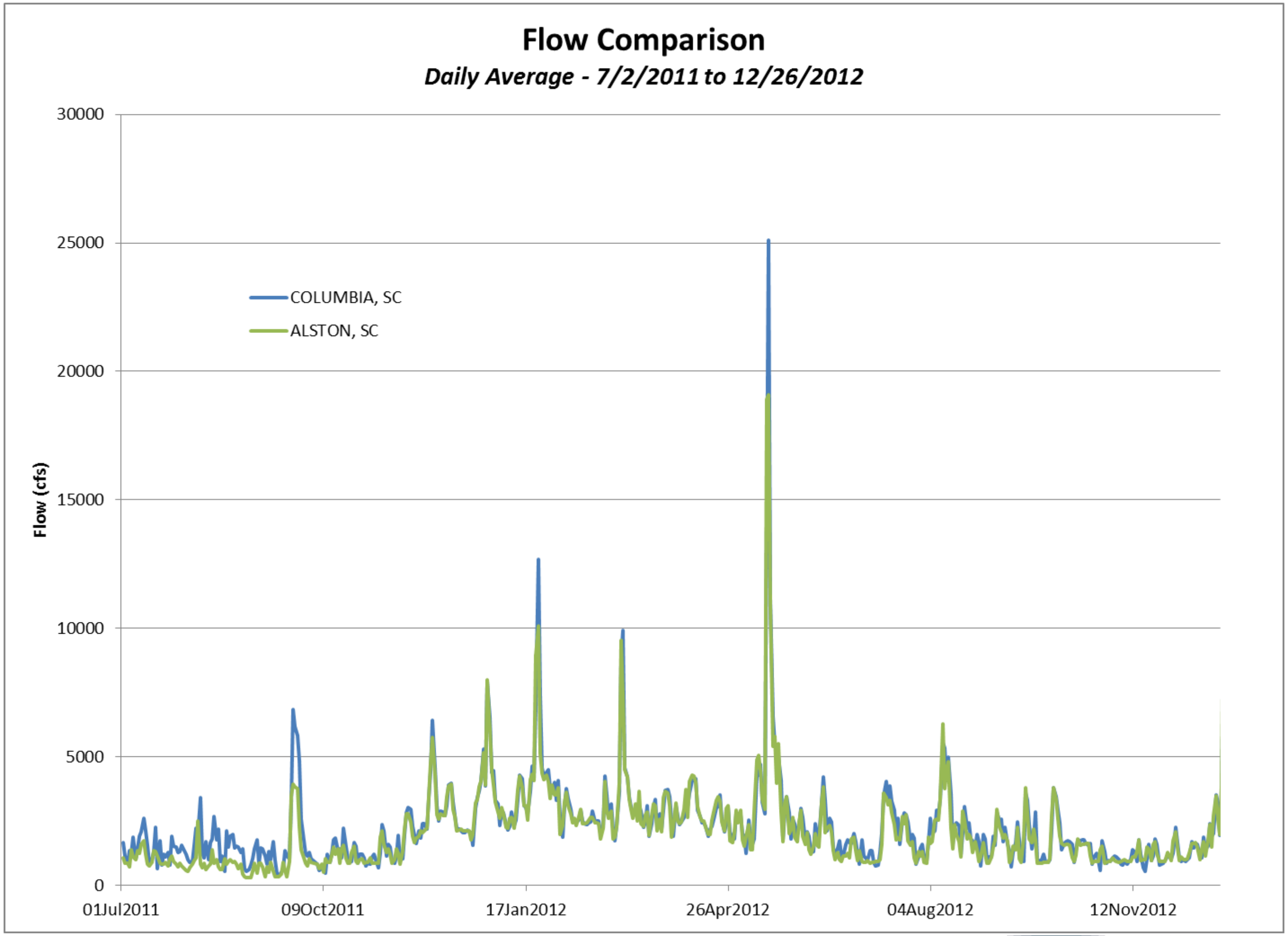
Flow Comparison
Daily Average - 7/2/2011 to 12/26/2012
30000
25000
20000
15000
10000
5000
0
Flow (cfs)
COLUMBIA, SC
ALSTON, SC
01Jul2011
09Oct2011
17Jan2012
26Apr2012
04Aug2012
12Nov2012

Average Daily Flow Comparison*

Period	7/2/2011 to present	7/2/2011 to 12/26/2012
Alston	4,150	2,097
Columbia	4,633	2,282
Difference	483	185
% of Columbia	10.4%	8.1%
# of values	1,122	540

*Includes only days with data values from both gages

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MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Joint RCG Meeting

October 9, 2014

Final KDM 12-15-14

ATTENDEES:

Steve Summer (SCANA)
Milton Quattlebaum (SCANA)
Bill Marshall (SCDNR)
Randy Mahan (SCANA)
Bill Argentieri (SCE&G)
John Fantry (Town of Winnsboro)
Byron Hamstead (USFWS)
Pace Wilber (NOAA) via conference call
Amy Bresnahan (SCE&G)
Greg Mixon (SCDNR)
Bill Stangler (Congaree Riverkeeper)
David Eargle (SCDHEC)
Dick Christie (SCDNR)
Tommy Boozer (SCE&G)
Beth Trump (SCE&G)
Henry Mealing (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Shane Boring (Kleinschmidt)
Alison Jakupca (Kleinschmidt)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The purpose of the joint RCG meeting was to discuss the draft Parr Hydroelectric Project Preliminary Application Document (PAD). The draft PAD was developed using existing Project data to describe the Project resources and how it operates under the current FERC license. The draft PAD was distributed to stakeholders to review and comment on prior to submittal to FERC.

Henry opened the meeting by explaining that a PAD is not the Final License Application or a National Environmental Policy Act (NEPA) document. It is a starting point for relicensing based upon the results of the collection of existing Project related data. No new, relicensing-focused studies have been conducted and the actual relicensing process doesn't begin until the PAD is filed with FERC.

Bill A. told the group that he has received several letters from agencies and NGOs endorsing or expressing a neutral stance on SCE&G's request to use the Traditional Licensing Process. Bill A. explained that he will be visiting FERC in October and additional letters of concurrence would be appreciated.

Kelly then began reviewing the comments received on the PAD. Comments were submitted by SCDNR, SCDHEC, USFWS, and the Congaree Riverkeeper. Kelly told the group that many comments or edits were simply accepted, or added to the document, but several comments needed further discussion with the group. She told the group that all comments were combined into one document so the document could be reviewed from beginning to end during our meeting. During the review, Kelly noted the comments that were accepted, and identified the comments that required additional discussion.

PAD comments that were discussed at the meeting are listed below.

- Byron asked for further explanation of the 6 deviations listed in the Parr Hydro Minimum Flow Compliance Summary (Table 3-3). The footnote was expanded to clarify information on these deviations.
- SCDNR asked for further explanation on Article 50 and 51 regarding odor monitoring. Bill A. explained the history of the two license articles and that discontinuation of odor monitoring was approved by SCDHEC and FERC in 1982 and 1983, respectively. (see PAD Section 3.8: Compliance Summary).
- Byron asked for additional information on erosion within the Project Boundary. Parr and Monticello Reservoir erosion studies were added to the PAD, including maps that indicate erosion levels along each reservoir's shoreline. (See PAD section 4.1.4: Existing Erosion, Mass Soil Movement, Slumping, or Other Forms of Instability)
    - Greg asked if SCE&G monitored the islands on Lake Monticello for erosion. Bill A. said that they currently do not, but that this may be something to consider in the future. It was noted that currently no islands were indicated as areas of concern for cultural resources in the SHPO studies.
- Several comments were submitted regarding the dissolved oxygen levels downstream of Parr Shoals Dam. Kelly added information in the PAD to address this concern. (See PAD section 4.3.2: Effects of Project Operations on Existing Water Quality)
- Byron suggested that the information included in the PAD on the Santee River Basin Accord for Diadromous Fish Protection, Restoration and Enhancement be expanded to discuss the triggers for fish passage at Parr Shoals Dam. Kelly included the trigger information, along with information on passage at the Columbia Dam. (See PAD section 4.4.1.4: Diadromous Fish)
- Byron asked for additional clarification of the macroinvertebrate studies that were included in the PAD – try to summarize and shorten this section of the PAD. Kelly said that this section (PAD section 4.4.2: Macroinvertebrate Species and Habitats) would be reviewed and revised to provide a clearer, more concise summary of the studies. Byron said he would submit comments to aid in this effort.
- David asked that the Japanese Mystery Snail be added to PAD section 4.4.4 Invasive Aquatic Species. This section will also be reviewed to ensure all invasive aquatic species in the Project Area are listed.
- Dick said he would like to review the section on striped bass and submit additional comments.
- SCDNR asked for additional information on Land Use at the Project several times throughout the document. Alison discussed the information that was included in the PAD (Table 4-30: Land Use Classifications within the Project Boundary).

Additional edits to the PAD, including information on striped bass and macroinvertebrates, will be distributed to the group for final review. A copy of the final Parr Reservoir Erosion Report will also be distributed to the group when it becomes available.

Due to the size of the PAD, the edited version is not attached to the end of the notes, however, it will be provided upon request via email. If you would like a copy of the edited PAD, which reflects in track changes comments submitted before and during the meeting, please call or email Kelly. The final Parr Hydro Project PAD is scheduled to be submitted to FERC the first week of January 2015. A copy of the final PAD will also be emailed to the stakeholders and will be posted to the Project website at www.parrhydrorelicense.com.

ACTION ITEMS:

- Dick will submit additional comments on striped bass.
- Byron will submit additional comments on the macroinvertebrate section of the PAD.
- Kelly will review and clarify the section on macroinvertebrates.
- Additional major edits will be circulated to the group for review and approval.
- The final PAD will be distributed to the group when it is filed with FERC in 2015.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Lake and Land Management TWC Meeting

November 5-6, 2014

Final KDM 12-11-14

ATTENDEES:

Bill Marshall (SCDNR)
Byron Hamstead (USFWS)
Dick Christie (SCDNR)
Randy Mahan (SCE&G)
Beth Trump (SCE&G)
Steve Summer (SCANA)
Bill Argentieri (SCE&G)
Amy Bresnahan (SCE&G)
Tommy Boozer (SCE&G)
Henry Mealing (Kleinschmidt)
Alison Jakupca (Kleinschmidt)
Kelly Miller (Kleinschmidt)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The Lake and Land Management TWC met over two days to discuss the Shoreline Management Plans (SMPs) for Parr Reservoir and Monticello Reservoir. Alison prepared the SMPs from the outlines agreed upon at the LLM TWC meeting held on May 21, 2013.

November 5, 2014

The group discussed the Monticello Reservoir SMP. Edits made to the Monticello Reservoir SMP are included at the end of these notes in track changes.

Byron asked if the tables presenting the total miles of shoreline at Monticello Reservoir include the island shorelines. Alison said that island shoreline mileage was included in the total for Monticello Reservoir because the islands are used for recreation and are owned by SCE&G. The table presenting the total miles of shoreline at Parr Reservoir does not include island shoreline miles, as Parr Reservoir is characterized by shoals that may be present depending on water level. Although there are several islands on Parr Reservoir, they are not all owned by SCE&G.

Alison discussed the differences in the current land use classifications on Monticello versus the proposed land use classifications. Tommy said the biggest change is reclassifying the section of land next to the Fairfield Pumped Storage Channel from future recreation to project operations.

The group discussed the proposed waterfowl management area land use classification in great detail. Dick reviewed the SCDNR Wildlife Management Area Classifications with the group. Dick said that the SCDNR waterfowl management area classification are specific for waterfowl hunting, however a wildlife management area allows for hunting of deer and other small game. Although the group was unsure of the hunting specifics allowed in these areas currently at Monticello and Parr reservoirs (water versus land, species allowed, how many days of the week, etc.), the group decided to list the hunting areas in the SMPs as Wildlife Management Areas (WMAs) and refer the public to DNR for more specific information. Dick will also research this issue.

Byron asked if there would be a specific classification for "natural areas" as he was interested to see if the SMP definition of natural areas lines up with that of the USFWS. Alison noted that although there wasn't a specific land use classification for natural areas, all of the shoreline within the PBL (except for those areas that are developed for recreation and within a permitted meandering path) has a non-disturbance classification. SCE&G does employ timber management along certain areas of the shoreline, but adheres to sound forest management practices, as discussed further below. Alison said that the group will have a meeting to discuss each parcel around the reservoirs and its classification and will review the management of each area at that time. Henry said that Monticello and Parr have different natural environments. The cove areas have some vegetation, but mostly the shoreline is a pine forest that extends to the lake's edge.

Byron asked if any commercial activities will be allowed on Monticello. Alison said that no commercial activities will be permitted, only governmental and residential water withdrawals will be considered for permits. The group also discussed boat lifts, and decided that they would not be permitted until public interest warrants a change.

Byron asked about the maintenance restrictions for meandering paths on Monticello, and if SCE&G has any issues with straight paths. Tommy said paths must be kept clear and if there are steps, they need to stay in place. He also said there are no issues with straight paths, because when a permit is issued, SCE&G comes to flag out the path before construction. Meandering paths are associated with docks on Monticello, so they will be tracked through the dock permit. Docks will not be permitted on Parr Reservoir at this time however meandering paths will be allowed, and will be tracked through a permit. Specifics on meandering paths will be included in the permitting handbook.

Beth told the group that forest management land is included within the Project Boundary, so the SMPs will need to be amended to include information on these areas. SCE&G adheres to the forestry best management practices put forth by South Carolina. Tommy said that the forestry management areas are mostly located around the upper end of Monticello Reservoir, near the Recreational Lake. These lands are located in areas classified for recreation. SCE&G has a forestry management plan, however since this plan is subject to change, it will be referenced in the SMPs, but the actual document will not be included. Alison will work with Beth to procure these documents and share them with the group. The group will also review which areas in particular are managed under the forestry management program when they review each parcel in the Project Area.

November 6, 2014

The group focused on discussing the Parr Reservoir SMP. Edits made to the Parr Reservoir SMP are included at the end of these notes in track changes.

The group discussed the permitting of meandering paths on Parr. Tommy noted that if someone has land along the Parr shoreline, they will naturally want to create a path to the water. Permitting this activity will allow SCE&G a say on the most appropriate positioning for this path. Randy added that because of the nature of Parr Reservoir (riverine, topography, etc.) SCE&G would prefer to consider permitting on a case by case basis for limited uses, such as meandering paths and water withdrawals. Dick expressed concern that allowing meandering paths might promote boat ramps. Tommy said that allowing a 5 foot path is more acceptable than a 10 foot path, because a larger path is more likely to become a boat launch. The group agreed that the majority of Parr Reservoir shoreline should be classified as non-development areas. Within these non-development areas, 5-foot meandering paths and water withdrawals may be allowed with a permit.

The group then discussed water withdrawals. Henry said that a water withdrawal that is 1 MGD must be permitted by SCDHEC, and FERC also has to be involved. The group decided that within the SMPs, instead of labeling water withdrawals as residential or commercial, they should be defined by volume.

As with the Monticello Reservoir SMP, the subject of Wildlife Management Areas on Parr Reservoir was discussed. The group agreed that waterfowl hunting should be restricted to boats because of the fluctuation of the reservoir. However, Dick pointed out that SCDNR will have difficulty enforcing this. Dick said he would talk to SCDNR enforcement and provide more information on how to best deal with the hunting issues. This will be discussed in more detail at future meetings.

Byron said he is interested in seeing the specific places where watering livestock in the lake is allowed. He also wants to see where docks and water withdrawals are located and where the shoreline is managed for timber on both Monticello and Parr reservoirs. He wants to see how the overall shorelines are balanced. Tommy will plan a trip to the reservoirs in the March to April 2015 timeframe for Byron and others.

The group then discussed the Permitting Handbook outline. Edits made to the Permitting Handbook are included at the end of these notes in track changes.

The group discussed having a small pull-out section of the handbook for distribution to the public, since there is concern on the final size of the handbook. After the entire handbook is developed, the group will decide if this is needed or not.

After the meeting, Byron Hamstead with USFWS submitted a document clarifying a comment he made during the meeting. This document is attached to the end of these notes. Action items stemming from these meetings are listed below.

ACTION ITEMS:

- Alison and Beth will work together to include information on SCE&G's forestry practices in the Monticello and Parr SMPs.
- Dick will gather information from SCDNR enforcement regarding the hunting issues at Parr and Monticello reservoirs.
- Tommy and Scott will develop a new location map with the Project Boundary and updated shoreline classifications.
- Alison will update the SMPs based on the edits discussed at the meetings.
- Tommy will schedule a meeting in March/April 2015 to show agencies the project boundary areas on Parr and Monticello.

SHORELINE MANAGEMENT PLAN
MONTICELLO RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

September 2014

SHORELINE MANAGEMENT PLAN
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(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

EXECUTIVE SUMMARY

South Carolina Electric & Gas Company ("SCE&G") is the Licensee of the Parr Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 1894) ("Project"). The Project consists of the Parr Shoals Development and the Fairfield Pumped Storage Development. The developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project developments form two distinct Project reservoirs. Parr Reservoir is located along the Broad River, as impounded by Parr Shoals Dam, and functions as the lower reservoir for the Fairfield Development. Monticello Reservoir is located adjacent to the Broad River and functions as the upper reservoir for the Fairfield Development. Both Project reservoirs serve as popular recreation destinations and are used and enjoyed by local residents as well as visitors to the state.

In conjunction with its relicensing activities, SCE&G has assembled a diverse and inclusive group of stakeholders to advise and assist in the development of two Shoreline Management Plans ("SMPs"), each tailored to a specific reservoir. SMPs are comprehensive plans for the management of Project land and adjoining water resources and their uses, consistent with License requirements and broad Project purposes, and appropriately accessible and beneficial to adjacent shoreline residents and the recreating public. A SMP serves to identify existing and appropriate future uses and to provide plans and programs for responsible future use and management of project lands and waters as well as the flora and fauna encompassed within them. This SMP exists specifically to address shoreline uses surrounding Monticello Reservoir. A SMP to address Parr Reservoir is included under separate cover and available from the SCE&G Lake Management Department (Lake Management).

In addition to a SMP for each Project reservoir, a Shoreline Management Handbook and Permitting Guidelines (Permitting Handbook) was developed for both developments in consultation with governmental, non-governmental, and individual stakeholders to address activities that will require consultation with and/or permits from SCE&G. These activities include construction, maintenance, and placement of docks, shoreline stabilization, lake access pathways and other shoreline activities.

The classification of Project lands surrounding Monticello Reservoir is described in Section 5.0 and includes five management classifications. These classifications are as follows: Project Operations; Nuclear Exclusion Zone; Shoreline Permitting; Public Recreation; and Undeveloped Areas/Dock Exclusion Areas. Public Recreation land includes land within public parks, SCE&G developed recreation areas, and islands.[1] Undeveloped Areas/Dock Exclusion Areas are areas protected from development to preserve environmental resources and aesthetic values. Conversely, lands included within the Shoreline Permitting classification are not automatically excluded from development related shoreline use, and hence may be available for permitted shoreline development such as access paths and docks. Lands reserved for Project operations are those lands that are specifically required for operation of the Project. They include areas such as plant facility locations, dams, electrical substations, etc. The Nuclear Exclusion Zone (NEZ) is a defined area surrounding the V.C. Summer Nuclear Station. Within the NEZ, SCE&G, as the licensed nuclear plant operator, has responsibility and the authority to control all activities and has the absolute right to exclude or remove persons and property.

Land use prescriptions associated with these land management classifications are discussed in Section 6.0. Prescriptions are administered through the Permitting Handbook.

SCE&G maintains a strong commitment to the management of the waters and shoreline of Monticello Reservoir, focusing on the social, ecological, and economic impacts of activities on and near the shoreline and water, taking into consideration in particular, the environmental, aesthetic, and recreational character of the shoreline and lake. Section 7.07.0 details the activities and structures on and adjacent to Monticello Reservoir that require SCE&G consultation and/or approval. The permitting procedures for shoreline activities or structures are set out in more detail in Section 8.0 and in the Permitting Handbook.

[1] SCE&G owns all land within the Monticello Development, including all islands within Lake Monticello

Section 9.0 details SCE&G's fee structure for the shoreline management program. Such fees can be one-time or periodic.

Periodic surveys of the Monticello Reservoir shoreline are conducted by SCE&G and include, among other things, inventories and inspections of all docks, including those built and permitted throughout the current year. SCE&G also looks for unauthorized structures ~~below the 425-foot National Geodetic Vertical Datum ("NGVD") contour (high water mark) as well as~~ within ~~Buffer Zones~~Project boundary at that time. These represent violations of the SMP. SMP violations will be dealt with as deemed by SCE&G, in its sole discretion, to be appropriate. Consequences of violations may range from dock permit cancellations to fines and/or legal action, and are discussed more fully in Section 10.0.

SCE&G Shoreline Management Practices include actions taken to lessen or mitigate for potential impacts to a particular resource resulting from direct or indirect use. These include but may not be limited to shoreline stabilization and vegetation management, as well as aquatic plant management. Shoreline Management Practices are further described in Section 11.0 of this document.

Public education and outreach on the protection of valuable shoreline resources is integral to the effectiveness of the SMPs. Section 12.0 of this document details specific measures to be undertaken to help educate both adjacent shoreline residents and other Project resource users. Among included objectives will be SMP education and Best Management Practices ("BMP") education.

In its Application for New License, SCE&G is proposing 10 year review periods for the SMP. The 10 year SMP review periods provide reasonable opportunities for SCE&G, in concert with governmental, non-governmental, and individual stakeholders, periodically and deliberately to assess new issues that arise as a result of development around the Reservoir, and allow for analyses of cumulative effects. Concurrently with the FERC SMP review process, SCE&G will review the Permitting Handbook with interested stakeholders periodically to evaluate and improve its effectiveness. SCE&G reserves the right, however to make changes to the permitting process as it deems necessary and appropriate. This is discussed in Section 10.0.

1.0 INTRODUCTION

The Parr Hydroelectric Project ("Project") is located on the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1-1~~Figure 1-1~~). The Project is located approximately 31 river miles downstream of the Neal Shoals Hydroelectric Project (Federal Energy Regulatory Commission ["FERC" or "Commission"] No. 2315) and 24 river miles upstream of the Columbia Diversion Dam. The Project consists of two developments;~~,~~ the Parr Shoals Development ("Parr Development") and the Fairfield Pumped Storage Development ("Fairfield Development"). Subsequently, two primary reservoirs are included as part of the Project, Monticello Reservoir[2] and Parr Reservoir. The normal maximum water level in Monticello Reservoir is El. 425.0 feet National Geodetic Vertical Datum ("NGVD"), which corresponds to a surface area of 6,800 acre~~-feet~~s, and a gross storage of 400,000 acre-feet. Monticello Reservoir has approximately ~~54~~ 56 miles of shoreline within the Project boundary. Parr Reservoir's normal maximum water level is at El. 266.0 feet NGVD, with a corresponding surface area of 4,400 acres. The gross storage is estimated to be 32,000 acre-feet. Parr Reservoir has 94 miles of shoreline within the Project boundary.

Comment [b1]: Revise to FERC throughout document. Remove "Commission" from rest of document.

An active storage of up to 29,000 acre-feet is transferred between the two reservoirs by the pumped storage operations of the Fairfield Development. Fairfield Development's alternate cycles of generation and pumping results in daily fluctuations in the water levels of both Monticello and Parr Reservoirs. Monticello, when beginning at normal maximum pool elevation, drops 4.5 to 5 feet over a 10 to 12 hour period during the generating phase of operation. At the same time, the water from Monticello and from the Broad River is flowing into Parr Reservoir, causing it to rise as much as 10 feet. During the pumping cycle, the reverse occurs - the water level rises in Monticello Reservoir and drops in Parr Reservoir.

The Project boundary[3] encompasses land around each reservoir, extending between 50 and 200 horizontal feet from the high water mark. A 300-acre Recreation Sub-impoundment ("Recreation Lake") is situated adjacent to Monticello Reservoir and is included within the FERC Project

[2] The State of South Carolina considers Monticello Reservoir waters of the State and refers to it as "Lake Monticello".

[3] Standard License Article 5 requires licensees to acquire and retain sufficient property and rights to construct, maintain, and operate their projects, as identified in their specific license, including any property or rights needed to accomplish all designated project purposes. As such, Project lands are those lands within the FERC project boundary owned by SCE&G in fee title and those lands for which SCE&G has acquired or retained an easement.

boundary. This lake was constructed by South Carolina Electric & Gas Company ("SCE&G") solely for recreational use. The Recreation Lake is unaffected by operational reservoir fluctuations on Monticello Reservoir.

SCE&G manages SCE&G-owned lands within the Project boundary to comply with the FERC license for the Project (the "License"). The goal of project land management is to serve the public interest by providing recreational access and opportunities, protecting wildlife habitat and water quality, producing electricity, and protecting and preserving cultural and aesthetic resources. The Shoreline Management Plan ("SMP") provides a set of administrative policies, procedures, and practices by which SCE&G seeks to manage the Project shoreline to achieve these goals. Future proposals for specific shoreline related developments or activities will be reviewed for consistency with the SMP.

A draft of the initial Project SMP was filed with the ~~Commission~~ FERC in 1991. After several years of discussion and revisions, the initial SMP was approved by the ~~Commission~~ FERC on June 4, 2001. The history of the Project's SMP is described in more detail in Section 3.0 (History of the Shoreline Management Plan). The current relicensing[4] of the Project provides a near term impetus and opportunity for SCE&G to review the existing SMP in cooperation with relicensing stakeholders, including federal and state regulatory agencies, interested non-governmental organizations ("NGO"s), and individuals. Through discussions with these parties, it was decided that the existing FERC approved SMP, which encompasses both Monticello and Parr Reservoirs, should be divided into two distinct SMP's, one for each reservoir. Hence, this SMP has been prepared for Monticello Reservoir and is being submitted to FERC as part of SCE&G's Parr Hydroelectric Project comprehensive relicensing package. A SMP for Parr Reservoir is included under separate cover.

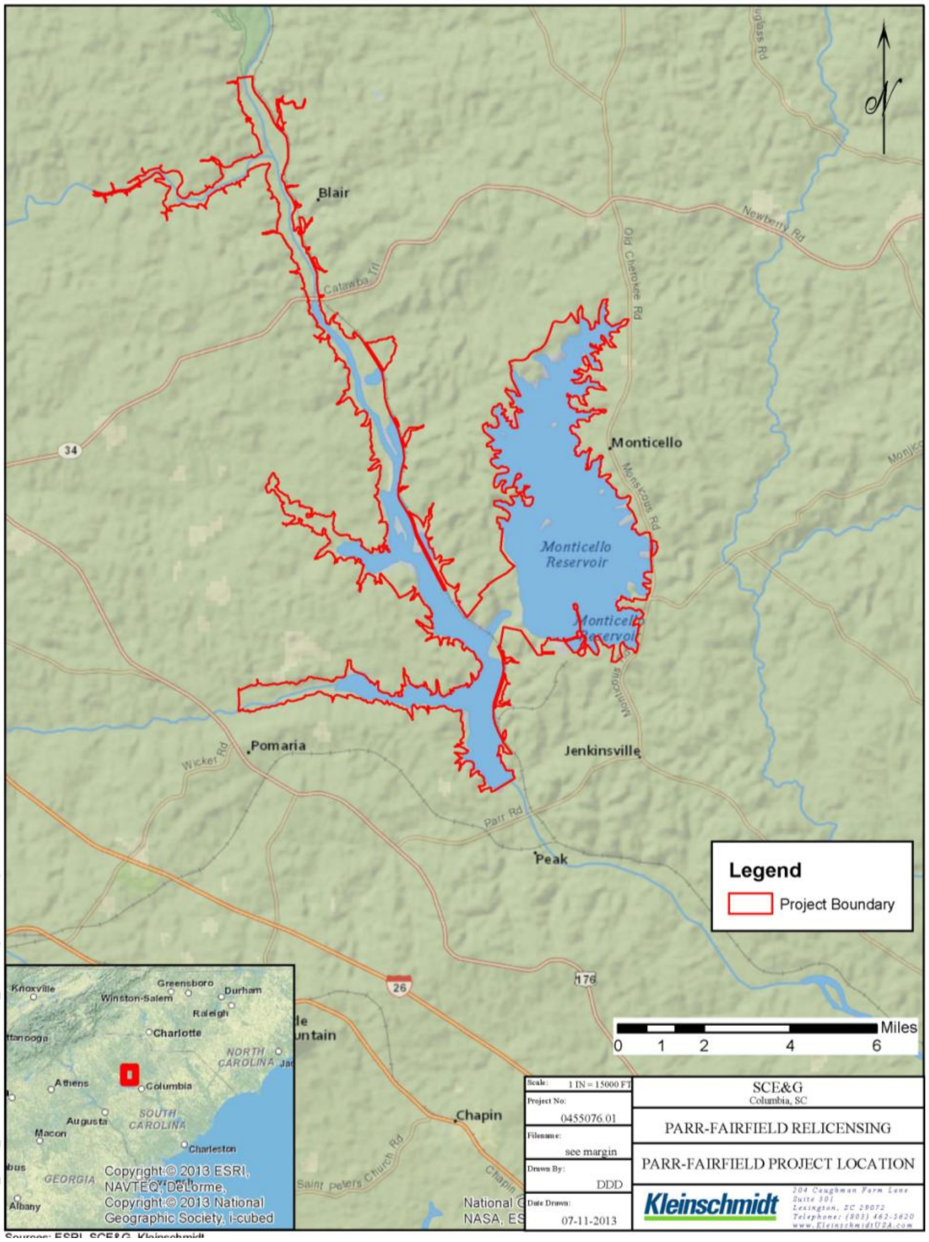
The management guidelines set forth in this SMP are applicable to all lands within the Project boundary surrounding Monticello Reservoir. Among other things, the current document includes the following components:

- Detailed descriptions, management prescriptions and mapping of land classifications;
- Summary information on the Permitting Handbook and fee policies;

[4] The current operating license for the Project is due to expire on June 30, 2020. As such, SCE&G will file for a new license with FERC on or before June 30, 2018.

- Best management practices ("BMP"s);
- Public education and outreach;
- Reservoir monitoring; and,
- A proposed review process.

FIGURE 1-1: PROJECT LOCATION AND BOUNDARY MAP



2.0 PURPOSE AND SCOPE OF THE SHORELINE MANAGEMENT PLAN

The Project has served as a major source of power generation for SCE&G's customers and recreation for local residents and visitors to South Carolina for several decades. Consistent with FERC's Standard Land Use Article, a licensee may authorize specific non-project uses and occupancies of a project's shoreline. Examples of non-project uses at Monticello Reservoir include residential boat docks, boat lifts, access paths across SCE&G property, and erosion control structures. SCE&G has a responsibility to ensure that non-Project uses remain consistent with Project purposes, including protection and enhancement of the Project's scenic, recreational, and environmental values.

As development increases in areas surrounding the Project, so too does stress placed upon Project reservoirs and the surrounding watershed. Thus, a comprehensive SMP for each reservoir that recognizes and addresses sources of potential environmental impact is essential to managing each reservoir for the benefit of all interests and to ensure that non-Project uses remain consistent with the License.

The implementation of the SMP by SCE&G will help to maintain and conserve the area's natural and man-made resources. The SMP will comply with the terms of the License, as well as the regulations and orders of FERC, and is intended to assist in providing a balance between recreational use and development, environmental protection, and energy production.

3.0 HISTORY OF THE SHORELINE MANAGEMENT PLAN

On August 28, 1974, the Federal Power Commission (FPC), predecessor to the FERC, issued SCE&G a new License for the Parr Hydroelectric Project. In addition to relicensing the existing 14.88 megawatt (MW) Parr Shoals Development, the new License authorized the construction of the 511.2 MW Fairfield Pumped Storage Development. This resulted in the creation of the Fairfield Development's upper pool, Monticello Reservoir. The new License also authorized the enlargement of the existing Parr Reservoir to serve as the lower pool to the Fairfield Development. This involved raising the height of Parr Dam approximately 9 feet, thereby nearly doubling Parr Reservoir's surface area. The construction of newly licensed facilities was completed in 1978, with the facilities beginning commercial operation that same year (F.P.C., 1974).

Article 48 of the Project License issued in 1974 required that SCE&G purchase in fee and include within the project boundary all lands necessary or appropriate for project operations, including lands for recreational use and shoreline control. The lands encompassed by the project boundary shall include, but not be limited to: the islands in the Parr and Monticello Reservoirs formed by the 266-foot and 425-foot contour intervals, respectively; shoreline lands up to the 270-foot contour, or 50 feet (measured horizontally) from the Parr Reservoir's 266-foot contour, whichever is greater; and, shoreline lands up to the 430-foot contour interval, or 50 feet (measured horizontally) from Monticello Reservoir's 425-foot contour, whichever is greater. Provided that the Project boundary, except with respect to land necessary or appropriate for recreational purposes, shall not exceed 200 feet, horizontally measured, from the 266-foot or the 425-foot contour, unless satisfactory reasons to the contrary are given. This area is referred to as the "Buffer Zone". The FPC determined that acquiring these lands would provide SCE&G with adequate shoreline control around the reservoirs, in addition to serving the purposes of Project operation and recreation (F.P.C., 1974).

Comment [b2]: Bill A to provide additional wording from Article 48.

Comment [b3]: Take out reference to Buffer Zone, just refer to Project property.

Furthermore, Article 20 of the Project License orders that SCE&G allow public access, to a reasonable extent to Project waters and adjacent Project lands (with the exception of lands necessary for the protection of life, health, and property) for navigation and outdoor recreational purposes. This Article also allows SCE&G to grant permits for public access to the reservoirs subject to FERC approval (F.P.C., 1974).

In 1991, SCE&G recognized that appropriate policies and procedures should be in place to govern shoreline activities at the Project. Utilizing experience gained at their Saluda Hydroelectric Project (FERC No. 516), SCE&G filed a proposed SMP with the Commission to regulate the use of Project shorelines. After extensive stakeholder consultation, an amended SMP was filed with the Commission. It was approved on June 4, 2001. The SMP was included as part of the Project's Exhibit R (FERC, 2001).

The SMP approved in 2001 primarily covered activities associated with Monticello Reservoir. It dealt with the following matters: water quality management; forest management; waterfowl management; nuclear exclusion zone restrictions for the operation of SCE&G's V.C. Summer Nuclear Station; fishing, boating, and hunting; public access and recreation; private boat docks and access; vegetation removal; water withdrawal; erosion control; and prohibited activities.

In 2006, SCE&G amended the SMP's policy regarding common docks. The original policy allowed for two to five adjacent property owners to share a single common dock if the shoreline frontage requirement of 200 feet was met. The policy was amended to allow no more than two individual, adjacent single family residential lots to share a common dock. The shoreline frontage requirement of 200 feet was retained.

3.1 CURRENT SMP DOCUMENT AND SHORELINE CLASSIFICATIONS

The SMP serves as a reference document for SCE&G in implementing the Standard Land Use Article, which authorizes SCE&G to permit certain non-project uses of project lands and waters. FERC did not begin including the Standard Land Use Article in new licenses until the early 1980's; thus it was not included in the Project License issued in 1974 (FERC, 2012). However, FERC granted SCE&G the specific authority to permit certain non-Project uses through the approval of the 2001 SMP, and added the Standard Land Use Article to the License (Article 62) in 2011, as revised in 2013 (Article 63). This present document, submitted in conjunction with SCE&G's License application, presents a management plan, covering only Monticello Reservoir (a SMP for Parr Reservoir is included under separate cover), while adhering to the historical management goals agreed to and developed with agencies and stakeholders.

In addition to an updated SMP for each Project reservoir, a Permitting Handbook was developed in consultation with stakeholders and agencies to address activities requiring consultation with and/or permits from SCE&G. These activities include, but are not limited to the following:

construction, maintenance, and placement of docks and boat lifts; shoreline stabilization; construction and maintenance of lake access pathways; limited brushing; and other shoreline activities. SCE&G will review the Permitting Handbook with interested stakeholders periodically to evaluate its effectiveness; however, SCE&G may make changes to the permitting process at any time as it determines in its sole judgment to be necessary and appropriate.

3.2 PROJECT BOUNDARY

Comment [b4]: Reword to address Article 48 condition. Bill A to provide

SCE&G owns all lands within the Project boundary surrounding Monticello Reservoir. As noted, this area ~~is referred to as the "Buffer Zone" and may~~ encompasses but is not limited to an area up to the 430-foot contour or measuring up to 50 feet but no greater than 200 feet horizontally from the 425-foot contour on Monticello Reservoir, whichever is greater.

3.3 ~~ACREAGE OF PROJECT LANDS~~ (SECTION TO BE MOVED TO TABLE UNDER SECTION 5.0)

4.0 SHORELINE MANAGEMENT PLAN GOALS AND OBJECTIVES

The overall goal of this SMP is to define, document, and present the processes and criteria that SCE&G will employ to manage and balance private and public access to and uses of Project lands, specifically including Monticello Reservoir's shoreline, consistent with public safety, energy production operations, environmental protection for Project land as well as Project waters, and reasonable recreational opportunities. This SMP will help to ensure the protection and enhancement of the Project's scenic, environmental, recreational, natural and cultural resources over the term of the License.

This SMP represents a consensus-based, updated management plan intended for submittal with the Project No. 1894 License Application. Specific goals relative to the SCE&G relicensing process that are discussed under this SMP include the following:

1. Provide for reasonable current and future public access;
2. ~~Preserve opportunities~~Provide for current and future ~~to meet~~ recreational needs within the Project;
3. Protect fish and wildlife habitat;
4. Protect cultural resources;
5. Protect the ability to meet operational needs;
6. Facilitate compliance with License articles;
7. Minimize adverse impacts to water quality;
8. Monitor and address erosion;
9. ~~Minimize adverse, manageable~~Protect scenic ~~impacts~~values;
10. ~~Guide the control and~~ Monitor and permit~~ting of~~ shoreline activities ~~development~~;
11. Provide a summary catalogue of the types and locations of existing recreational opportunities;
12. Establish Land Management Classifications and Land Use Prescriptions to help in the management of non-Project uses of the Monticello Reservoir shoreline lands within the Project boundary;
13. Describe the SMP amendment and monitoring process; and
14. Educate and encourage property owners who own property adjacent to or adjoining Project Property (herein referred to as "adjacent property owners") on the use of voluntary BMPs.

4.1 Consultation

The Project relicensing provides an opportunity for SCE&G to seek input on Project-related shoreline management issues from interested stakeholders. SCE&G recognizes that successfully completing the relicensing process requires identifying and resolving Project issues in consultation with federal and state resource agencies, local and national NGOs, homeowner associations, and individuals who have an interest in the Parr Hydroelectric Project (Table 4-1: ~~Table 4-1~~). SCE&G began public outreach efforts in January 2013 by holding a series of public workshops in Winnsboro, Newberry, Columbia, and Jenkinsville, SC. Since that time, SCE&G has sought active public involvement in the process and fostered commitment to issue resolution among SCE&G and stakeholders.

Table 4-1: Participating Groups in Parr Hydroelectric Project Relicensing

Stakeholder Groups
American Rivers
American Whitewater
Catawba Indian Nation
City of Columbia
Chestnut Hill Plantation HOA
Coastal Conservation League
Congaree Riverkeeper
Environmentalists Inc.
Fairfield County
Gills Creek Watershed
National Marine Fisheries Service
National Park Service
Newberry County
South Carolina Department of Health and Environmental Control
South Carolina Department of Natural Resources
South Carolina Department of Parks, Recreation and Tourism
South Carolina Electric & Gas Company
South Carolina Historic Preservation Office
Town of Winnsboro, SC
Tyger-Enoree River Alliance
United States Fish and Wildlife Service
United States Forest Service
University of South Carolina

4.1.1 RECREATION/LAKE AND LAND MANAGEMENT RESOURCE CONSERVATION GROUP

In support of the relicensing effort, SCE&G formed three Resource Conservation Groups ("RCG"s) to identify, address and resolve Project-related issues by resource area. The RCGs are as follows: the Fish, Wildlife and Water Quality RCG; the Project Operations RCG; and the Lake & Land Management and Recreation RCG. Consideration of potential issues by resource area allows for more focused topic discussion and targeted issue resolution. Some RCGs have established sub-groups, or Technical Working Committees ("TWC"s), for issues requiring special knowledge, education, or experience. Consequently, the Lake & Land Management and Recreation RCG has a Lake and Land Management TWC as well as a Recreation TWC. The Lake and Land Management TWC is discussed further below.

4.1.2 LAKE AND LAND MANAGEMENT TECHNICAL WORKING COMMITTEE

The primary mission of the Lake and Land Management TWC is to revise the existing Parr Hydroelectric Project SMP to provide a management framework within which Project resources can be effectively protected while assuring appropriate public and private access to the Project resources and the recreational opportunities they present. Another important focus of the TWC is to allow interested parties an effective opportunity to provide input on resource issues and the overall future management of shoreline resources. The resulting collaboration has resulted in the contribution of valuable information by entities and individuals familiar with the Project. The forum was instrumental in addressing important issues relevant to the operation and management of the Project over the term of the new License. In working collaboratively, the members of the TWC (Table 4-2~~Table 4-2~~) aimed to blend the objectives of the state and federal resource agencies with other stakeholder interests.

TABLE 4-2: ORGANIZATIONS PARTICIPATING ON THE LAKE AND LAND MANAGEMENT TWC

STAKEHOLDER GROUPS
American Rivers
American Whitewater
Coastal Conservation League
Congaree Riverkeeper
Fairfield County
Gills Creek Watershed
Adjacent Property Owners

STAKEHOLDER GROUPS
National Marine Fisheries Service
National Park Service
South Carolina Department of Health and Environmental Control
South Carolina Department of Natural Resources
South Carolina Department of Parks, Recreation and Tourism
South Carolina Electric & Gas Company
Tyger-Enoree River Alliance
United States Fish and Wildlife Service
United States Forest Service

4.1.3 MEETING SCHEDULES

Between October of 2013 and January of 2018, SCE&G has held ~~over X~~numerous meetings of the Lake and Land Management and Recreation RCG and Lake and Land Management TWC to discuss the details of the Project SMPs. The efforts of the TWC are reflected herein.

5.0 LAND USE CLASSIFICATIONS

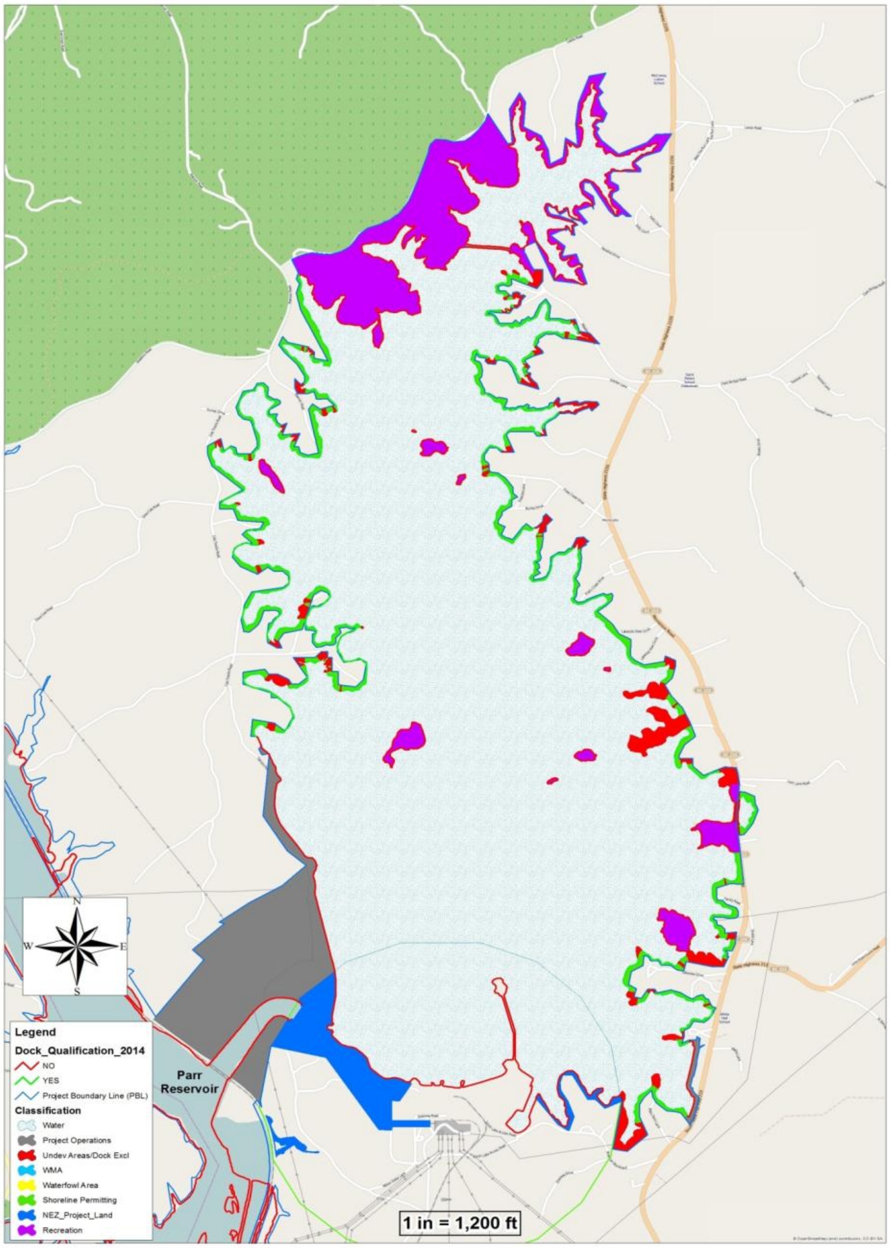
Five distinct land management classifications have been developed for the shorelines surrounding Monticello Reservoir. These land management classifications are as follows: Project Operations; Nuclear Exclusion Zone; Shoreline Permitting; Public Recreation; and, ~~Undeveloped Areas/Dock Exclusion~~Non-Development Areas. The Public Recreation Classification includes designated public recreation areas, the Recreation Lake, and all islands on Monticello Reservoir. Although SCE&G intends to manage its lands according to this classification system, the public generally will not be precluded from access to SCE&G-owned lands regardless of classification, with the exception of lands reserved and used for Project operations, lands/areas within the Nuclear Exclusion Zone, or other areas specifically protected from public access and posted as such. The sections below explain/define the land management classifications. The acreages and parcels for each of the classifications are provided in Table 5-1: ~~Table 5-1~~. Figure 5-1~~Figure 5-1~~ depicts their distribution around Monticello Reservoir.

TABLE 5-1: SHORELINE MILES AND ACREAGES BY LAND USE CLASSIFICATION

CLASSIFICATION	SHORELINE MILES	ACRES
Project Operation	2.47	457
Nuclear Exclusion Zone	5.43	184
Shoreline Permitting	21.46	238
Public Recreation*	18.73	895
~~Undeveloped Areas/Dock Exclusion~~Non-Development	8.14	145
Total	**56.23**	**1,919**

* - Includes the shoreline surrounding the Recreation Lake and all islands

FIGURE 5-1: SHORELINE CLASSIFICATIONS MAP FOR MONTICELLO RESERVOIR



5.1 Project Operations

Areas under this classification include SCE&G-owned and managed lands required for operation of the Fairfield Development. Public access to these lands is restricted to ensure public safety or to assure the security of the infrastructure system.

5.2 Nuclear Exclusion Zone

In addition to its use as part of the Fairfield Development, Monticello Reservoir provides cooling water for the V.C. Summer Nuclear Station located on its shore (authorized under 52 F.P.C. 537 [1974]). The Nuclear Exclusion Zone consists of the area surrounding the V.C. Summer Nuclear Station between the Project boundary line and shoreline and a specified area within Monticello Reservoir where SCE&G as the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property. This area is designated by warning signs on the landward side and by buoys on the lakeward side. Admittance to this area is restricted in order to comply with licensing requirements administered by the Nuclear Regulatory Commission.

5.3 Shoreline Permitting

It is the policy of SCE&G to authorize certain private uses of and/or acts within the ~~Buffer Zone~~Project boundary by permit when such uses or acts are consistent with the public interest and comply with the requirements of the Project License. Areas within the Shoreline Permitting Classification may be eligible for certain private residential or residential associations' uses upon approval by SCE&G. This does not include commercial activities.

5.4 Public Recreation

Project lands under this classification serve as recreational resources for the public and include areas managed expressly for recreation as well as those with recreation as a secondary usage. Public recreation lands include the following:

- Public boat launches, and other areas currently being managed as public access;
- Islands owned by SCE&G;
- Properties owned by SCE&G that are set aside for future recreational development.
- Recreation Lake
- ~~Wildlife Management Areas ("WMA") (Water Only)~~

Comment [b5]: Add sub-sections that discuss each of these bullets.

5.4.1 ISLANDS

There are 8 islands within Monticello Reservoir, all of which are available for public recreational use in accordance with authorized activities (see Permitting Handbook for authorized activities).

5.4.2 RECREATION LAKE

The Recreation Lake is located at the north end of Monticello Reservoir and is approximately 300 acres and 10 miles of shoreline. The Recreation Lake was constructed to provide stable water fisheries and recreation opportunities.

~~5.4.3 WILDLIFE MANAGEMENT AREA (WATER ONLY)~~

~~The waters of Monticello Reservoir, excluding the Recreation Lake, are included in the South Carolina Department of Natural Resources ("SCDNR") statewide WMA Program. These areas are open to the public for hunting or other recreational activities. The designation for WMA allows hunting on or in the water only and not on adjacent land. For additional information on these areas please visit the SCDNR website at http://dnr.sc.gov/wma/index.html.~~

5.5 NON-DEVELOPMENT ~~UNDEVELOPED AREAS/DOCK EXCLUSION~~ AREAS

~~Project lands under this classification are protected from private developmental uses. This is done for the protection of the environmental and aesthetic integrity of the shoreline.~~ Lands under this classification warrant special protection because they may provide important habitat, aesthetic values, or other significant Project characteristics.

Comment [WU6]: I think we should discuss clarifying the acreage associated with this classification. The table lists a total of 898 acres in recreation, but we know there are 6,800 acres of water in this classification(water only).

Comment [ACJ7]: I believe that include the water with the land classifications is a bit confusing. My suggestion is to move the WMA water discussion under Section 12.3 (Public Education and Outreach).

Comment [b8]: Make sure classisifcation is consistent throughout document.

6.0 LAND USE PRESCRIPTIONS

Land use prescriptions are based upon and reflect the guiding principles regarding the management of the SCE&G-owned lands within each classification. SCE&G publishes a detailed Permitting Handbook (included under separate cover) that contains descriptions of the permitting processes and specifications for various shoreline developments. Activities that require consultation with and/or permits from SCE&G include the following: construction, maintenance and placement of docks and boat lifts, shoreline stabilization; construction and maintenance of shoreline pathways, and other shoreline activities. Persons interested in shoreline development must contact SCE&G's Lake Management Department (803) 217-9221, or at https://www.sceg.com/about-us/lake-murray (see Lake Monticello Dock Permits Application), to obtain permitting guidance and a copy of the Permitting Handbook. Section 8.0 of this document discusses the Permitting Handbook in greater depth. General information regarding permitting requirements is included where applicable within the scope of each management prescription below.

Comment [ACJ9]: SCE&G is working on getting a webpage set up just for Monticello. Therefore the link will change.

6.1 PROJECT OPERATIONS

Properties classified as Project Operation contain project works critical to the operation of the Fairfield Development. Public access to, or activities upon, these lands is restricted for reasons of safety and security.

Comment [b10]: Check grammer

6.2 NUCLEAR EXCLUSION ZONE

Properties and waters classified as Nuclear Exclusion Zone contain project works/areas critical to the operation of the V.C. Summer Nuclear Station. Public access to, or activities within~~,~~ these lands is restricted for reasons of safety and security.

Comment [b11]: Check grammer

6.3 SHORELINE PERMITTING

Residential landowners whose property adjoins lands within the Shoreline Permitting classification may be eligible for access to Monticello Reservoir by a single meandering path and a dock/boat lift upon written consent from SCE&G's Lake Management Department through its permitting program. SCE&G may allow such structures within this classification, but strictly regulates their placement and construction. Shoreline stabilization and water withdrawal for

~~non-commercial agricultural/~~residential ~~landscaping~~ irrigation purposes are also acceptable permitted activities in this classification.

To address aspects of shoreline structures, SCE&G has developed permitting application procedures and associated dock specifications guidelines. These guidelines are detailed in SCE&G's Permitting Handbook.

6.4 PUBLIC RECREATION

Project lands devoted to public recreation include developed park sites, properties set aside for future recreational development, and islands on Monticello Reservoir owned by SCE&G. With the exception of the islands, which are maintained in their natural condition, SCE&G manages the areas based on the specific, designated recreational activities for each, including swimming, fishing, picnicking, and boat launching[5]. SCE&G developed and maintained access areas on Monticello Reservoir are depicted in Figure 12-1~~Figure 12-1~~. Private permitted activities, other than those noted under the Recreation Lake Section (Section 6.4.2) are excluded.

6.4.1 ISLANDS

SCE&G owns all of the islands on Monticello Reservoir and they are available for passive public recreational use, such as fishing, walking and bird watching. Hunting is prohibited on the islands.

Comment [b12]: Add footnote for definition of passive.

6.4.2 RECREATION LAKE

The park area at the Recreation Lake offers fishing, swimming and picnic facilities. Regulations for its use are posted at the park site. The swimming/beach area is closed October through March. The boat launch area is open every day, all year long. No private docks or boat ramps will be permitted on the shoreline of the Recreation Lake. Meandering paths and water withdrawals for residential irrigation only may be considered on a case-by-case basis.

~~6.4.3 WILDLIFE MANAGEMENT AREA (WATER ONLY)~~

Comment [ACJ13]: Suggestion to delete this section and move this wording down to Section 12.3

~~The waters of Monticello Reservoir are designated as a category II waterfowl management area and are available for public waterfowl hunting. Permitted activities are excluded from this classification. and wildlife management as part of the SCDNR statewide WMA Program. A South Carolina WMA permit is required, and These public hunting areas are shown on WMA~~

[5] The waters of Monticello Reservoir, excluding the Recreation Lake, are available for public waterfowl hunting as discussed under Section 12.3.

~~Maps available through the SCDNR.~~ ~~Permitted activities are excluded from this classification.~~ ~~A WMA permit is required to hunt in areas with this designation.~~ ~~Regulations pertaining to Monticello Reservoir are available at SCDNR's website at: http://dnr.sc.gov/wma/index.html, or by contacting SCDNR at:~~

~~Waterfowl and Hunting Regulations~~
~~S.C. Department of Natural Resources~~
~~Wildlife and Fresh Water Fisheries~~
~~1000 Assembly Street~~
~~Columbia, South Carolina 29201~~
~~Telephone: 803-734-3886~~

6.5 ~~UNDEVELOPED~~ NON-DEVELOPMENT AREAS ~~/DOCK EXCLUSION AREAS~~

~~Lands under this classification warrant special protection because they may provide important habitat or aesthetic values. Water withdrawals may be considered on a case-by-case basis. Private permitted activities, other than water withdrawals on a case-by-case basis, are excluded in this classification.~~ SCE&G will not permit private shoreline development for Project lands under this classification.

7.0 SHORELINE ACTIVITIES REQUIRING SCE&G APPROVAL

SCE&G maintains a strong commitment to managing the shoreline of Monticello Reservoir for multiple resources by considering the impact of various activities on the environmental, aesthetic, and recreational character of the lands. SCE&G owns and manages the ~~Buffer Zone~~Project lands around the entire periphery of Monticello Reservoir and the Recreation Lake. Thus, any activity occurring on the "shoreline" is occurring on SCE&G property. Any activity not in compliance with the shoreline activity parameters outlined in this SMP and in the Permitting Handbook constitutes a trespass which SCE&G may elect to prosecute.

7.1 AUTHORIZED ACTIVITIES REQUIRING APPROVAL THROUGH THE PERMITTING HANDBOOK

Only the following activities and structures may be permitted on Monticello Reservoir:

- Construction or modification to private docks and boat lifts;
- Construction of a meandering access path and associated vegetation removal;
- Shoreline stabilization methods (including rip-rap and bio-engineering);
- Water withdrawal ~~for non-commercial agricultural/landscaping irrigation purposes~~.

Comment [b14]: Remove boat lifts throughout document

Comment [b15]: Make this change to reference water withdrawal only throughout document

7.2 PROHIBITED STRUCTURES AND ACTIVITIES

Activities and structures that SCE&G does not allow include, but are not limited to, the following:

- Roofs or covers over docks;
- Boat slips;
- Jet skis;
- Water skiing;
- Boathouses;
- Fueling facilities on a dock;
- Private boat ramps;
- Mooring;
- Houseboats;
- Watercraft exceeding 30 feet in length;

- Watercraft with marine sanitation devices ("MSD")~~ are permitted on Monticello Reservoir~~;
- Excavations/dredging;
- Effluent discharges;
- Commercial marinas;
- Marine rails; ~~and,~~
- Sea walls~~.~~;
- Fences;
- Electrical service;
- Permanent structures other than permitted docks;
- Land-based structures, storage buildings, shelters, patios, gazebos, fences, swimming pools, satellite dishes, signs, storage of boats, camper trailers, canoes or other watercraft, motor homes or automobiles;
- Septic tanks and/or drain fields;
- Planting of grass except as a permitted erosion control measure;
- Storage or stockpiling of construction material;
- Vegetation removal of any type except in a permitted access path to the shoreline; and,
- Limbing or trimming of ~~Buffer Zone~~ vegetation within the Project boundary to create views or visual corridors.

8.0 PERMITTING PROCESS FOR SHORELINE ACTIVITIES OR STRUCTURES

8.1 ~~LAND MANAGEMENT CLASSIFICATION OF PROPOSED PROJECT LOCATION~~ (SECTION REMOVED FROM DRAFT)

8.2 ~~ALLOWABLE AND PROHIBITED FACILITIES AND USES FOR PROPOSED PROJECT LOCATION~~ (SECTION REMOVED FROM DRAFT)

8.3 SHORELINE PERMITTING PROCEDURES

Applicants must obtain the proper permit(s), per the SCE&G's Permitting Handbook, prior to the initiation of any construction or activity on the Monticello Reservoir shoreline, which consists of the lands ~~below the 425 foot contour interval and designated Buffer Zones~~within the Project boundary. As noted above, some activities may also require local, state, and/or federal permits

Whether a non-Project use is approved under the Standard Land Use article or through ~~prior~~ Project-specific FERC approval, SCE&G is responsible for ensuring that the use is consistent with the purposes of protecting or enhancing the scenic, recreational, and other environmental values of the Project. To assist applicants in the permitting process, the staff at the SCE&G Lake Management Department is available to answer questions regarding documentation, permits, and specification requirements for their particular project. Permits from SCE&G are required for the following activities:

- Construction of a meandering access path;
- Water withdrawal for ~~non-commercial agricultural/landscaping~~residential irrigation purposes.
- Installation/application of shoreline stabilization; and,
- Installation of private docks~~ and boat lifts~~.

It is highly advisable to begin the consultation process with SCE&G Lake Management staff at the planning stage of a project. SCE&G staff will be available to discuss specific permitting requirements with the property owner. Depending on the proposed new facility or activity, local, state and federal resource agencies may impose requirements on construction start/stop dates, the placement of erosion control devices, treatment plans, remedial measures, submittal of start construction notifications, and/or BMPs. Any permit applicant should be aware of such conditions, as violations may nullify a permit.

An overview of permitted activities is included below. Detailed information on SCE&G's permitting process, guidelines, and specifications, is provided in SCE&G's Permitting Handbook available at https://www.sceg.com/about-us/lake-murray, under Lake Monticello Dock Permits Application, or by calling (803) 217-9221), or by writing:

Comment [ACJ16]: Website will change to be more specific to Monticello

SCE&G Lake Management Department
6248 Bush River Road
Columbia, SC 29212

8.3.1 DOCKS ~~AND BOAT LIFTS~~

A permit must be obtained from SCE&G Lake Management Department for the construction, installation, replacement of, or addition to any dock ~~or boat lift~~ prior to the start of the activity. The configuration and location of a dock will be determined during a site visit by an SCE&G representative. At a minimum, dock construction and location must not create a nuisance, or otherwise be incompatible with overall Project recreation use. Impact on navigation or an adjoining property owner will be a strong determining factor. Size, length, or orientation may be restricted, or a permit may be denied if the dock would interfere with navigation or unreasonably impact an adjoining property owner. Dock length may vary depending on curvature or slope of the shoreline or lot line configuration. Any variance (i.e. increase in size or length) from guidelines included in the Permitting Handbook will be evaluated as to the effects on navigation, aesthetic value, or impact on adjacent properties and may be denied if in SCE&G's sole judgment the effects and impacts warrant denial. No dock will be permitted in narrow cove areas, which are defined to be areas where the distance across the water from one shoreline to the other at the 425-foot contour (normal high water level) is less than 200 feet. Only one dock will be permitted on a single-family lot[6]. Please see the Permitting Handbook for additional requirements.

[6] SCE&G does not guarantee usable water access to the waters of Monticello Reservoir at any time. Each lot along the shoreline will have different slopes and contours that will determine water depth in front of the lot. The Monticello Reservoir is a pumped storage project that can fluctuate vertically up to 4.5 feet over a 10 to 12 hour period during generation and pumping phases. The fluctuation of the reservoir will, at times, limit or restrict the use of most docks on the Monticello shoreline.

General boat dock design may involve either fixed or a combination of fixed and floating structures. Common docks are encouraged and may be mandated for all adjacent property owners as an alternative to individual docks and will be required on property with inadequate property line frontage (property line frontage requirements included in Permitting Handbook), or in such other circumstances that SCE&G deems appropriate. Dock layout ~~figures~~ specifications are included in the Permitting Handbook.

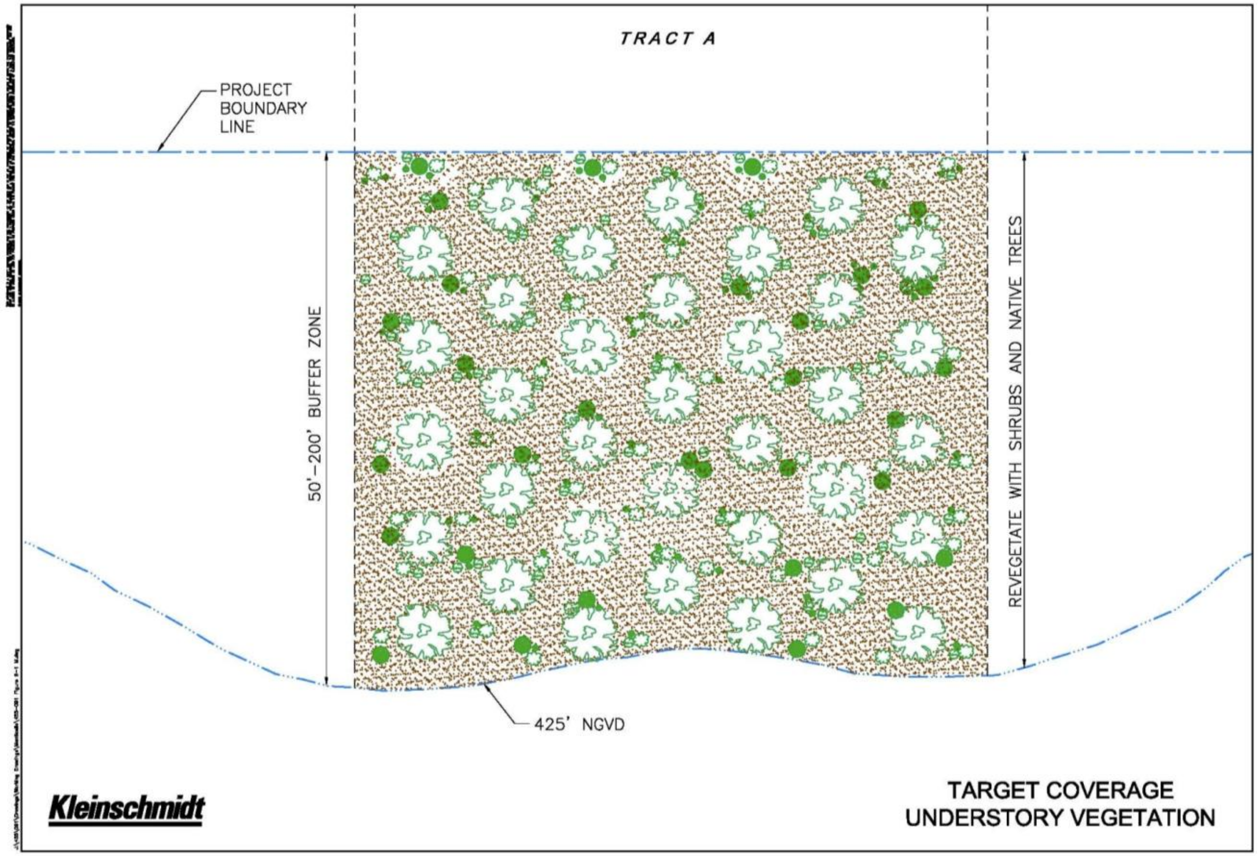
Docks generally will not be permitted on shoreline affected by significant erosion or steep slopes. Applicants may submit a request for approval accompanied by a plan to address ~~unless the applicant agrees to provide approved~~ shoreline erosion ~~control devices. This~~ that can ~~must~~ be accomplished without the clearing of vegetation or disturbance of shallow water habitat. ~~Even if these conditions are agreed to,~~However, SCE&G ~~may~~ reserves the right, in its sole discretion, to deny a permit ~~if, in its sole discretion, it determines that the installation of a dock at that location would present too much negative impact~~.

The types of docks permitted include private individual and private common docks. See Permitting Handbook for more details describing dock permitting policies.

8.3.2 Shoreline Vegetation Management

In general, SCE&G maintains a policy of non-disturbance of any vegetation ~~below the 425-foot contour or within a Buffer Zone~~within the Project boundary without approval from SCE&G. Permission to remove vegetation within a permitted access path will only be granted by SCE&G Lake Management after a site visit with the applicant. Once clearing of the access path is completed according to the permit, the applicant may maintain the site in the permitted condition. Any unauthorized removal of shoreline vegetation may result in the cancellation of the dock and other permits issued by SCE&G as well as legal action. Violators may be required to replant and restore the disturbed area with such plantings and/or shoreline manipulation as SCE&G determines is necessary to mitigate and correct the situation. SCE&G will review areas that are currently manicured, or that were previously pasture land, and will meet with the adjacent property owner to develop re-vegetation plans as appropriate. See Figure 8-1~~Figure 8-1~~ for an example of target coverage for understory vegetation.

FIGURE 8-1: EXAMPLE OF TARGET COVERAGE FOR UNDERSTORY VEGETATION IN DISTURBED AREAS



8.3.3 ACCESS PATH (NEW SECTION)

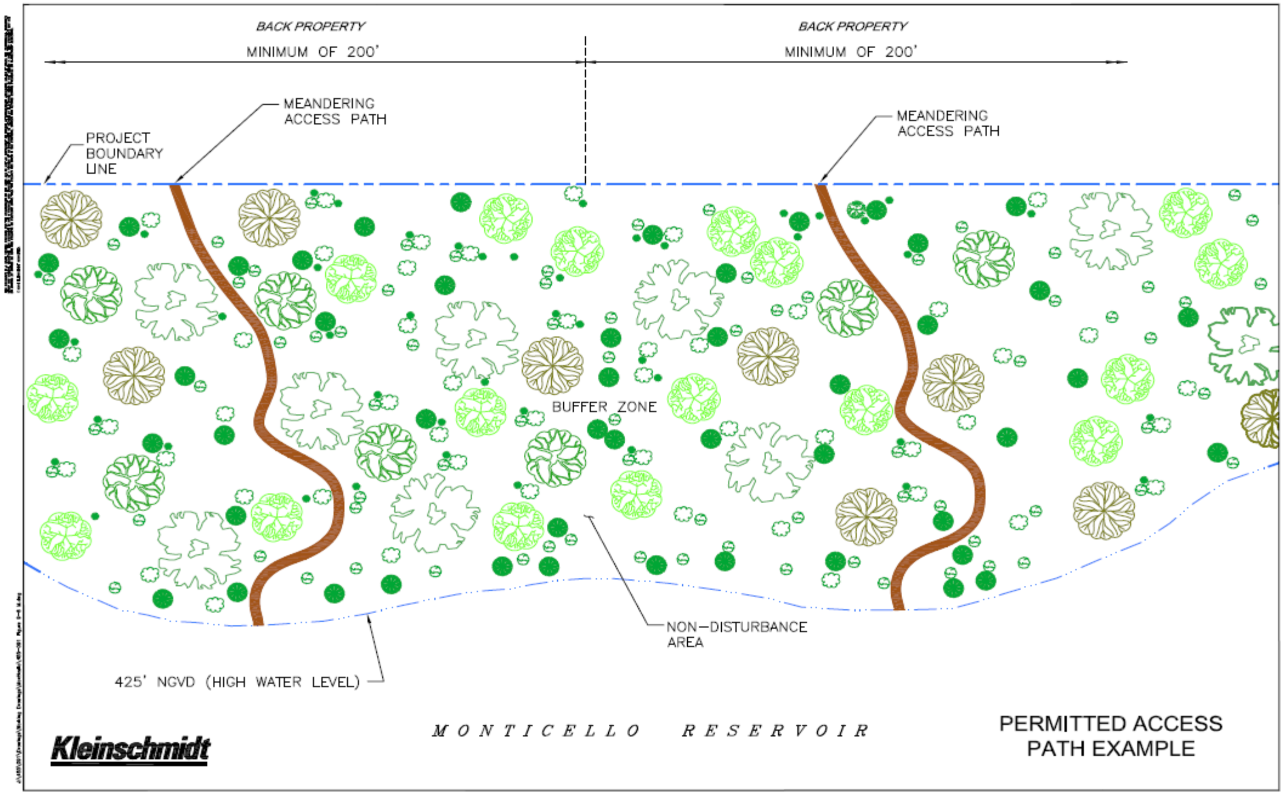
A single ~~pedestrian~~ access path may be cleared from the adjacent property owner's land upon approval of SCE&G. The access path must follow a meandering route to prevent erosion and to protect the aesthetics of the shoreline. No trees larger than 10-inches at breast height may be removed within the access path. A SCE&G Lake Management representative will identify and designate the location of all access paths. Access path restrictions are included in the Permitting Handbook. An example of a permitted access path is included as Figure 8-2~~Figure 8-2~~.

8.3.4 SHORELINE STABILIZATION

Shoreline erosion occurs in some areas where the reservoir shoreline is exposed to prolonged or recurrent wind and wave action. Such erosion, if significant enough, can lead to sedimentation in those areas of the reservoir, affecting aquatic habitats and drainage channels, stream channels, water intakes, and affecting the character of the reservoir in general. Provided it conforms to good engineering standards, as judged by it, SCE&G supports voluntary efforts to address shoreline erosion in the immediate area of docks or footpath access for adjacent property owners. To ensure that appropriate, effective techniques and materials are used, SCE&G monitors and controls erosion control projects on or directly affecting Project Property as detailed in the Permitting Handbook. Owners of property adjoining Project Property who wish to employ erosion control measures on or affecting Project Property must use SCE&G shoreline stabilization practices appropriate for the specific situation.

Because shoreline vegetation serves several important functions (i.e., soil integrity, wildlife habitat, water cleansing functions, and aesthetic value) SCE&G prefers to see employment of vegetative shoreline stabilization techniques to address soil erosion problems, whenever possible. These techniques may be referred to as bioengineering, and consist of installing living plant material as a main component in controlling problems of land instability. Plants used should consist of native species that, ideally, have been collected in the immediate vicinity of a project site to ensure that they are well-adapted to site conditions. The ultimate goal in using bioengineering techniques is to establish diverse plant communities to stabilize erosion prone areas through development of a vegetative cover and a reinforcing root matrix.

FIGURE 8-2: PERMITTED ACCESS PATH



Bioengineering techniques are least effective at sites with significant and prolonged exposure to strong currents or wind-generated waves. Stabilization of areas experiencing strong erosion pressure may also require the use of structural erosion control methods such as rip-rap. Areas with high-gradient banks or those in advanced stages of erosion may also benefit from such structural components. The optimal solution at a given location often involves combinations of techniques providing both structural and environmental benefits to the shoreline. A variety of bioengineering methodologies and devices are available to address erosion. Illustrations of erosion control designs that utilize both vegetation and structural elements are provided in Figure 8-3~~Figure 8-3~~ and Figure 8-4~~Figure 8-4~~. As depicted in the figures, rip rap can provide immediate shoreline stability, thereby enabling plantings to become established to add root-based soil integrity. Optimal erosion control designs must account for site specific slope and erosion pressure as well as homeowner/landowner preferences. Figure 8-5~~Figure 8-5~~ illustrates a site at which SCE&G's general guidance on using rip rap is followed. Bricks, blocks, tires, or materials other than rip-rap are prohibited as alternative shoreline stabilization material. SCE&G's Lake Management Department is available to provide the benefit of its knowledge and experience to help homeowners attempting to select the design right for them and the Reservoir environment.

FIGURE 8-3: EXAMPLES OF SHORELINE EROSION CONTROL DESIGNS UTILIZING BIOENGINEERING AND STRUCTURAL TECHNOLOGIES (A)

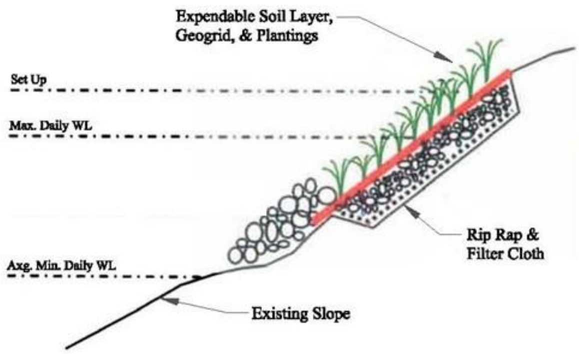


FIGURE 8-4: EXAMPLES OF SHORELINE EROSION CONTROL DESIGNS UTILIZING BIOENGINEERING AND STRUCTURAL TECHNOLOGIES (B)

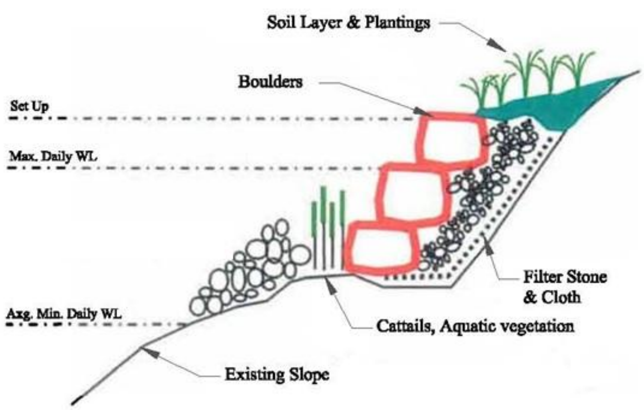
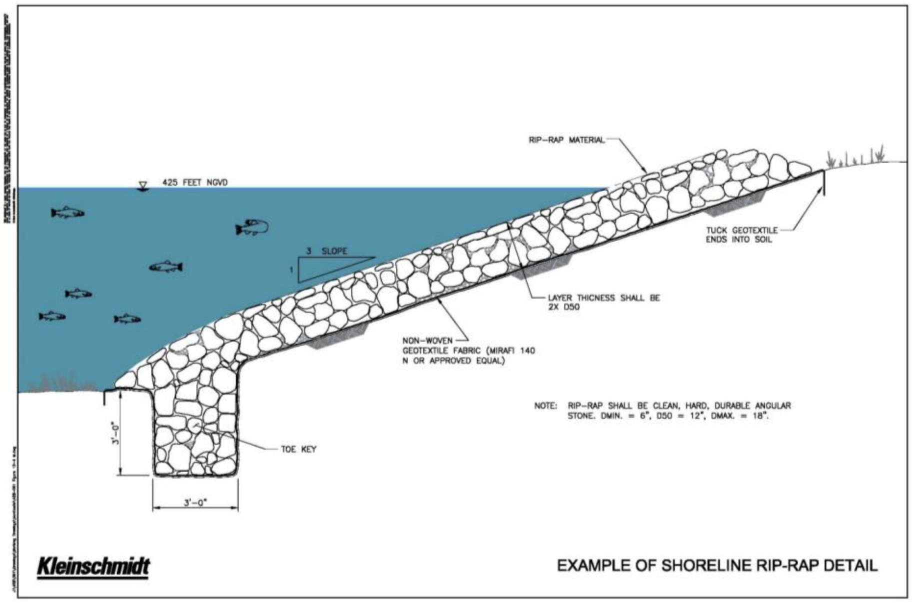


FIGURE 8-5: EXAMPLE OF SHORELINE RIP-RAP DETAIL



8.3.5 WATER WITHDRAWAL

~~Commercial and residential water~~ Water withdrawals requiring piping and other transportation/delivery equipment to be placed along the shoreline or in the littoral zone, are managed according to the terms of this SMP. Water withdrawal for residential property must be for irrigation purposes only. Permits are required, and will not be issued for any other purpose. Associated pumps and electrical service must be located outside SCE&G property. SCE&G reserves the right to prohibit withdrawal during times of drought or water drawdown.

Applications for a ~~commercial~~ permit to remove water must be submitted to SCE&G for review. ~~Large commercial water~~ Water withdrawal applications for greater than one million gallons per day (MGD) will be forwarded to the FERC for approval. Requests for withdrawal of one MGD or less may require agency consultation prior to approval. SCE&G may impose limits in granting permits for approved applications (see Permitting Handbook). The applicant may be required to bear the expenses of filing the application and will be required to compensate SCE&G for water withdrawn.

9.0 SCE&G PERMITTING FEE POLICIES

FERC allows licensees the right to charge reasonable fees to cover the costs of administering shoreline management programs, which add management responsibilities and associated costs to project operations. SCE&G administers its SMP in part through a permitting program, which does include a fee component. This ensures that activities occurring within the Project and in particular on Project land, are consistent with the overall goals for the Project, and that SCE&G's customers are not burdened with the full cost of administering programs that also have significant private, and often non-customer, benefit. Permit fees are due with applications and are required for docks, ~~boat lifts,~~ access paths, water withdrawal, and erosion control projects. Should an application be denied, associated permit fees will be returned. Periodic permit renewal fees may be required depending on the shoreline activity. ~~One-time and periodic permit~~ Permit fees for Monticello Reservoir shoreline activities are detailed in the Permitting Handbook. Failure to comply with this policy may result in, among other things, revocation of existing permits, fines, or legal action, as well as loss of consideration for future permits.

SCE&G will give reasonable public notice through appropriate communication avenues before changing the fee structure.

10.0 ENFORCEMENT OF SHORELINE MANAGEMENT PLAN

10.1 VIOLATIONS OF SHORELINE MANAGEMENT PLAN

SCE&G conducts periodic surveys of the Monticello Reservoir shoreline to inventory and inspect docks, ~~boat lifts,~~ access paths, and shoreline erosion control structures/projects. Lake Management representatives make note of unauthorized structures that they see, as well as urging residents and Reservoir visitors to report anything they believe to be unauthorized activity ~~below the 425-foot contour or within Buffer Zones~~within the Project boundary. Anyone believing that an activity violating the SMP is occurring is urged to contact SCE&G Lake Management at (803) 217-9221.

SCE&G Lake Management representatives will issue Stop Work Directives and/or Trespass Notices for any violations detected on SCE&G property. Any unauthorized clearing of trees or underbrush may result in the revocation of responsible parties' dock permits within 30 days if the violation(s) is (are) not corrected or a course of and schedule for corrective action has not been agreed to and approved by SCE&G. SCE&G may also commence legal action, if it deems it necessary, to require re-vegetation of the affected area. Removal of merchantable timber will require reimbursement to SCE&G subject to valuation of the Forestry Operations Department, including legally allowable "penalties." Consequences for violations may also include restrictions of access to SCE&G property, legal actions, fines, and loss of consideration for future permits.

11.0 SHORELINE MANAGEMENT PRACTICES

11.1 SCE&G SHORELINE MANAGEMENT PRACTICES

~~In addition to development activities, the environment around Monticello Reservoir is susceptible to impacts associated with residential and recreational activities. These include, for example only, improper fertilizer/pesticide use, boat maintenance, and debris disposal. Adjacent property owners can mitigate negative impacts otherwise associated with their property uses and instead make significant positive contributions to the Reservoir environment, and ultimately the watershed, by employing BMPs that preserve bank integrity and minimize non-point sources of pollution and contamination. Adjacent property owners should understand that using BMPs will help to preserve the scenic, environmental, and recreational qualities of the Reservoir that they so highly value. Examples of effective BMPs recommended to adjacent property owners are provided in the succeeding sections. SCE&G is available to provide more information and to assist landowners in determining effective BMPs for activities on their properties. Also, anyone may contact the Natural Resource Conservation Service or local county extension office (http://www.sc.nrcs.usda.gov/contact/).~~ SCE&G has established a set of management practices that apply to all of the lands included in the Project ~~B~~boundary. These practices are reflective of each of their developments unique qualities. The ~~current~~ management practices for the Fairfield Development (which includes Monticello Reservoir) ~~are~~ described ~~in this section~~herein, ~~but~~ may be reviewed and revised periodically during the period of the FERC license.

Comment [b17]: Define Project boundary earlier in the document.

11.1.1 FOREST MANAGEMENT SHORELINE MANAGEMENT PRACTICES (SECTION REMOVED FROM DRAFT)

Comment [b18]: Add back in as we do forest management within the PBL

11.1.2 ~~SHORELINE PERMITTING PROGRAM~~ (REMOVED, DISCUSSED IN SECTION 8.0)

11.1.3 SHORELINE STABILIZATION AND VEGETATION MANAGEMENT (REMOVED, DISCUSSED IN SECTION 8.0)

11.1.4 AQUATIC PLANT MANAGEMENT ACTIVITIES

Some species of aquatic plants can become significant nuisances to recreation and Project operations should their populations not be controlled. Some of the common problem species that may be found in Monticello Reservoir include hydrilla, water primrose, and several species of pondweed. When managing invasive and exotic aquatic plants it is important to also protect the aquatic ecosystems and fish habitat. This requires the integration and use of specific BMPs appropriate to the regional and local conditions.

SCE&G's Lake Management Department, in cooperation with the South Carolina Aquatic Plant Management Council, manages the Aquatic Weed Program on Monticello Reservoir. Because some aquatic weed control techniques can harm fish and native plant species if improperly used, it is unlawful, per state and federal regulations, for individuals to spray or treat aquatic growth in the waters of Monticello Reservoir. SCE&G joins with SCDNR to ask that any aquatic vegetation problems recognized by Reservoir visitors or adjacent property owners be reported to SCE&G's Lake Management Department and the SCDNR. In addition, to help curb the spread of invasive aquatic species, SCE&G joins with SCDNR to ask that Reservoir visitors examine their boats and trailers and remove all vegetation from boats and trailers before placing them into the waters of Monticello Reservoir and after removing them from Monticello Reservoir. This plea and advice also applies to every body of water in the State.

Comment [b19]: Explore options used by SCE&G to control aquatic plants. SCE&G prohibits spraying herbicides on Monticello.

Comment [b20]: Add link to SCDNR website For aquatic plant management

11.1.5 WOODY DEBRIS & STUMP MANAGEMENT (NEW SECTION)

Monticello Reservoir does not have a significant source of woody debris. ~~To the extent that w~~Woody debris and stump management ~~becomes an issue, it is~~are discussed in the Permitting Handbook.

11.2 LANDOWNER RECOMMENDED BMPS (NEW SECTION)

In addition to development activities, the environment around Monticello Reservoir is susceptible to impacts associated with residential and recreational activities. These include, for example only, improper fertilizer/pesticide use, boat maintenance, and debris disposal. Adjacent property owners can mitigate negative impacts otherwise associated with their property uses and instead make significant positive contributions to the Reservoir environment, and ultimately the watershed, by employing BMPs that preserve bank integrity and minimize non-point sources of pollution and contamination. Adjacent property owners should understand that using BMPs will help to preserve the scenic, environmental, and recreational qualities of the reservoir that they so highly value. Examples of effective BMPs recommended to adjacent property owners are provided in the succeeding section. SCE&G is available to provide more information and to assist landowners in determining effective BMPs for activities on their properties. Also, anyone may contact the Natural Resource Conservation Service or local county extension office (http://www.sc.nrcs.usda.gov/contact/).

11.2.1 MINIMIZING NON-POINT SOURCE POLLUTION (NEW SECTION)

Reservoir pollution may result from a variety of activities related to residential development, agriculture, forestry, and construction. Contaminants may enter the reservoir and tributaries via overland flows carrying biological, chemical, and other substances picked up and carried by runoff from rain events. This runoff water may contain sediment, bacteria, oil, grease, detergents pesticides, fungicides, fertilizers, and other pollutants. These pollutants, depending on type, quantities, and concentrations can overwhelm a reservoir's natural ability to filter and process them ~~to at least a neutral or *de minimis* impact~~, thus leading to degraded water quality and aquatic environments.

Although a single point of impact or action may seem insignificant in its effect on the reservoir, the cumulative effects of the resource may be considerable. With this in mind, SCE&G encourages adjacent land owners to be mindful that they are members of a larger community that uses and impacts the reservoir. Employing the following BMPs can go a long way in preserving and improving reservoir water quality:

- Use permeable paving materials and reduce the area of impervious surfaces, particularly driveways, sidewalks, walkways, and parking areas;
- Dispose of vehicle fluids, paints, and/or household chemicals as indicated on their respective labels and do not deposit these products into storm drains, project waters, or onto the ground;
- Use soap sparingly when washing vehicles and wash them on a grassy areas , preferably sloping gently away from the reservoir, so the ground can filter the water naturally;
- Use hose nozzles with triggers to save water and dispose of used soapy water in sinks or other vessels that direct the materials into sewer systems, not in the street;
- Maintain septic tanks and drain fields according to the guidelines and/or regulations established by appropriate regulatory authorities;
- Remove and dispose of pet waste properly in areas that do not drain to the reservoir; and

- Use only low or no phosphorous fertilizer on lawns near the reservoir.

12.0 PUBLIC EDUCATION AND OUTREACH

This SMP is intended to foster management of shoreline use and development to achieve consistency with the FERC License, as well as to promote protection of public safety and environmental quality (water quality, natural habitat, aesthetics, etc.). To garner support and compliance from the public and lake users, it is key to educate them to the need and means to protect shoreline resources. Additionally, the public must be aware of the management and permitting programs put in place to provide this protection. To accomplish the task of increasing public awareness of the goals and objectives of this SMP SCE&G has developed an education and outreach program that includes the components described below.

12.1 SHORELINE MANAGEMENT PLAN EDUCATION

SCE&G's Public Education and Outreach program seeks to educate the public on various aspects of the management of Monticello Reservoir, including the Permitting Handbook, recommended BMP use, relevant Project Operations information, and the Safety Program. To accomplish this, SCE&G uses various public education measures including informational pamphlets, public meetings, newsletters, and an internet webpage.

The Internet, in particular, presents an excellent mechanism for disseminating information and improving awareness. SCE&G maintains a website designed to provide information on the SMP and the Permitting Handbook. Printed copies of the following materials may also be obtained by contacting SCE&G Lake Management at (803) 217-9221. Information and materials that will be available at the website include the following:

- Permitting Handbook;
- Permit application forms;
- Examples and information on BMPs;
- Alternative and example designs for shoreline stabilization; and
- Useful links and other related information.

Additional outreach mechanisms that SCE&G intends to employ in implementing the SMP include the following:

- Provide speakers for homeowner and other organizations' meetings;
- Provide information to realtors and encourage dissemination of this information to all potential Reservoir shoreline back-property buyers; and
- Develop and distribute new, "user friendly" brochures that include general reservoir information, permitting processes, shoreline BMPs, and relevant contact information.

12.2 PUBLIC ACCESS AREA MAPS

A figure depicting existing and future Public Access Areas on Monticello Reservoir is included as Figure 12-1~~Figure 12-1~~.

12.3 WILDLIFE MANAGEMENT AREAS/WATERFOWL ONLY

The waters of Monticello Reservoir, excluding the Recreation Lake, are designated as a ~~category II~~ waterfowl management area and are available for public waterfowl hunting. The designation for waterfowl management allows hunting on or in the water only and not on adjacent land. A South Carolina Wildlife Management Area (WMA) permit is required ~~is required~~ to hunt in areas with this designation. Regulations pertaining to Monticello Reservoir are available at SCDNR's website at: http://dnr.sc.gov/wma/index.html, or by contacting SCDNR at:

Waterfowl and Hunting Regulations
S.C. Department of Natural Resources
Wildlife and Fresh Water Fisheries
1000 Assembly Street
Columbia, South Carolina 29201
Telephone: 803-734-3886

~~12.3~~12.4 WATER SAFETY ~~PROGRAMS~~

Due to operation of the pumped storage generating plant, the waters of Monticello Reservoir can fluctuate several feet in a matter of a few hours. This rapid fluctuation makes it especially important for boaters and other recreationists to exercise a high degree of care and fully assume personal responsibility for their safety by being especially aware and cautious. For public safety, hazardous areas which are marked should not be entered and any other warnings posted around the reservoir should be observed as well.

SCE&G and SCDNR cooperate to mark shoals and other hazardous areas to increase boating safety. However, boaters should not assume all shoals and hazardous areas have been marked.

Comment [ACJ21]: I took the wording from the Classification and Prescription Sections above and meshed it into the following wording with SCDNR's suggestions.

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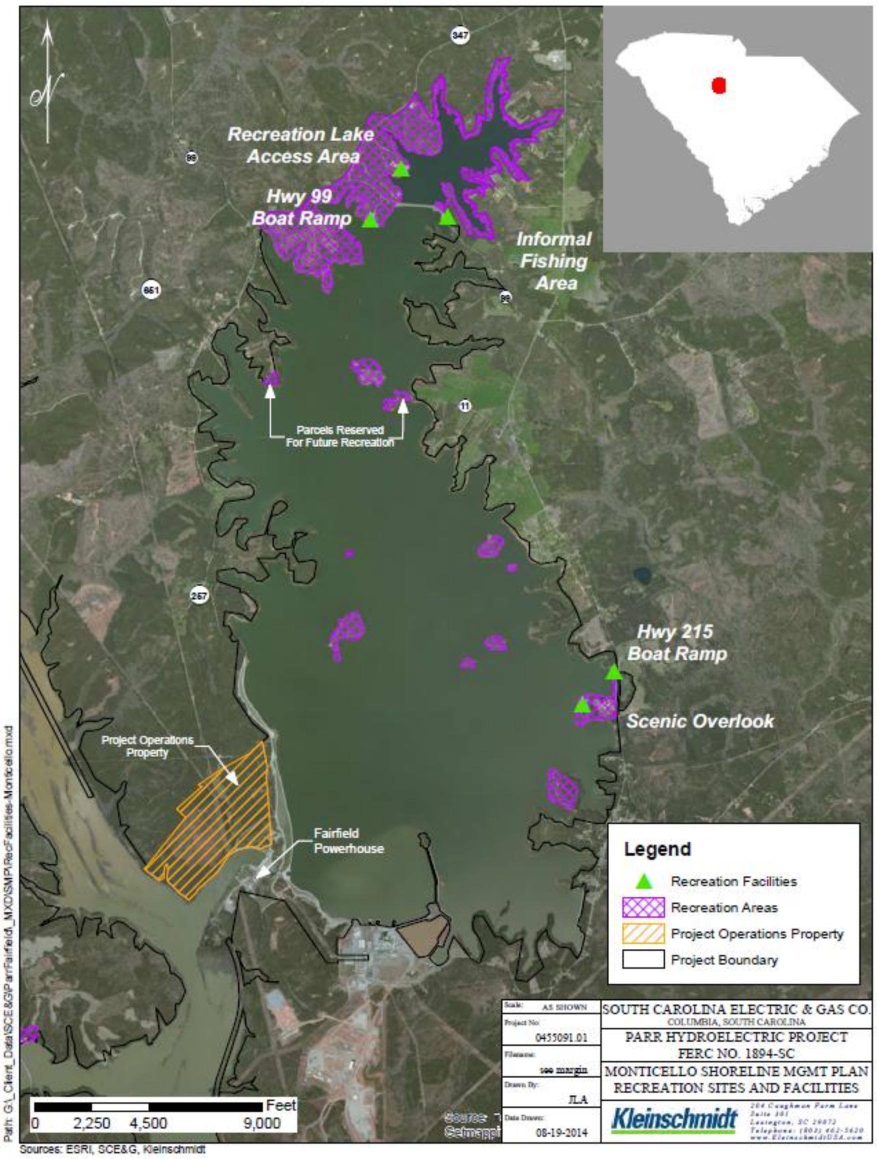
SCDNR also enforces the boating laws of South Carolina. Boaters should ensure that watercraft and safety equipment are in good working condition and in compliance with all applicable state laws. ~~The boating laws of South Carolina are enforced by SCDNR. Boaters and sportsmen should be aware of dangerous areas which are marked and for public safety should not be entered. Other warnings are posted around the reservoir and should be observed as well. Due to operation of the pumped storage generating plant, the waters of Monticello Reservoir can fluctuate several feet in a matter of a few hours. This rapid fluctuation makes it especially important for boaters and other recreationists to exercise a high degree~~ of ~~care and fully assume personal responsibility for their safety by being especially aware and cautious. Shoals and hazardous areas are marked by the SCDNR to increase boating safetyto create a safer boating environment. However, it must not be assumed that every potentially dangerous shoal and hazardous area has been marked.~~

FIGURE 12-1: MONTICELLO RESERVOIR PUBLIC ACCESS AREA MAP



Comment [b22]: Get new map to remove recreation area upstream of Highway 34. This should not be recreation.

Change all references of Undeveloped to Non-Developed.

Update map to be consistent with SCE&G maps.

Color in waterfowl areas instead of using a triangle .

13.0 MONITORING AND REVIEW PROCESS

13.1 OVERALL LAND USE MONITORING

As demographics and user groups change within the Project area, changes in residential and commercial areas may occur. Often this type of use change is incremental and cumulative, occurring over a period of years or decades. To monitor land use around Monticello Reservoir, SCE&G will employ a geographic information system (GIS) to compare new and existing permit applications against GIS data for the land management classifications. Such monitoring will provide long-term data that should be useful in identifying areas experiencing change. Every 10 years, during the SMP review process (see Section 13.2 on Review Process below), SCE&G will report on changes in land use for the various land management classifications~~ in addition to filing Form 80 surveys~~. If it is found that material changes within the Project boundary have occurred that are not consistent with the current SMP goals, amendments to the SMP may be warranted. Such situations might include significant changes in land ownership, major commercial upgrades or uses, or new residential uses or pressures.

13.2 REVIEW PROCESS

SCE&G proposes a 10 year SMP review cycle interval. A 10 year SMP review period interval should provide reasonable opportunities for SCE&G, in concert with governmental, non-governmental, and individual stakeholders, periodically and deliberately to assess new issues that arise as a result of development around the Reservoir, and allow for analyses of cumulative effects. The SMP review process will begin sufficiently in advance of the end of each period so that it will be completed within the 10 year time frame. One month prior to the scheduled start of the review process, its occurrence will be advertised in various media formats (e.g., web site, newsletter, contact with homeowner associations, etc.). SCE&G will use those same media avenues to issue a report on the outcome of the review process. As in the past, SCE&G will solicit input from interested parties in addressing issues that arise and have a bearing on Reservoir management. This includes keeping lines of communication open during the time between review periods. Concurrently with the FERC SMP review process, SCE&G will review the Permitting Handbook periodically with interested stakeholders to ensure its effectiveness; however, changes to the permitting process may be made, as needed, outside of the scheduled review periods.

14.0 REFERENCES

Federal Power Commission (F.P.C.). 1974. Order Issuing New License for the Parr Hydroelectric Project. August 28, 1974. 52 F.P.C. 537.

Federal Energy Regulatory Commission (FERC). 2012. Guidance for Shoreline Management Planning at Hydropower Projects. Online. [URL]: http://www.ferc.gov/industries/hydropower/gen-info/guidelines/smpbook.pdf.

Federal Energy Regulatory Commission (FERC). 2001. Order Approving Land use and Shoreline Management Plan. June 4, 2001. 95 FERC ¶ 61,351.

SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

September 2014

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

EXECUTIVE SUMMARY

South Carolina Electric & Gas Company ("SCE&G") is the Licensee of the Parr Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 1894) ("Project"). The Project consists of the Parr Shoals Development and the Fairfield Pumped Storage Development. The developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project developments form two distinct Project reservoirs. Parr Reservoir is located along the Broad River, as impounded by Parr Dam, and functions as the lower reservoir for the Fairfield Development. Monticello Reservoir is located adjacent to the Broad River and functions as the upper reservoir for the Fairfield Development. Both Project reservoirs serve as popular recreation destinations and are used and enjoyed by local residents as well as visitors to the state.

In conjunction with its relicensing activities, SCE&G has assembled a diverse and inclusive group of stakeholders to advise and assist in the development of two Shoreline Management Plans ("SMPs"), each tailored to a specific reservoir. SMPs are comprehensive plans for the management of Project land and adjoining water resources and their uses, consistent with License requirements and broad Project purposes, and appropriately accessible and beneficial to adjacent shoreline residents and the recreating public. A SMP serves to identify existing and appropriate future uses and to provide plans and programs for responsible future use and management of project lands and waters as well as the flora and fauna encompassed within them. This SMP exists specifically to address shoreline uses surrounding Parr Reservoir. A SMP to address Monticello Reservoir is included under separate cover and is available from the SCE&G Lake Management Department (Lake Management).

In addition to a SMP for each Project reservoir, a Shoreline Management Handbook and Permitting Guidelines (Permitting Handbook) was developed for both developments in consultation with governmental, non-governmental, and individual stakeholders to address activities that will require consultation with and/or permits from SCE&G. These activities include construction, maintenance, and placement of docks on Monticello Reservoir, shoreline stabilization, lake access pathways and other shoreline activities.

The classification of ~~P~~project lands surrounding Parr Reservoir is described in Section 5.0 and includes four management classifications. These classifications are as follows: Project Operations; Public Recreation; Waterfowl Areas; and, Undeveloped Areas. Public Recreation land includes land within SCE&G developed recreation areas~~, waterfowl hunting areas,~~ and islands that are owned by SCE&G. Undeveloped areas are areas protected from development to preserve the environmental resources and aesthetic values. Lands reserved for Project operations are those lands that are specifically required for operation of the Project. They include areas such as plant facility locations, dams, electrical substations, etc. Land use prescriptions associated with these land management classifications are discussed in further detail in Section 6.0. Prescriptions are administered through the Permitting Handbook.

SCE&G maintains a strong commitment to the management of the waters and shoreline of Parr Reservoir, focusing on the social, ecological, and economic impacts of activities on and near the shoreline and water, taking into consideration in particular the environmental, aesthetic, and recreational character of the shoreline and lake. Section 7.0 details the activities and structures on and adjacent to Parr Reservoir that require SCE&G consultation and/or approval. The permitting procedures for shoreline activities or structures are set out in more detail in Section 8.0 and in the Permitting Handbook.

Section 9.0 details SCE&G's fee structure for the shoreline management program. Such fees can be one-time or periodic.

Periodic surveys of the Parr Reservoir shoreline are conducted by SCE&G and include, among other things, inventories of unauthorized structures. These represent violations of the SMP. SMP violations will be dealt with as deemed by SCE&G, in its sole discretion, to be appropriate. Consequences of violations may range from required removal of unauthorized structure, fines, and/or legal action, and are discussed more fully in Section 10.0.

SCE&G Shoreline Management Practices include actions taken to lessen or mitigate for potential impacts to a particular resource resulting from its direct or indirect use. These include but may not be limited to landowner Best Management Practices ("BMP"). Shoreline Management Practices are further described in Section 11.0 of this document.

Public education and outreach on the protection of valuable shoreline resources is integral to the effectiveness of the SMP. Section 12.0 of this document details specific measures to be undertaken to help educate both adjacent shoreline residents and other Project resource users. Among included objectives will be SMP education and BMP education.

In its Application for New License, SCE&G is proposing 10 year review periods for the SMP. The 10 year SMP review periods provide reasonable opportunities for SCE&G, in concert with governmental, non-governmental, and individual stakeholders, periodically and deliberately to assess new issues that arise as a result of development around the Reservoir, and allow for analyses of cumulative effects. Concurrently with the FERC SMP review process, SCE&G will review the Permitting Handbook with interested stakeholders periodically to ensure its effectiveness; however, changes to the permitting process may be made as it deems necessary and appropriate. This is discussed in Section 13.0.

1.0 INTRODUCTION

The Parr Hydroelectric Project ("Project") is located on the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1-1~~Figure 1-1~~). The Project is located approximately 31 river miles downstream of the Neal Shoals Hydroelectric Project (Federal Energy Regulatory Commission ["FERC" or "Commission"] No. 2315) and 24 river miles upstream of the Columbia Diversion Dam. The Project consists of two developments: the Parr Shoals Development ("Parr Development") and the Fairfield Pumped Storage Development ("Fairfield Development"). Subsequently, two reservoirs are included as part of the Project, Monticello Reservoir[1] and Parr Reservoir. The normal maximum water level in Monticello Reservoir is El. 425.0 feet National Geodetic Vertical Datum ("NGVD"), which corresponds to a surface area of 6,800 acres~~ feet~~, and a gross storage of 400,000 acre-feet. Monticello Reservoir has approximately ~~54~~ 56 miles of shoreline within the Project boundary[2]. Parr Reservoir's normal maximum water level is at El. 266.0 feet NGVD, with a corresponding surface area of 4,400 acres. The gross storage is estimated to be 32,000 acre-feet. Parr Reservoir has 94 miles of shoreline within the Project boundary.

Comment [b1]: Revise to FERC throughout document. Remove "Commission" from rest of document.

An active storage of up to 29,000 acre-feet is transferred between the two reservoirs by the pumped storage operations of the Fairfield Development. Fairfield Development's alternate cycles of generation and pumping results in daily fluctuations in the water levels of both Monticello and Parr Reservoirs. Monticello, when beginning at normal maximum pool elevation, drops 4.5 to 5 feet over a 10 to 12 hour period during the generating phase of operation. At the same time, the water from Monticello and from the Broad River is flowing into Parr Reservoir, causing it to rise as much as 10 feet. During the pumping cycle, the reverse occurs - the water level rises in Monticello Reservoir and drops in Parr Reservoir.

The Project boundary encompasses land around each reservoir, extending between 50 and 200 horizontal feet from the high water mark. South Carolina Electric & Gas Company ("SCE&G") manages SCE&G-owned lands within the Project boundary to comply with the FERC License

[1] The State of South Carolina considers Monticello Reservoir waters of the State and refers to it as "Lake Monticello".

[2] Standard License Article 5 requires licensees to acquire and retain sufficient property and rights to construct, maintain, and operate their projects, as identified in their specific license, including any property or rights needed to accomplish all designated project purposes. As such, Project lands are those lands within the FERC project boundary owned by SCE&G in fee title and those lands for which SCE&G has acquired or retained an easement.

for the Project (the "Licensee"). The goal of project land management is to serve the public interest by providing recreational access and opportunities, protecting wildlife habitat and water quality, producing electricity, and protecting and preserving cultural and aesthetic resources. The Shoreline Management Plan ("SMP") provides a set of administrative policies, procedures, and practices by which SCE&G seeks to manage the Project shoreline to achieve these goals. Future proposals for specific shoreline related developments or activities will be reviewed for consistency with the SMP.

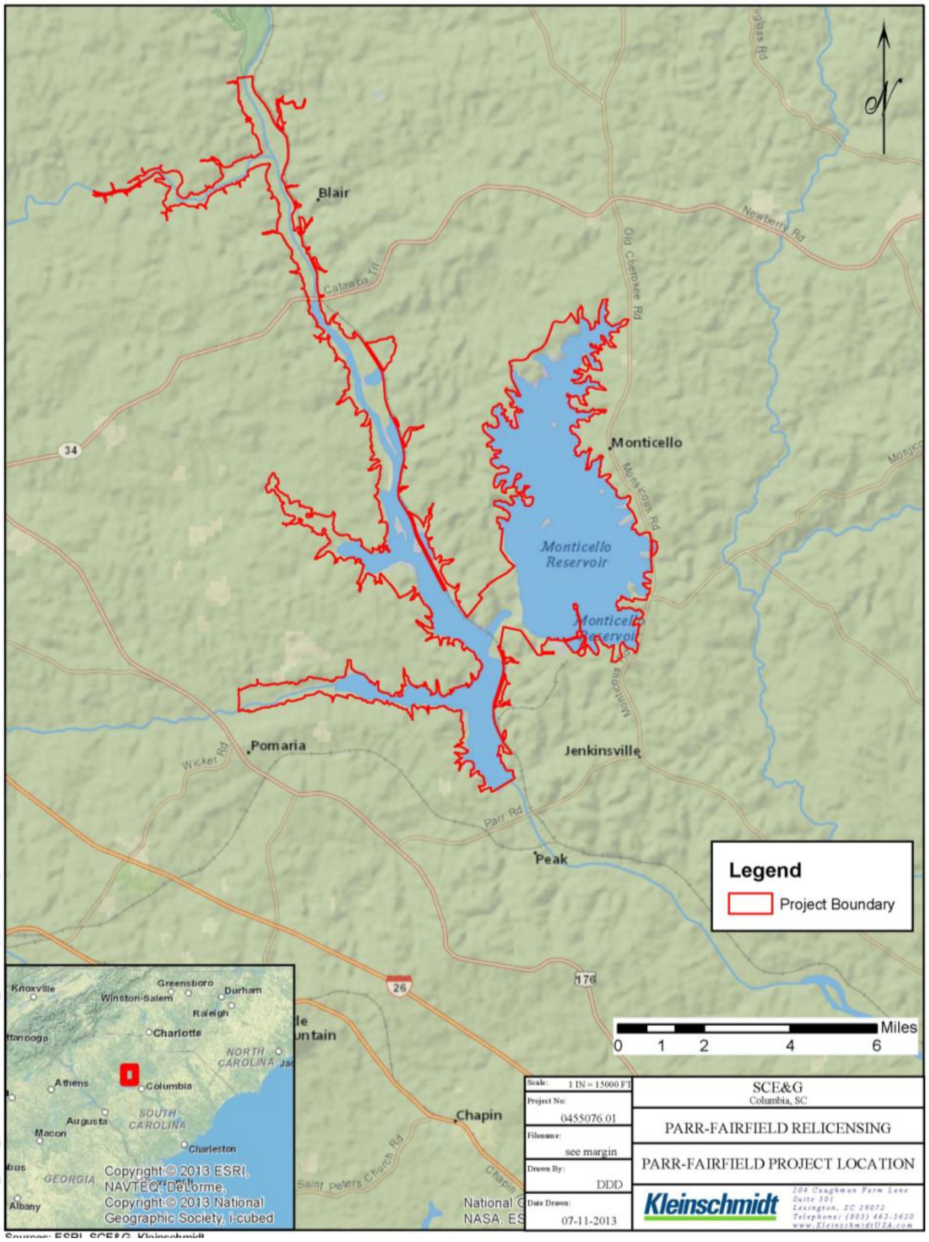
A draft of the initial Project SMP was filed with the ~~Commission~~ FERC in 1991. After several years of discussion and revisions, the initial SMP was approved by the ~~Commission~~ FERC on June 4, 2001. The history of the Project's SMP is described in more detail in Section 3.0 (History of the Shoreline Management Plan). The current relicensing[3] of the Project provides a near term impetus and opportunity for SCE&G to review the existing SMP in cooperation with relicensing stakeholders, including federal and state regulatory agencies, interested non-governmental organizations ("NGO"s), and individuals. Through discussions with these parties, it was decided that the existing FERC approved SMP, which encompasses both Parr and Monticello Reservoirs, should be divided into two distinct SMP's, one for each reservoir. Hence, this SMP has been prepared for Parr Reservoir and is being submitted to FERC as part of SCE&G's Parr Hydroelectric Project comprehensive relicensing package. A SMP for Monticello Reservoir is included under separate cover.

The management guidelines set forth in this SMP are applicable to all lands within the Project boundary surrounding Parr Reservoir. Among other things, the current document includes the following components:

- Detailed descriptions, management prescriptions and mapping of land classifications;
- Summary information on the Permitting Handbook and fee policies;
- Best management practices ("BMP"s);
- Public education and outreach;
- Reservoir monitoring; and,
- A proposed review process.

[3] The current operating License for the Project is due to expire on June 30, 2020. As such, SCE&G will file for a new License with FERC on or before June 30, 2018.

FIGURE 1-1: PROJECT LOCATION AND BOUNDARY MAP



2.0 PURPOSE AND SCOPE OF THE SHORELINE MANAGEMENT PLAN

The Project has served as a major source of power generation for SCE&G's customers and recreation for local residents and visitors to South Carolina for several decades. Consistent with FERC's Standard Land Use Article, a licensee may authorize specific non-project uses and occupancies of a project's shoreline. Examples of non-project uses at Parr Reservoir include access paths across SCE&G property, and water withdrawal. SCE&G has a responsibility to ensure that non-Project uses remain consistent with Project purposes, including protection and enhancement of the Project's scenic, recreational, and environmental values.

As development increases in areas surrounding the Project, so too does stress placed upon Project reservoirs and the surrounding watershed. Thus, a comprehensive SMP for each reservoir that recognizes and addresses sources of potential environmental impact is essential to managing each reservoir for the benefit of all interests and to ensure that non-Project uses remain consistent with the License.

The implementation of the SMP by SCE&G will help to maintain and conserve the area's natural and man-made resources. The SMP will comply with the terms of the License, as well as the regulations and orders of FERC, and is intended to assist in providing a balance between recreational use and development, environmental protection, and energy production.

3.0 HISTORY OF THE SHORELINE MANAGEMENT PLAN

Parr Reservoir is formed by the Parr Shoals Dam ("Dam"), which was originally constructed between 1912 and 1914. The Dam is situated across the Broad River and houses a 14.88 megawatt (MW) hydroelectric facility, located in an integral powerhouse. On August 28, 1974, the Federal Power Commission (FPC), predecessor to the FERC, issued SCE&G a new operating License for the Parr Shoals Development. In addition to relicensing the existing facilities, the new License authorized the construction of the 511.2 MW Fairfield Pumped Storage Development. This resulted in the creation of the Fairfield Development's upper pool, Monticello Reservoir. The new License also authorized the enlargement of the existing Parr Reservoir to serve as the lower pool to the Fairfield Development. This involved raising the height of the Dam approximately 9 feet, thereby nearly doubling Parr Reservoir's surface area. The construction of newly licensed facilities was completed in 1978, with the facilities beginning commercial operation that same year (F.P.C., 1974). The newly developed Project, including both Parr and Fairfield Developments, was subsequently referred to as the Parr Hydroelectric Project.

Article 48 of the Project License issued in 1974 required that SCE&G purchase in fee and include within the Project boundary all lands necessary or appropriate for project operations, including lands for recreational use and shoreline control. The lands encompassed by the project boundary shall include, but not be limited to: the islands in the Parr and Monticello Reservoirs formed by the 266-foot and 425-foot contour intervals, respectively; shoreline lands up to the 270-foot contour, or 50 feet (measured horizontally) from the Parr Reservoir's 266-foot contour, whichever is greater; and, shoreline lands up to the 430-foot contour interval, or 50 feet (measured horizontally) from Monticello Reservoir's 425-foot contour, whichever is greater. Provided that the Project boundary, except with respect to land necessary or appropriate for recreational purposes, shall not exceed 200 feet, horizontally measured, from the 266-foot or the 425-foot contour, unless satisfactory reasons to the contrary are given. This area is referred to as the "Buffer Zone". The FPC determined that acquiring these lands would provide SCE&G with adequate shoreline control around the reservoirs, in addition to serving the purposes of Project operation and recreation (F.P.C., 1974).

Furthermore, Article 20 of the Project License orders that SCE&G allow public access, to a reasonable extent to Project waters and adjacent Project lands (with the exception of lands

Comment [b2]: Bill A to provide additional wording from Article 48.

Comment [b3]: Take out reference to Buffer Zone, just refer to Project property.

necessary for the protection of life, health, and property) for navigation and outdoor recreational purposes. This Article also allows SCE&G to grant permits for public access to the reservoirs subject to FERC approval (F.P.C., 1974).

In 1991, SCE&G recognized that appropriate policies and procedures should be in place to govern shoreline activities at the Project. Utilizing experience gained at their Saluda Hydroelectric Project (FERC No. 516), SCE&G filed a proposed SMP with the Commission to regulate the use of Project shorelines. After extensive stakeholder consultation, an amended SMP was filed with the Commission. It was approved on June 4, 2001. The SMP was included as part of the Project's Exhibit R (FERC, 2001).

The SMP approved in 2001 primarily covered activities associated with Monticello Reservoir. It dealt with the following matters: water quality management; forest management; waterfowl management; nuclear exclusion zone restrictions for the operation of SCE&G's V.C. Summer Nuclear Station; fishing, boating, and hunting; public access and recreation; private boat docks and access; vegetation removal; erosion control; and, prohibited activities.

In 2006, SCE&G amended the SMP's policy regarding common docks on Monticello Reservoir. The original policy allowed for two to five property owners to share a single common dock if the shoreline frontage requirement of 200 feet was met. The policy was amended to allow no more than two individual, adjacent single family residential lots to share a common dock. The shoreline frontage requirement of 200 feet was retained.

As noted, the previous SMP included very little pertaining to Parr Reservoir. As such, the need for a new SMP specifically pertaining to Parr Reservoir was identified.

3.1 CURRENT SMP DOCUMENT AND SHORELINE CLASSIFICATIONS

The SMP serves as a reference document for SCE&G in implementing the Standard Land Use Article, which authorizes SCE&G to permit certain non-project uses of project lands and waters. FERC did not begin including the Standard Land Use Article in new licenses until the early 1980's; thus, it was not included in the Project License issued in 1974 (FERC, 2012). However, FERC granted SCE&G the authority to permit certain non-Project uses through the approval of the 2001 SMP, and added the Standard Land Use Article to the License (Article 62) in 2011, as revised in 2013 (Article 63). This present document, submitted in conjunction with SCE&G's

License application, presents a management plan, covering only Parr Reservoir (a SMP for Monticello Reservoir is included under separate cover), while adhering to the historical management goals agreed to and developed with agencies and stakeholders.

In addition to an updated SMP for each Project reservoir, a Permitting Handbook was developed in consultation with stakeholders and agencies to address activities requiring consultation with and/or permits from SCE&G. These activities include, but are not limited to the following: shoreline stabilization, access path development, and other shoreline activities. SCE&G will review the Permitting Handbook with interested stakeholders periodically to evaluate its effectiveness; however, SCE&G may make changes to the permitting process at any time as it determines in its sole judgment to be necessary and appropriate.

3.2 PROJECT BOUNDARY

Comment [b4]: Reword to address Article 48 condition. Bill A to provide

SCE&G owns all lands or obtained flowage rights within the Project boundary surrounding Parr Reservoir. As noted, this area ~~is referred to as the "Buffer Zone" and may~~ encompasses but is not limited to an area up to the 270-foot contour or measuring up to 50 feet but no greater than 200 feet horizontally from the 266-foot contour on Parr Reservoir, whichever is greater.

3.3 ~~ACREAGE OF PROJECT LANDS~~ (SECTION TO BE MOVED TO TABLE UNDER SECTION 5.0)

4.0 SHORELINE MANAGEMENT PLAN GOALS AND OBJECTIVES

The overall goal of this SMP is to define, document, and present the processes and criteria that SCE&G will employ to manage and balance private and public access to and uses of Project lands, specifically including Parr Reservoir's shoreline, consistent with public safety, energy production operations, environmental protection for Project land as well as Project waters, and reasonable recreational opportunities. This SMP will help to ensure the protection and enhancement of the Project's scenic, environmental, recreational, natural and cultural resources over the term of the License.

This SMP represents a consensus-based, updated management plan intended for submittal with the Project No. 1894 License Application. Specific goals relative to the SCE&G relicensing process that are discussed under this SMP include the following:

1. Provide for reasonable current and future public access;
2. Provide for current and future ~~Preserve opportunities to meet~~ recreational needs within the Project;
3. Protect fish and wildlife habitat;
4. Protect cultural resources;
5. Protect the ability to meet operational needs;
6. Facilitate compliance with License articles;
7. Minimize adverse impacts to water quality;
8. Protect scenic values~~Minimize adverse, manageable scenic impacts~~;
9. Monitor and permit shoreline activities~~Guide the control and permitting of shoreline development~~;
10. Provide a summary catalogue of the types and locations of existing recreational opportunities;
11. Establish Land Management Classifications and Land Use Prescriptions to help in the management of non-Project uses of the Parr Reservoir shoreline lands within the Project boundary;
12. Describe the SMP amendment and monitoring process; and
13. Educate and encourage property owners who own property adjacent to or adjoining Project Property (herein referred to as "adjacent property owners") on the use of voluntary BMPs.

4.1 CONSULTATION

The Project relicensing provides an opportunity for SCE&G to seek input on Project-related shoreline management issues from interested stakeholders. SCE&G recognizes that successfully completing the relicensing process requires identifying and resolving Project issues in consultation with federal and state resource agencies, local and national NGOs, homeowner associations, and individuals who have an interest in the Parr Hydroelectric Project (Table 4-1: ~~Table 4-1~~). SCE&G began public outreach efforts in January 2013 by holding a series of public workshops in Winnsboro, Newberry, Columbia, and Jenkinsville, SC. Since that time, SCE&G has sought active public involvement in the process and fostered commitment to issue resolution among SCE&G and stakeholders.

TABLE 4-1: PARTICIPATING GROUPS IN PARR HYDROELECTRIC PROJECT RELICENSING

STAKEHOLDER GROUPS
American Rivers
American Whitewater
Catawba Indian Nation
City of Columbia
Chestnut Hill Plantation HOA
Coastal Conservation League
Congaree Riverkeeper
Environmentalists Inc.
Fairfield County
Gills Creek Watershed
National Marine Fisheries Service
National Park Service
Newberry County
South Carolina Department of Health and Environmental Control
South Carolina Department of Natural Resources
South Carolina Department of Parks, Recreation and Tourism
South Carolina Electric & Gas Company
South Carolina Historic Preservation Office
Town of Winnsboro, SC
Tyger-Enoree River Alliance
United States Fish and Wildlife Service
United States Forest Service
University of South Carolina

4.1.1 Recreation/Lake and Land Management Resource Conservation Group

In support of the relicensing effort, SCE&G formed three Resource Conservation Groups ("RCG"s) to identify, address and resolve Project-related issues by resource area. The RCGs are as follows: the Fish, Wildlife and Water Quality RCG; the Project Operations RCG; and the Lake & Land Management and Recreation RCG. Consideration of potential issues by resource area allows for more focused topic discussion and targeted issue resolution. Some RCGs have established sub-groups, or Technical Working Committees ("TWC"s), for issues requiring special knowledge, education, or experience. Consequently, the Lake & Land Management and Recreation RCG has a Lake and Land Management TWC as well as a Recreation TWC. The Lake and Land Management TWC is discussed further below.

4.1.2 Lake and Land Management Technical Working Committee

The primary mission of the Lake and Land Management TWC is to revise the existing Parr Hydroelectric Project SMP to provide a management framework within which Project resources can be effectively protected while assuring appropriate public and private access to the Project resources and the recreational opportunities they present. Another important focus of the TWC is to allow interested parties an effective opportunity to provide input on resource issues and the overall future management of shoreline resources. The resulting collaboration has resulted in the contribution of valuable information by entities and individuals familiar with the Project. The forum was instrumental in addressing important issues relevant to the operation and management of the Project over the term of the new License. In working collaboratively, the members of the TWC (Table 4-2~~Table 4-2~~) aimed to blend the objectives of the state and federal resource agencies with other stakeholder interests.

Table 4-2: Organizations Participating on the Lake and Land Management TWC

Stakeholder Groups
American Rivers
American Whitewater
Coastal Conservation League
Congaree Riverkeeper
Fairfield County
Gills Creek Watershed
Adjacent Property Owners

STAKEHOLDER GROUPS
National Marine Fisheries Service
National Park Service
South Carolina Department of Health and Environmental Control
South Carolina Department of Natural Resources
South Carolina Department of Parks, Recreation and Tourism
South Carolina Electric & Gas Company
Tyger-Enoree River Alliance
United States Fish and Wildlife Service
United States Forest Service

4.1.3 MEETING SCHEDULE

Between October of 2013 and January of 2018, SCE&G has held ~~over X~~numerous meetings of the Lake and Land Management and Recreation RCG and Lake and Land Management TWC to discuss the details of the Project SMPs. The efforts of the TWC are reflected herein.

5.0 LAND USE CLASSIFICATIONS

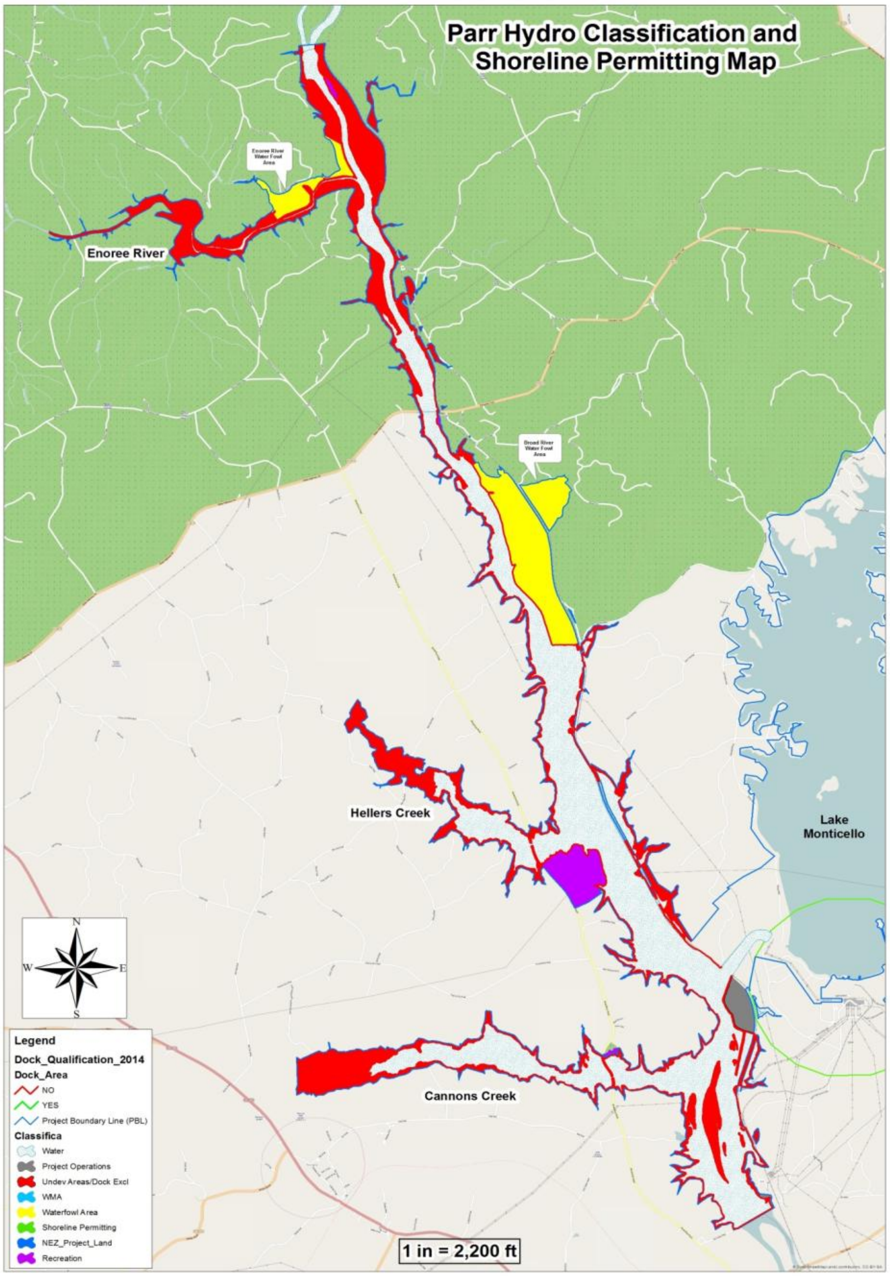
Four distinct land management classifications have been developed for the shorelines surrounding Parr Reservoir. These land management classifications are as follows: Project Operations; Public Recreation; ~~Waterfowl Areas;~~ and, Undeveloped Areas. The Public Recreation Classification includes designated public recreation areas, WMA and ~~as well as~~ some islands within Parr Reservoir. Although SCE&G intends to manage its lands according to this classification system, the public generally will not be precluded from access to SCE&G-owned lands regardless of classification, with the exception of lands reserved and used for Project operations or other areas specifically protected from public access and posted as such. The sections below explain/define the land management classifications. The acreages and parcels for each of the classifications are provided in Table 5-1:~~Table 5-1~~. Figure 5-1~~Figure 5-1~~ depicts their distribution around Parr Reservoir.

TABLE 5-1: SHORELINE MILES AND ACREAGES BY LAND USE CLASSIFICATION

CLASSIFICATION	SHORELINE MILES	ACRES
Project Operation	2.26	90
Public Recreation	2.84	219
~~Waterfowl Areas~~	2.46	723
~~Undeveloped~~ Non-Development Areas	81.79	2,188
Total	**89.35**	**3,220**

Comment [b5]: Be consistent with 94 in other places of SMP.

FIGURE 5-1: SHORELINE CLASSIFICATIONS MAP FOR PARR RESERVOIR



5.1 Project Operations

Areas under this classification include SCE&G-owned and managed lands required for operation of the Parr Development. Public access to these lands is restricted to ensure public safety or to assure the security of the infrastructure system.

5.2 Shoreline Permitting (Section Removed)

5.3 Public Recreation

Project lands under this classification serve as recreational resources for the public and include areas managed expressly for recreation as well as those with recreation as a secondary usage. Public recreation lands include the following:

- Public boat launches, and other areas currently being managed as public access;
- Islands owned by SCE&G;
- Properties owned by SCE&G that are set aside for future recreational development.
- Hunting
- ~~Wildlife Management Areas ("WMA") (Water Only)~~

Comment [b6]: Add sub-sections that discuss each of these bullets.

5.3.1 Islands and Shoals (New Section)

Pearson's Island is located within Parr Reservoir and is available for public recreational use in accordance with authorized activities (See the Permitting Handbook for authorized activities). Due to the fluctuation of Parr Reservoir associated with the Fairfield Development's pumped storage operations, shoals (areas of exposed, or nearly exposed, shallow lake bottom) in Parr Reservoir may be dewatered and are open for passive recreational activities.

5.3.2 Wildlife Management Areas

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Portions of Project lands are included in the South Carolina Department of Natural Resources ("SCDNR") statewide Wildlife Management Areas (WMA) Program. These areas are open to the public for hunting and other recreational activities (visit http://dnr.sc.gov/wma/index.html for additional information). The Broad River and Enoree River WMA's are open to public hunting only on specified days. Hunting is not allowed on SCE&G property unless designated under SCDNR's Wildlife Management Areas (WMA) Program. For additional information on these areas, please visit the SCDNR website at http://dnr.sc.gov/wma/index.html.

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~~5.3.2 Wildlife Management Area (water only)~~

~~Certain portions of Parr Reservoir are included in the South Carolina Department of Natural Resources ("SCDNR") statewide WMA Program. These areas are open to the public for hunting or other recreational activities. The designation for WMA allows hunting on or in the water only and not on adjacent land. For additional information on these areas please visit the SCDNR website at http://dnr.sc.gov/wma/index.html.~~

Comment [ACJ7]: Suggest deleting this section and moving discussion under Section 12.3

~~5.4 Waterfowl Areas~~

~~Portions of Project lands are under the management jurisdiction of SCDNR under its W~~ildlife Management ~~MA Program. Waterfowl management areas are located on the Broad River (Broad River Waterfowl Sub-impoundment)~~, ~~and the Enoree River (Enoree River Waterfowl Sub-impoundment)~~, and Parr Reservoir~~.~~

~~5.5~~5.4 ~~Undeveloped~~ Non-Development Areas

Project lands under this classification are protected from private development. This is done for the protection of the environmental and aesthetic integrity of the shoreline.

6.0 LAND USE PRESCRIPTIONS

Land use prescriptions are based upon and reflect the guiding principles regarding the management of the SCE&G-owned lands within each classification. SCE&G publishes a detailed Permitting Handbook (included under separate cover) that contains descriptions of the permitting processes and specifications for various shoreline developments. Activities that require consultation with and/or permits from SCE&G include the following: construction, maintenance and placement of docks and boat lifts, shoreline stabilization; construction and maintenance of shoreline pathways, and other shoreline activities. Persons interested in shoreline development must contact SCE&G's Lake Management Department (803) 217-9221, or at https://www.sceg.com/about-us/lake-murray to obtain permitting guidance and a copy of the Permitting Handbook. Section 8.0 of this document discusses the Permitting Handbook in greater depth. General information regarding permitting requirements is included where applicable within the scope of each management prescription below.

6.1 PROJECT OPERATIONS

Properties classified as Project Operation contain project works critical to the operation of the Parr Shoals Development. Public access to, or activities upon, these lands is restricted for reasons of safety and security.

6.2 PUBLIC RECREATION

Project lands devoted to public recreation include developed park sites, properties set aside for future recreational development, Pearson's Island and shoals on Parr Reservoir owned by SCE&G. With the exception of the islands, which are maintained in their natural condition, SCE&G manages the areas based on the specific, designated recreational activities including swimming, fishing, picnicking, and boat launching. SCE&G developed and maintained access areas on Parr Reservoir are depicted in Figure 12-1~~Figure 12-1~~. Private permitted activities are excluded.

Comment [b8]: Add primitive camping under public recreation section.

6.2.1 ISLAND AND SHOALS

Pearson's Island is located on Parr Reservoir and is open for passive public recreational use, such as fishing, walking, and bird watching. Hunting is prohibited on SCE&G owned islands. Due to the fluctuation of Parr Reservoir resulting from the Fairfield Development's pumped storage operations, shoals (areas of exposed or nearly exposed, shallow lake bottom) in Parr Reservoir may be dewatered and are open for passive recreational activities.

~~6.2.2 WILDLIFE MANAGEMENT AREA (WATER ONLY)~~

~~Portions of Parr Reservoir are available for public hunting and wildlife management as part of the SCDNR statewide Wildlife Management Program. These public hunting areas are shown on Wildlife Management Area Maps available through the SCDNR. Permitted activities are excluded from this classification. Permitted activities are excluded from this classification. Regulations pertaining to Parr Reservoir are available at SCDNR's website at: http://dnr.sc.gov/wma/index.html, or by contacting SCDNR at:~~

~~Waterfowl and Hunting Regulations~~
~~S.C. Department of Natural Resources~~
~~Wildlife and Fresh Water Fisheries~~
~~1000 Assembly Street~~
~~Columbia, South Carolina 29201~~
~~Telephone: 803-734-3886~~

6.2.2 ~~WATERFOWL AREAS~~ WILDLIFE MANAGEMENT AREAS

~~6.3 (New Section)~~

Hunting is not allowed on SCE&G property unless designated under SCDNR's WMA Program. WMA Program areas may be available for hunting of waterfowl, small game and/or deer. Other recreational activities are allowed as well. See SCDNR website for regulations and WMA maps.

Portions of Parr Reservoir are designated as a waterfowl management area under the WMA program, and is discussed under Section 12.3.

~~Approximately 730 acres of land along Parr Reservoir are located in the Broad River and Enoree River Waterfowl Areas and are leased to SCDNR for public hunting and wildlife management as part of the statewide~~ WMA ~~Wildlife Management~~ Program. ~~Portions of Parr Reservoir (water only) are also designated as a category II waterfowl management area and area available for public waterfowl hunting as described under Section 12.3. These public hunting areas are shown on Wildlife Management Area (WMA) Maps available through the SCDNR. Permitted activities~~

Comment [ACJ9]: My suggestion would be to delete this Section 6.2.2, "Water Only classification", out of the Land Classification and Prescription Sections and include it under 12.3. I have also included a sentence below. I recommend spelling out waterfowl management area, and using the acronym for Wildlife Management Area (WMA).

Comment [WU10]: We might want to combine this paragraph with the following paragraph to reduce redundancy. We may also need some clarification between WMA's and wma's.

Comment [WU11]: How many acres of Project lands are leased to DNR? I am thinking 5,123 (4,400 plus 730) of approximately 7,311 (reservoir plus undeveloped plus Broad And Enoree waterfowl areas.

Comment [ACJ12]: I believe we should keep the land and the water numbers separate.

Comment [b13]: This will be a sub-section under Public Recreation

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Comment [WU14]: Parr Reservoir is also a waterfowl management area and it includes 4400 acres.

Comment [ACJ15]: As noted above, I would suggest keeping the land and water acreages separate.

~~are excluded from this classification. Regulations pertaining to these areas and Parr Reservoir, proper, are available at SCDNR's website at: http://dnr.sc.gov/wma/index.html, or by contacting SCDNR at:~~

~~Waterfowl and Hunting Regulations~~

~~S.C. Department of Natural Resources~~

~~Wildlife and Fresh Water Fisheries~~

~~1000 Assembly Street~~

~~Columbia, South Carolina 29201~~

~~Telephone: 803-734-3886~~

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~~6.4~~6.3 ~~UNDEVELOPED~~ NON-DEVELOPMENT AREAS

Comment [ACJ16]: Comment to stakeholders: currently DNR allows hunting on the land around Parr, however, we would like to discuss changing this to hunting only on the water.

Comment [WU17]: We are discussing this with DNR staff and should have a response by 2018.

Lands under this classification warrant special protection because they may provide important habitat or aesthetic values. Meandering paths and water withdrawals must be permitted and may be considered on a case-by-case basis.

7.0 SHORELINE ACTIVITIES REQUIRING SCE&G APPROVAL

SCE&G maintains a strong commitment to managing the shoreline of Parr Reservoir for multiple resources by considering the impact of various activities on the environmental, aesthetic, and recreational character of the lands. SCE&G owns and manages the Buffer Zone around the entire periphery of Parr Reservoir. Thus, any activity occurring on the "shoreline" is occurring on SCE&G property. ~~Any~~ A~~a~~ctivities~~y~~ not in compliance with the shoreline activity parameters outlined in this SMP and in the Permitting Handbook may constitute~~s~~ a trespass which SCE&G may elect to prosecute.

Comment [WU18]: I think some activities that are not in compliance with either SMP or SMG were "Grandfathered" and do not constitute a trespass.

Comment [ACJ19]: Correct.

7.1 AUTHORIZED ACTIVITIES REQUIRING APPROVAL THROUGH THE PERMITTING HANDBOOK

Only the following activities and structures may be permitted on Parr Reservoir:

- Construction of a meandering access path;
- Water withdrawal for non-commercial agricultural/landscaping irrigation purposes.

7.2 PROHIBITED STRUCTURES AND ACTIVITIES

Activities and structures that SCE&G does not allow include, but are not limited to, the following:

- Private boat docks;
- Private shoreline stabilization;
- Jet skiing;
- Water skiing;
- Boathouses;
- Private boat ramps;
- Mooring;
- Excavations/dredging (except commercial operations permitted by the state~~authorized by SCE&G~~);
- Effluent discharges;
- Commercial marinas;
- Marine rails;
- Sea walls;

- Fences within the Buffer Zone;
- Electrical service within the Buffer Zone;
- Permanent structures;
- Land-based structures, storage buildings, shelters, patios, gazebos, fences, swimming pools, satellite dishes, signs, storage of boats, canoes or other watercraft or automobiles;
- Septic tanks and/or drain fields;
- Storage or stockpiling of construction material;
- Vegetation removal of any type except in a permitted access path to the shoreline; and,
- Limbing or trimming of Buffer Zone vegetation to create views or visual corridors.

8.0 PERMITTING PROCESS FOR SHORELINE ACTIVITIES OR STRUCTURES

8.1 ~~LAND MANAGEMENT CLASSIFICATION OF PROPOSED PROJECT LOCATION~~ (SECTION REMOVED FROM DRAFT)

8.2 ~~ALLOWABLE AND PROHIBITED FACILITIES AND USES FOR PROPOSED PROJECT LOCATION~~ (SECTION REMOVED FROM DRAFT)

8.3 SHORELINE PERMITTING PROCEDURES

Applicants must obtain the proper permit(s), per the SCE&G's Permitting Handbook, prior to the initiation of any construction or activity on the Parr Reservoir shoreline, which consists of the lands below the 266-foot contour interval and in designated Buffer Zones. As noted above, some activities may also require local, state, and/or federal permits.

Whether a non-Project use is approved under the Standard Land Use article or through prior FERC approval, SCE&G is responsible for ensuring that the use is consistent with the purposes of protecting or enhancing the scenic, recreational, and other environmental values of the Project. To assist applicants in the permitting process, the staff at the SCE&G Lake Management Department is available to answer questions regarding documentation, permits, and specification requirements for their particular project. Permits from SCE&G are required for the following activities:

- Construction of a meandering access path;
- Water withdrawal for non-commercial agricultural/landscaping irrigation purposes.

It is highly advisable to begin the consultation process with SCE&G Lake Management staff at the planning stage of a project. SCE&G staff will be available to discuss specific permitting requirements with the property owner. Depending on the proposed new facility or activity, local, state and federal resource agencies may impose requirements on construction start/stop dates, the placement of erosion control devices, treatment plans, remedial measures, submittal of start construction notifications, and/or best management practices. Any permit applicant should be aware of such conditions, as violations may nullify a permit.

An overview of permitted activities is included below. Detailed information on SCE&G's permitting process, guidelines, and specifications, is provided in SCE&G's Permitting

Handbook available at https://www.sceg.com/about-us/lake-murray, by calling (803) 217-9221), or by writing:

SCE&G Lake Management Department
6248 Bush River Road
Columbia, SC 29212

8.3.1 ~~Docks~~ (Removed from Draft)

8.3.2 Shoreline Vegetation Management

In general, SCE&G maintains a policy of non-disturbance of any vegetation below the 266-foot contour or within a Buffer Zone without approval from SCE&G. Permission to remove vegetation within a permitted access path will only be granted by SCE&G Lake Management after a site visit with the applicant. Once clearing of the access path is completed according to the permit, the applicant may maintain the site in the permitted condition. Any unauthorized removal of shoreline vegetation may result in the cancellation of permits issued by SCE&G, as well as legal action. Violators may be required to replant and restore the disturbed area with such plantings and/or shoreline manipulation as SCE&G determines is necessary to mitigate and correct the situation. SCE&G will review areas that are currently manicured, or that were previously pasture land, and will meet with the adjacent property owner to develop a re-vegetation plan. See Figure 8-1~~Figure 8-1~~ for an example of target coverage for understory vegetation.

8.3.3 Access Path (New Section)

A single pedestrian access path may be cleared from the adjacent property owner's land upon approval of SCE&G. The access path must follow a meandering route to prevent erosion and to protect the aesthetics of the shoreline. No trees larger than 10-inches at breast height may be removed within the access path. A SCE&G Lake Management representative will identify and designate the location of all access paths. Access path restrictions are included in the Permitting Handbook. An example of a permitted access path is included as Figure 8-2~~Figure 8-2~~

FIGURE 8-1: TARGET COVERAGE FOR UNDERSTORY VEGETATION

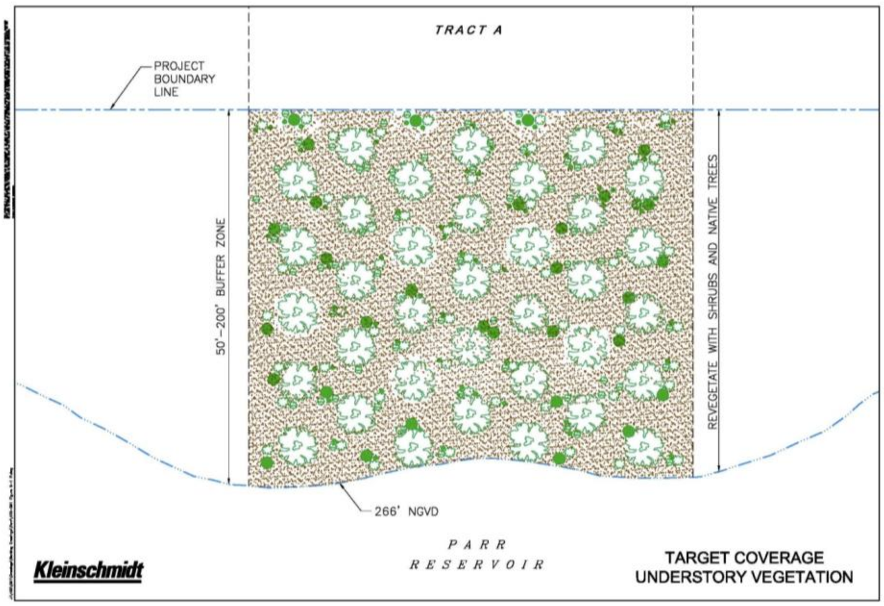
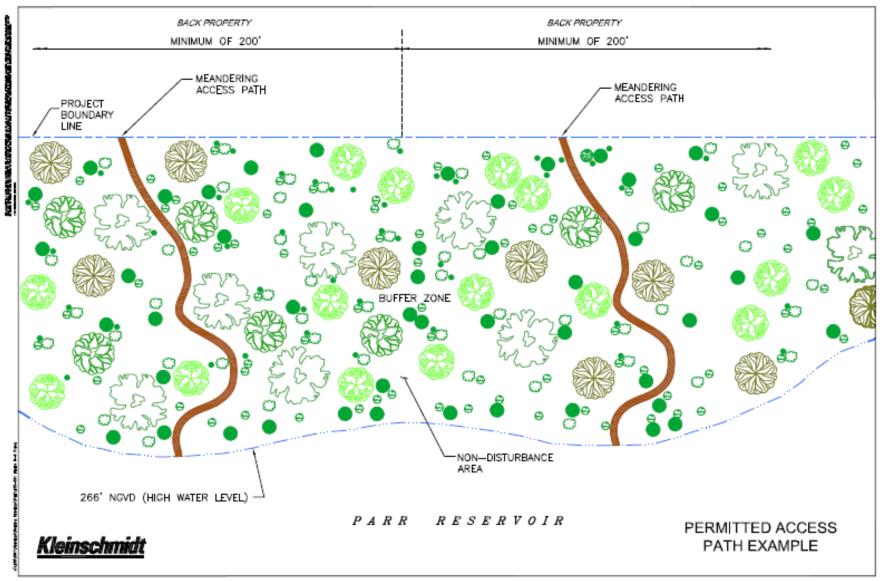


FIGURE 8-2: PERMITTED ACCESS PATH



8.3.4 SHORELINE STABILIZATION (REMOVED FROM DRAFT)

8.3.5 WATER WITHDRAWAL

~~Commercial and residential water~~ Water withdrawals requiring piping and other transportation/delivery equipment to be placed along the shoreline or in the littoral zone, are managed according to the terms of this SMP. Water withdrawal for residential property must be for irrigation purposes only. Permits are required, and will not be issued for any other purpose. Associated pumps and electrical service must be located outside SCE&G property. SCE&G reserves the right to prohibit withdrawal during times of drought or water drawdown.

Applications for a ~~commercial~~ permit to remove water must be submitted to SCE&G for review. ~~Large commercial water~~ Water withdrawal applications for greater than one million gallons per day (MGD) will be forwarded to the FERC for approval. Requests for withdrawal of one MGD or less may require agency consultation prior to approval. SCE&G may impose limits in granting permits for approved applications (see Permitting Handbook). The applicant may be required to bear the expenses of filing the application and will be required to compensate SCE&G for water withdrawn.

9.0 SCE&G PERMITTING FEE POLICIES

FERC allows licensees the right to charge reasonable fees to cover the costs of administering shoreline management programs, which add management responsibilities and associated costs to project operations. SCE&G administers its SMP in part through a permitting program, which does include a fee component. This ensures that activities occurring within the Project and in particular on Project land, are consistent with the overall goals for the Project, and that SCE&G's customers are not burdened with the full cost of administering programs that also have significant private, and often non-customer, benefit. Permit fees are due with applications and are required for docks, boat lifts, access paths, water withdrawal, and erosion control projects. Should an application be denied, associated permit fees will be returned. Periodic permit renewal fees may be required depending on the shoreline activity. One-time and periodic permit fees for Parr Reservoir shoreline activities are detailed in the Permitting Handbook. Failure to comply with this policy may result in, among other things, revocation of existing permits, fines, or legal action, as well as loss of consideration for future permits.

SCE&G will give reasonable public notice through appropriate communication avenues before changing the fee structure.

10.0 ENFORCEMENT OF SHORELINE MANAGEMENT PLAN

10.1 VIOLATIONS OF SHORELINE MANAGEMENT PLAN

SCE&G conducts periodic surveys of the Parr Reservoir shoreline to inventory and inspect permitted uses throughout the year. Lake Management representatives make note of unauthorized structures that they see, as well as urging residents and Reservoir visitors to report anything they believe to be unauthorized activity below the 266-foot contour, or within Buffer Zones. Anyone believing that an activity violating the SMP is occurring is urged to contact SCE&G Lake Management at (803) 217-9221.

SCE&G Lake Management representatives will issue Stop Work Directives and or Trespass Notices for any violations detected on SCE&G property. Any unauthorized clearing of trees or underbrush will result in the revocation of any SCE&G issued permits within 30 days if the violation(s) is (are) not corrected or a course of and schedule for corrective action has not been agreed to and approved by SCE&G. SCE&G may also commence legal action, if it deems it necessary, to require re-vegetation of the affected area. Removal of merchantable timber will require reimbursement to SCE&G subject to valuation of the Forestry Operations Department, including legally allowable "penalties." Consequences for violations may also include restrictions of access to SCE&G property, legal actions, fines, and loss of consideration for future permits.

11.0 SHORELINE MANAGEMENT PRACTICES

11.1 SCE&G SHORELINE MANAGEMENT PRACTICES

~~In addition to development activities, the environment around Parr Reservoir is susceptible to impacts associated with residential and recreational activities. These include, for example only, improper fertilizer/pesticide use, boat maintenance, and debris disposal. Adjacent property owners can mitigate negative impacts otherwise associated with their property uses and instead make significant positive contributions to the Reservoir environment, and ultimately the watershed, by employing BMPs that preserve bank integrity and minimize non-point sources of pollution and contamination. Adjacent property owners should understand that using BMPs will help to preserve the scenic, environmental, and recreational qualities of the Reservoir that they so highly value. Examples of effective BMPs recommended to adjacent property owners are provided in the succeeding sections. SCE&G is available to provide more information and to assist landowners in determining effective BMPs for activities on their properties. Also, anyone may contact the Natural Resource Conservation Service or local county extension office (http://www.sc.nrcs.usda.gov/contact/).~~ SCE&G has established a set of management practices that apply to all of the lands included in the Project Boundary. These practices are reflective of each of their developments unique qualities. The current management practices for the Parr Development (which includes Parr Reservoir) are described in this section, but may be reviewed during the period of the FERC license.

11.1.1 FOREST MANAGEMENT SHORELINE MANAGEMENT PRACTICES (SECTION REMOVED FROM DRAFT)

Comment [b20]: Add this back in and add text

11.1.2 ~~SHORELINE PERMITTING PROGRAM~~ (REMOVED, DISCUSSED IN SECTION 8.0)

11.1.3 SHORELINE STABILIZATION AND VEGETATION MANAGEMENT (REMOVED, DISCUSSED IN SECTION 8.0)

11.1.4 AQUATIC PLANT MANAGEMENT ACTIVITIES (REMOVED FROM DRAFT NOT APPLICABLE TO PARR)

11.2 LANDOWNER RECOMMENDED BMPS (NEW SECTION)

Comment [WU21]: See section 11.1 above.

Comment [ACJ22]: This section should remain. The wording in Section 11.1 was meant to be removed.

In addition to development activities, the environment around Monticello Reservoir is susceptible to impacts associated with residential and recreational activities. These include, for example only, improper fertilizer/pesticide use, boat maintenance, and debris disposal. Adjacent property owners can mitigate negative impacts otherwise associated with their property uses and instead make significant positive contributions to the Reservoir environment, and ultimately the watershed, by employing BMPs that preserve bank integrity and minimize non-point sources of pollution and contamination. Adjacent property owners should understand that using BMPs will help to preserve the scenic, environmental, and recreational qualities of the reservoir that they so highly value. Examples of effective BMPs recommended to adjacent property owners are provided in the succeeding section. SCE&G is available to provide more information and to assist landowners in determining effective BMPs for activities on their properties. Also, anyone may contact the Natural Resource Conservation Service or local county extension office (http://www.sc.nrcs.usda.gov/contact/).

11.2.1 MINIMIZING NON-POINT SOURCE POLLUTION (NEW SECTION)

Reservoir pollution may result from a variety of activities related to residential development, agriculture, forestry, and construction. Contaminants may enter the reservoir and tributaries via overland flows carrying biological, chemical, and other substances picked up and carried by runoff from rain events. This runoff water may contain sediment, bacteria, oil, grease, detergents pesticides, fungicides, fertilizers, and other pollutants. These pollutants, depending on type, quantities, and concentrations can overwhelm a reservoir's natural ability to filter and process them, ~~to at least a neutral or *de minimis* impact~~, thus leading to degraded water quality and aquatic environments.

Although a single point of impact or action may seem insignificant in its effect on the reservoir, the cumulative effects of the resource may be considerable. With this in mind, SCE&G

encourages adjacent land owners to be mindful that they are members of a larger community that uses and impacts the reservoir. Employing the following BMPs can go a long way in preserving and improving reservoir water quality:

- Use permeable paving materials and reduce the area of impervious surfaces, particularly driveways, sidewalks, walkways, and parking areas;
- Dispose of vehicle fluids, paints, and/or household chemicals as indicated on their respective labels and do not deposit these products into storm drains, project waters, or onto the ground;
- Use soap sparingly when washing vehicles and wash them on a grassy areas , preferably sloping gently away from the reservoir, so the ground can filter the water naturally;
- Use hose nozzles with triggers to save water and dispose of used soapy water in sinks or other vessels that direct the materials into sewer systems, not in the street;
- Maintain septic tanks and drain fields according to the guidelines and/or regulations established by appropriate regulatory authorities;
- Remove and dispose of pet waste properly in areas that do not drain to the reservoir; and
- Use only low or no phosphorous fertilizer on lawns near the reservoir.

12.0 PUBLIC EDUCATION AND OUTREACH

This SMP is intended to foster management of shoreline use and development to achieve consistency with the FERC License, as well as the promote protection of public safety and environmental quality (water quality, natural habitat, aesthetics, etc.). To garner support and compliance from the public and lake users, it is key to educate them to the need and means to protect shoreline resources. Additionally, the public must be aware of the management and permitting programs put in place to provide this protection. To accomplish the task of increasing public awareness of the goals and objectives of this SMP SCE&G has developed an education and outreach program that includes the components described below.

12.1 SHORELINE MANAGEMENT PLAN EDUCATION

SCE&G's Public Education and Outreach program seeks to educate the public on various aspects of the management of Parr Reservoir, including the Permitting Handbook, recommended BMP use, relevant Project Operations information, and the Safety Program. To accomplish this, SCE&G uses various public education measures including informational pamphlets, public meetings, newsletters, and an internet webpage.

The Internet, in particular, presents an excellent mechanism for disseminating information and improving awareness. SCE&G maintains a website designed to provide information on the SMP and the Permitting Handbook. Printed copies of the following materials may also be obtained by contacting SCE&G Lake Management at (803) 217-9221. Information and materials that will be available at the website include the following:

- Permitting Handbook;
- Permit application forms;
- Examples and information on BMPs;
- Alternative and example designs for shoreline stabilization on Monticello Reservoir; and
- Useful links and other related information.

Additional outreach mechanisms that SCE&G intends to employ in implementing the SMP include the following:

- Provide speakers for homeowner and other organizations' meetings;
- Provide information to realtors and encourage dissemination of this information to all potential adjacent property buyers; and
- Develop and distribute new, "user friendly" brochures that include general reservoir information, permitting processes, shoreline BMPs, and relevant contact information.

12.2 Public Access Area Maps

A figure depicting existing and future Public Access Areas on Parr Reservoir is included as Figure 12-1~~Figure 12-1~~. Waterfowl area maps are available from the SCDNR at: http://dnr.sc.gov/wma/maps.html.

12.3 ~~Wildlife Management Areas~~Waterfowl Hunting on Parr Reservoir

Portions of Parr Reservoir are open for public waterfowl hunting only during specified days and times during state waterfowl seasons. ~~are available for public hunting and wildlife management as part of the SCDNR statewide Wildlife Management Program. These public hunting areas are designated as a category II waterfowl management area and are shown on WMA Maps available through the SCDNR.~~ Regulations and maps pertaining to Parr Reservoir are available at SCDNR's website at: http://dnr.sc.gov/wma/index.html, or by contacting SCDNR at:

Waterfowl and Hunting Regulations

S.C. Department of Natural Resources
Wildlife and Fresh Water Fisheries
1000 Assembly Street
Columbia, South Carolina 29201
Telephone: 803-734-3886

~~12.3~~12.4 Safety Programs

The boating laws of South Carolina are enforced by SCDNR. Boaters and sportsmen should be aware of dangerous areas which are marked and for public safety should not be entered. Other warnings are posted around the reservoir and should be observed as well. Due to operation of the pumped storage generating plant, the waters of Parr Reservoir can fluctuate several feet in a matter of a few hours. This rapid fluctuation makes it especially important for boaters and other recreationists to exercise a high degree of care and fully assume personal responsibility for their safety by being especially aware and cautious. Shoals and hazardous areas are marked by the

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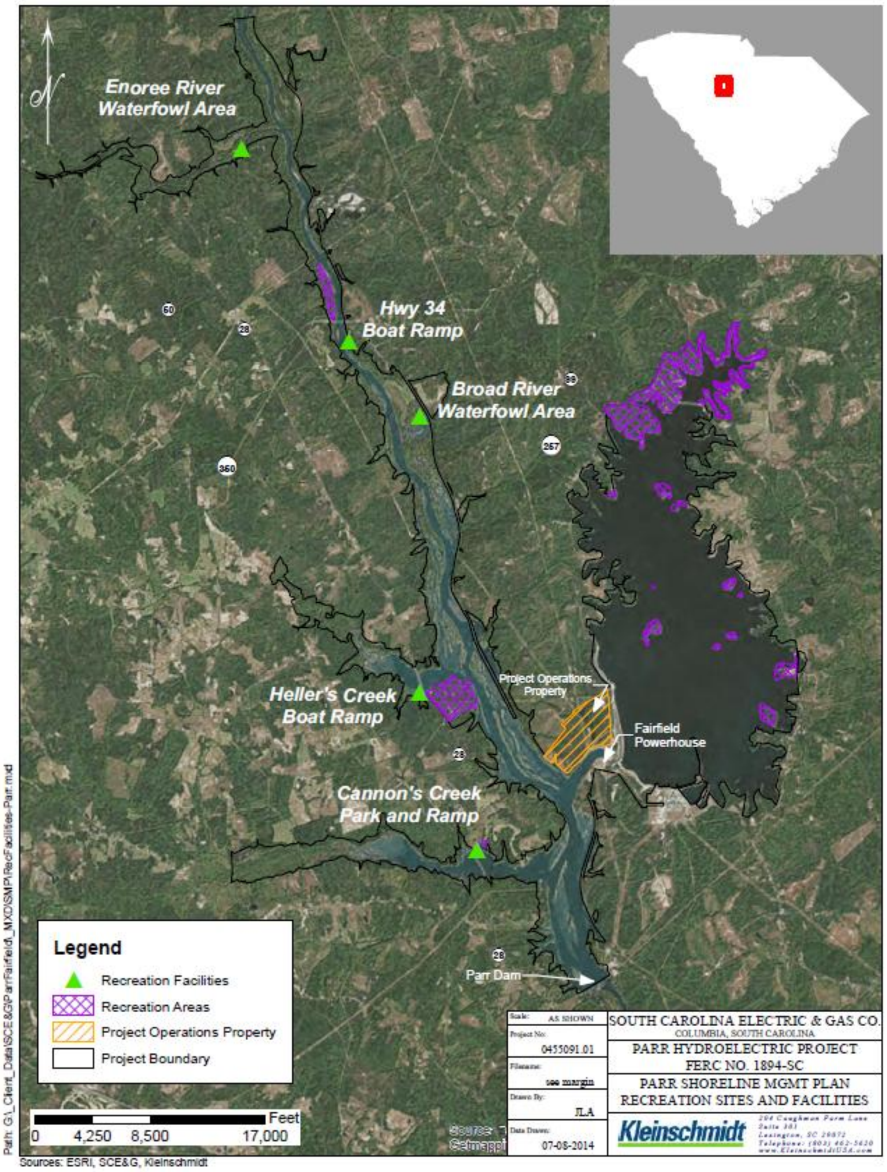
Comment [b23]: Revise based on Monticello comments.

SCDNR to create a safer boating environment. However, it must not be assumed that every potentially dangerous shoal and hazardous area has been marked.

FIGURE 12-1: PARR RESERVOIR PUBLIC ACCESS AREA MAP



Comment [ACJ24]: Comment to stakeholders: Currently, the property adjacent to the Fairfield powerhouse and dams is under the Recreation classification, and is set aside for future recreation. However, as discussed during previous TWC meetings, SCE&G intends to change this land classification to Project Operations due to its proximity to Project structures. This property is depicted as Project operations on Figure 12-1.

Comment [b25]: Get new map to remove recreation area upstream of Highway 34. This should not be recreation.

Change all references of Undeveloped to Non-Developed.

Update map to be consistent with SCE&G maps.

Color in waterfowl areas instead of using a triangle .

13.0 MONITORING AND REVIEW PROCESS

13.1 OVERALL LAND USE MONITORING

As demographics and user groups change within the Project area, changes in residential and commercial areas may occur. Often this type of use change is incremental and cumulative, occurring over a period of years or decades. To monitor land use around Parr Reservoir, SCE&G will employ a geographic information system (GIS) to compare new and existing permit applications against GIS data for the land management classifications. Such monitoring will provide long-term data that should be useful in identifying areas experiencing change. Every 10 years, during the SMP review process (see Section 13.2 on Review Process below), SCE&G will report on changes in land use for the various land management classifications in addition to filing Form 80 surveys. If it is found that material changes within the Project boundary have occurred that are not consistent with the current SMP goals, amendments to the SMP may be warranted. Such situations might include significant changes in land ownership, major commercial upgrades or uses, or new residential uses or pressures.

13.2 REVIEW PROCESS

SCE&G proposes a 10 year SMP review cycle interval. A 10 year SMP review period interval should provide reasonable opportunities for SCE&G, in concert with governmental, non-governmental, and individual stakeholders, periodically and deliberately to assess new issues that arise as a result of development around the Reservoir, and allow for analyses of cumulative effects. The SMP review process will begin sufficiently in advance of the end of each period so that it will be completed within the 10 year time frame. One month prior to the scheduled start of the review process, its occurrence will be advertised in various media formats (e.g., web site, newsletter, contact with homeowner associations, etc.). SCE&G will use those same media avenues to issue a report on the outcome of the review process. As in the past, SCE&G will solicit input from interested parties in addressing issues that arise and have a bearing on Reservoir management. This includes keeping lines of communication open during the time between review periods. Concurrently with the FERC SMP review process, SCE&G will review the Permitting Handbook periodically with interested stakeholders to ensure its effectiveness; however, changes to the permitting process may be made periodically, as needed, outside of the scheduled review periods.

14.0 REFERENCES

Federal Power Commission (F.P.C.). 1974. Order Issuing New License for the Parr Hydroelectric Project. August 28, 1974. 52 F.P.C. 537.

Federal Energy Regulatory Commission (FERC). 2012. Guidance for Shoreline Management Planning at Hydropower Projects. Online. [URL]: http://www.ferc.gov/industries/hydropower/gen-info/guidelines/smpbook.pdf.

Federal Energy Regulatory Commission (FERC). 2001. Order Approving Land use and Shoreline Management Plan. June 4, 2001. 95 FERC ¶ 61,351.

SHORELINE MANAGEMENT HANDBOOK AND PERMITTING GUIDELINES

~~PARR~~ MONTICELLO AND PARR ~~MONTICELLO~~ RESERVOIRS

Comment [b1]: Change throughout the document

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtGroup.com

September 2014

SHORELINE MANAGEMENT HANDBOOK AND PERMITTING GUIDELINES

PARR AND MONTICELLO RESERVOIRS

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

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September 2014

SHORELINE MANAGEMENT HANDBOOK AND PERMITTING GUIDELINES
PARR AND MONTICELLO RESERVOIRS

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

[General Project Details and History of the Project]

2.0 PARR RESERVOIR

2.1 LAND USE CLASSIFICATIONS AND PRESCRIPTIONS

[Discuss the land use classifications identified in the SMP in greater detail]

2.1.1 PROJECT OPERATIONS

2.1.2 PUBLIC RECREATION

2.1.2.1 ISLANDS AND SHOALS

2.1.2.2 WILDLIFE MANAGEMENT AREA (WATER ONLY)

2.1.3 WATERFOWL AREAS

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2.2 ENVIRONMENTAL POLICIES AND PRACTICES

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2.2.2 WATER QUALITY STANDARDS

2.2.3 NON-DISTURBANCE POLICY

2.2.4 EFFLUENT DISCHARGES

2.2.5 PUBLIC FISHING, BOATING & HUNTING

[Provide DNR contact info up-front, include discussions of boating safety public hunting and fishery management (if applicable)]

2.3 PUBLIC ACCESS AREAS

[Identify public access sites on Parr Reservoir]

2.4 Shoreline Activities/Development Permitting

[Include general discussion paragraph under main Section 2.4 Header]

2.4.1 Shoreline Vegetation Management

2.4.2 Access Path

2.5 PROHIBITED ACTIVITIES/STRUCTURES

3.0 MONTICELLO RESERVOIR

3.1 LAND USE CLASSIFICATIONS AND PRESCRIPTIONS

[Discuss the land use classifications identified in the SMP in greater detail]

3.1.1 PROJECT OPERATIONS

3.1.2 NUCLEAR EXCLUSION ZONE

3.1.3 SHORELINE PERMITTING

3.1.4 PUBLIC RECREATION

3.1.4.1 ISLANDS

3.1.4.2 RECREATION LAKE

3.1.4.3 WILDLIFE MANAGEMENT AREA (WATER ONLY)

3.1.5 UNDEVELOPED AREAS/DOCK EXCLUSION AREAS

3.2 ENVIRONMENTAL POLICIES AND PRACTICES

3.2.1 GENERAL POLICY AND PURPOSE

3.2.2 WATER QUALITY STANDARDS

3.2.3 NON-DISTURBANCE POLICY

3.2.4 EFFLUENT DISCHARGES

3.2.5 PUBLIC FISHING, BOATING & HUNTING

[Provide DNR contact info up-front, include discussions of boating safety public hunting and fishery management (if applicable)]

3.2.6 AQUATIC PLANTS

3.2.7 WOODY DEBRIS & STUMP MANAGEMENT

3.3 PUBLIC ACCESS AREAS

[Identify public access sites on Monticello Reservoir]

3.4 Shoreline Activities/Development Permitting

[Include general discussion paragraph under main Section 3.4 Header]

3.4.1 Docks and Boat Lifts

3.4.1.1 Private Individual Docks

3.4.1.2 Private Common Docks

3.4.1.3 Dock Modifications

3.4.1.4 Boat Lifts

3.4.2 Shoreline Vegetation Management

3.4.3 Access Path

3.4.3.1 Monticello Reservoir

3.4.3.2 Recreation Lake

3.4.4 Shoreline Stabilization

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5.1 GENERAL PROCEDURE

5.2 PERMITTING FEES

5.3 PERMITTING VIOLATIONS

5.4 MISCELLANEOUS

South Carolina Electric & Gas Company
Lake Management Department
6248 Bush River Road
Columbia, South Carolina 29212

Published X

USFWS Comments on the meeting notes for the Parr and Monticello LLM TWC meeting held on November 5-6, 2014.

Hi Kelly,

The Service provides the following comments regarding the Parr and Monticello LLM TWC meeting notes:

Page 2, regarding "natural areas classification": I think I was trying to get some clarification on what kinds of shoreline and activities (e.g. silvaculture, livestock access, natural vegetation, riprap etc.) occur in "Undeveloped Areas/Dock Exclusion" land use classes for each reservoir.

I intended to express why this kind of clarification and specificity is helpful for me, but I may not have explained this very well. I need to determine if the SMPs offer a balanced consideration for ecological priorities as well as for development. I think that this could be evaluated by delineating and quantifying naturally vegetated shoreline that will remain undisturbed. Delineating this kind of shoreline should be done independently from the other classifications since not all "Undeveloped Areas/Dock Exclusion" areas are naturally vegetated. Moreover, naturally vegetated shoreline likely occurs adjacent to "Recreation" and other land use classes.

I am not so much concerned about the definition of "natural areas" at this time. I think that if the SMPs had an independent "natural areas" classification or sub-classification, we could reach an agreement on the definition without too much deliberation.

Thank you for considering these comments. The Service appreciates the opportunity to participate in the development of these SMPs and the Permitting Handbook.

Thank you,

Byron Hamstead

From:	Kelly Miller
To:	Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Brandon Kulik; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	FW: Mesohabitat Study Plan
Date:	Thursday, August 29, 2013 2:24:54 PM
Attachments:	001-Parr FF Mesohab Study Plan Memo.pdf

All,

Please submit any suggested edits or comments to the attached memo via email. If you have no edits, please submit your approval of the study plan to me by Friday, September 6th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Kelly Miller
Sent: Thursday, August 29, 2013 11:15 AM
To: Alan Stuart; Alison Jakupca; ARGENTIERI, WILLIAM R; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Brandon Kulik; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'
Subject: Mesohabitat Study Plan

All,

For your information, attached is a memo regarding the Mesohabitat Study Plan, reflecting points discussed at the previous Instream Flows TWC meeting, held on July 31st.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator

Kleinschmidt
Office: 803.462.5633
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MISCELLANEOUS

From:	Kelly Miller
To:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Brandon Kulik; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	Final Mesohabitat Assessment Report
Date:	Thursday, April 03, 2014 4:18:42 PM
Attachments:	001-Parr FF Mesohab Memo Report final.pdf

All,

Attached for your record is the final Mesohabitat Assessment Report. This report is also available at the project website at www.parrfairfieldrelicense.com.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Kelly Miller
To:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"; Brandon Kulik; Frank_Henning@nps.gov; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder
Subject:	Parr/FF Robust Redhorse Memo
Date:	Friday, May 02, 2014 11:21:43 AM
Attachments:	Parr FF Robust Redhorse Spawning Memo 04-29-2014 Final.pdf

All,

Attached is the final Robust Redhorse Memo for the Parr/Fairfield Project. Please note that this memo will also be included as an appendix to the final IFIM Study Plan. It will also be available on the project website at www.parrfairfieldrelicense.com.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Kelly Miller
To:	Chestnut, David; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); QUATTLEBAUM, MILTON; Randy Mahan (randolph.mahan@scana.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	revised Final Water Quality Report
Date:	Friday, January 17, 2014 10:14:11 AM
Attachments:	Parr_FF Water Quality Report_Final_011614.pdf

All,

The revised final version of the Water Quality Report for the Parr/Fairfield Project is attached to this email, as well as available on the Project website at www.parrfairfieldrelicense.com. After further consultation with SCDHEC, USFWS and other members of the Water Quality TWC, the following edits have been made to the report.

- Regarding the vertical profile data collected by SCANA for Parr and Monticello Reservoirs, tables were added summarizing the max, min and mean values for temperature, pH, dissolved oxygen, and conductivity.
- Data was added from all base and random SCDHEC monitoring sites within the Project Boundary. Parameters include water temperature, dissolved oxygen, pH, turbidity, total phosphorus and total nitrogen, chlorophyll-a, and metals.
- Information on SCDHEC sites listed on the 2012 303(d) list was included.
- USGS data from the Carlisle gage was included.
- Turbidity data collected by SCDNR was included.
- Data from four SCDHEC monitoring sites located at various points throughout the Project Boundary was graphically compared.
- Appendix B was added, which consists of the Thermal Mixing Zone Evaluation at VC Summer Nuclear Plant.

Additionally, for anyone who is interested, the raw data used in the report is available upon request. SCE&G and Kleinschmidt would like to thank SCDHEC, specifically David Chestnut and Rusty Wenerick, for all the time and effort they spent helping with the revisions of this report. We will be discussing this report at the upcoming Water Quality TWC meeting scheduled for the afternoon of February 4th. If you have any questions or concerns in the meantime, please let me know.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

NGO CONSULTATION

From:	Alison Jakupca
To:	Jeff Carter (jmcarter00@sc.rr.com)
Cc:	BARGENTIERI@scana.com; Kelly Miller; Henry Mealing; BOOZER, THOMAS C
Subject:	FW: Updated RUNS Study Plan
Date:	Wednesday, October 15, 2014 11:19:49 AM

Mr. Carter,

Kelly forwarded me your email as she is out of the office for a few days. Our decision not to include the Highway 34 site for exit interviews is not related to past safety issues, it has more to do with general safety protocols for our survey clerks. As survey clerks are stationed at one site for 4 to 6 hours at a time, we prefer for them to have a good cell phone signal and/or a general steady flow of use through the site so that someone visiting the site could help them in the event of an emergency (car breaking down, etc). From my discussions with other folks, and personal visits to the site, cell phone signal is not good in this particular area. This, coupled with its relatively remote location, led to our decision to only include this area for traffic counter data collection.

This being said, it is not our intention to imply that this site is not important. Traffic counter data will give us a wealth of information, and we will have employees visiting the site regularly to download the traffic counter data, perform vehicle spot counts at the site, and observe general site use. Moreover, not having a survey clerk at this site does not preclude improvements to this area in the future. As I noted before, we will be able to glean much about use from the traffic counter data and spot counts at this site.

I hope this helps address your concerns. Please let me know if you have any other questions or concerns on this matter.

Thanks and take care,

Alison

Alison Jakupca
Regulatory Coordinator
Kleinschmidt Associates
Office: 803.462.5628
www.Kleinschmidtusa.com

-------- Original message --------
From: Jeffrey Carter
Date:10/14/2014 9:33 AM (GMT-05:00)
To: Kelly Miller
Subject: Re: Updated RUNS Study Plan

Kelly, I am a little taken back that there are safety concerns at the Highway 34 landing. Could you elaborate as to what these reasons are and why SCE&G can't provide some level of comfort for not only individuals who would be doing a survey but more importantly users of that facility. This certainly sounds like there are past issues at this site that should be openly discussed. I would hope that there is proper safety protocols in place for any area within the PBL but this is concerning. Could you provide more detailed insight as to exactly what these issues are and how they will be addressed going forward.

Thanks
Jeff

Sent from my iPhone

On Oct 13, 2014, at 8:29 PM, Kelly Miller <Kelly.Miller@KleinschmidtGroup.com> wrote:

> All,
>
> As you are aware, the Recreation Use and Needs Study Plan describes the various study methodologies to be implemented at Project Area recreation sites. These methodologies include, but are not limited to, traffic counters and exit interviews administered by a survey clerk stationed at the recreation site.
>
> As previously drafted, the study plan called for exit interviews and a traffic counter at the Highway 34 boat ramp. Due to safety reasons, it has been determined that a survey clerk should not be stationed at this site to perform exit interviews. However, a traffic counter will be installed at this site and spot counts will be collected when traffic counter data is downloaded.
>
> An updated study plan, with track changes to reflect this modification, has been attached to this email. If you have any questions or concerns, please let us know by November 14th, at which time the updated study plan will be finalized.
>
> Thanks!
> Kelly
>
> **Kelly Miller**
> **Regulatory Coordinator**
> **<image001.gif>**
> **Office: 803.462.5633**
> **www.KleinschmidtGroup.com**
>
> <002-FINAL Parr Recreation Use and Needs Study Plan - revised 10-14.docx>

From:	Gerrit Jobsis
To:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	RE: draft Fisheries TWC meeting notes - 04/01/14
Date:	Tuesday, April 22, 2014 3:22:34 PM
Attachments:	draft_040114_Fisheries_TWC_notes (Jobsis).doc

Kelly,

Here are the comments of American Rivers. We made substantial headway at the end of our discussion on Parr Reservoir fluctuation study that is important to include. That is we agreed the study would provide more detail on how fluctuations affect navigation and loss of recreation use, as well as aquatic habitat. My edit reflecting this is attached.

Best regards,

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114 (M) 803.546.7926

Keep up on the latest river news and info: www.americanrivers.org/updates

Please consider the environment before printing this e-mail.

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From: Kelly Miller [mailto:Kelly.Miller@kleinschmidtusa.com]
Sent: Friday, April 18, 2014 10:29 AM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis; Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'
Subject: draft Fisheries TWC meeting notes - 04/01/14

All,

Attached are the meeting notes from the Fisheries TWC meeting held on Tuesday, April 1st. Please review and have any comments or edits back to me by Friday, May 2nd.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From: Tyger - Enoree River Alliance
To: Kelly Miller
Subject: Re: draft Parr Hydroelectric Project PAD
Date: Monday, July 28, 2014 4:43:45 PM

Hello Kelly,

I ran into some people from Kleinschmidt a month or two ago at a public scoping outside Chester, SC. There is a stream mitigation program going on out there and your company is working with that project as well, I think.

Anyway, someone from Kleinschmidt (maybe it was you?) recognized me and asked me to keep in touch regarding some work on waterfowl or the waterfowl area on the Enoree.... something to do with ducks anway! I am unsure exactly what the interest was. At any rate, we will be gearing up for our annual program that deals with plastic mitigation in waterfowl loads, shortly. We have a French company that we worked with last year, they produce bio degradable waterfowl loads. We will be working with them again this year and perhaps some other activities centered around habitat conservation. I don't know if this ties in with what is going on with the Parr Shoals project, but will be happy to see what we can do to help with your efforts. If you can forward this along to whomever is looking at watefowl issues, I would appreciate it.

Sincerely,

Jon Durham
(803) 271 6701
www.tygerenoree.com

----- Original Message -----
From: Kelly Miller
To: BARGENTIERI@scana.com ; Elizabeth Johnson (emjohnson@scdah.state.sc.us) ; Frank_Henning@nps.gov ; Kelly Miller ; QUATTLEBAUM, MILTON ; Randy Mahan (randolph.mahan@scana.com) ; randy mahan (rmahan@sc.rr.com) ; Steve Summer ; tboozer@scana.com ; Alison Jakupca ; Bill Marshall (marshallb@dnr.sc.gov) ; Bill Stangler (CRK@congareeriverkeeper.org) ; Byron Hamstead (Byron_hamstead@fws.gov) ; Chad Altman (altmankc@dhec.sc.gov) ; Charlene Coleman (cheetahtrk@yahoo.com) ; Chris Johnston (JohnstonWC@gmail.com) ; Chuck Hightower (hightocw@dhec.sc.gov) ; David Eargle (eargleda@dhec.sc.gov) ; Dick Christie (christied@dnr.sc.gov) ; Fritz Rohde (Fritz.Rohde@noaa.gov) ; Gerrit Jobsis (gjobsis@americanrivers.org) ; Hal Beard (BeardH@dnr.sc.gov) ; Henry Mealing ; J. Hagood Hamilton Jr. (jhamilton@scana.com) ; Jaclyn Daly (Jaclyn.Daly@noaa.gov) ; Jay Maher ; Jim Glover (gloverjb@dhec.sc.gov) ; Jon Durham (jondurham@bellsouth.net) ; Ley, Amanda ; Malcolm Leaphart (mwleapjr@att.net) ; Mark Caldwell (mark_caldwell@fws.gov) ; Mel Jenkins (greenpalmetto@yahoo.com) ; Pace Wilber (Pace.Wilber@noaa.gov) ; Ron Ahle ; Rusty Wenerick (weneriwr@dhec.sc.gov) ; Sam Stokes (stokess@dnr.sc.gov) ; Scott Castleberry (castlews@dhec.sc.gov) ; Scott Harder ; Shane Boring ; Tom McCoy (thomas_mccoy@fws.gov) ; 'Vivianne Vejdani' ; Wayne and Ginny Boland (wayneboland@bellsouth.net) ; btrump@scana.com ; David Haddon (dhaddon@scana.com) ; Erich Miarka (erich.miarka@gillscreekwatershed.org) ; Jeff Carter (jmcarter00@sc.rr.com) ; Joe Wojcicki ; John Fantry (jfantry@bellsouth.net) ; Mark Davis

(mdavis@scprt.com) ; Merrill McGregor (merrillm@scccl.org) ; rammarell@scana.com ; Robert Stroud (StroudR@dnr.sc.gov) ; Scott Collins (secollins@scana.com) ; William Hendrix (hendrixwb@dot.state.sc.us) ; Bret Hoffman ; Bruce Halverson ; Dick Christie (dchristie@comporium.net) ; Terri Hogan (terri_hogan@nps.gov)
Sent: Monday, July 28, 2014 3:54 PM
Subject: draft Parr Hydroelectric Project PAD

Good afternoon all!

Attached is the draft Parr Hydroelectric Project Pre-Application Document (PAD). Please review and have any comments or edits to me by August 31st. Please note that the appendices will be included with the final document.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Gerrit Jobsis
To:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	RE: Draft Reservoir Fluctuation Study Plan
Date:	Tuesday, April 01, 2014 6:13:22 PM
Attachments:	011-Draft Reservoir Fluctuations Study Plan 022514-Americn Rivers comments.docx

Kelly, et al. – Attached are American Rivers' written comments on the study plan which we made during the robust discussion at today's meeting.

Gerrit

____

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114   (M) 803.546.7926

Keep up on the latest river news and info: www.americanrivers.org/updates

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From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Tuesday, February 25, 2014 9:25 AM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis; Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'
Subject: Draft Reservoir Fluctuation Study Plan

All,

Attached is the draft Reservoir Fluctuation Study Plan. Please review and submit any comments or questions by Friday, March 14th. We will be discussing this study plan at the next Fisheries TWC meeting.

Thanks,
Kelly

Kelly Miller

Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Gerrit Jobsis
To:	Kelly Miller; Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@sccl.org); Pace Wilber (Pace.Wilber@noaa.gov); "Prescott Brownell"; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Rebecca Haynes; Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; "Vivianne Vejdani"; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject:	RE: Final Recreation TWC Meeting Notes - 05/14/13
Date:	Monday, June 17, 2013 5:08:50 PM

Bill, Alan and others,

I missed the May 14 Recreation TWC meeting due to conflicting work related travel and I could not voice my opinion at that time. I am surprised that the meeting summary provided includes no plans for a separate recreation flow study as was done for the Saluda and other relicensings in SC and NC. The state navigation flow assessment is certainly valid for determining minimum flow to meet state requirements, but the resulting flow is often different than what is needed for quality recreational experiences for non-motorized boaters and anglers.

American Rivers recommends that a recreational flow study be conducted as part of the relicensing to determine the quality of recreational experiences at different flows for non-motorized boaters and anglers. We do not believe the state navigation flow study which sets a single minimum flow will adequately address recreational boating needs for all recreation users.

Best regards,

Gerrit

____

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301
Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Monday, June 17, 2013 2:52 PM
To: Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka

(erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Gerrit Jobsis; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Kelly Miller; Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); 'Prescott Brownell'; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Rebecca Haynes; Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Final Recreation TWC Meeting Notes - 05/14/13

All,

Attached for your record are the final meeting notes from the May 14th Recreation TWC meeting. Please note that this document will also be posted to the Project website at www.parrfairfieldrelicense.com.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Gerrit Jobsis
To:	Kelly Miller; Alan Stuart; Shane Boring; Brandon Kulik; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); rammarell@scana.com; Thomas McCoy; QUATTLEBAUM, MILTON; Ron Ahle; byron_hamstead@fws.gov; Rusty Wenerick (weneriwr@dhec.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Dick Christie (dchristie@comporium.net); "Vivianne Vejdani"; Frank_Henning@nps.gov
Subject:	RE: IFIM meeting notes
Date:	Thursday, August 08, 2013 12:30:41 PM
Attachments:	draft_073113_Instream Flows_TWC_notes (Jobsis comments).doc

Kelly,

Thanks for your summary and the opportunity to review. Attached are my edits in redline related to navigation study, 2D modeling, striped bass spawning lifestage, snail bullhead juvenile lifestage, and channel indices.

Best regards,

Gerrit

____

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301
Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

From: Gerrit Jobsis
Sent: Friday, June 14, 2013 5:24 PM
To: 'Kelly Miller'; Alan Stuart; Shane Boring; Brandon Kulik; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); rammarell@scana.com; Thomas McCoy; QUATTLEBAUM, MILTON; Ron Ahle; Prescott Brownell - NOAA Federal
Subject: RE: IFIM Recon Trip - June 18-19

Thanks Kelly. I look forward to it. I'll be participating Tuesday but won't be able to make it Wednesday. See you then.

Gerrit

____

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301

Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Friday, June 14, 2013 2:01 PM
To: Alan Stuart; Shane Boring; Brandon Kulik; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); rammarell@scana.com; Thomas McCoy; QUATTLEBAUM, MILTON; Ron Ahle; Gerrit Jobsis; Prescott Brownell - NOAA Federal
Subject: IFIM Recon Trip - June 18-19

Good afternoon gentlemen!

The IFIM Recon Trip to establish transects for the Parr Relicensing IFIM Study is planned for next Tuesday and Wednesday, June 18th and 19th. As a reminder, a map of the general transect locations discussed during the Instream Flows TWC meeting is attached. Information on the trip is as follows:

Tuesday

- Please meet at 800 Lake Murray Blvd Irmo, SC 29063 at **7:30 am** Tuesday morning. (This is the same meeting location from the Broad River Canoe Trip in March.)
- You will then travel as a group to the first general transect area.
- A brief itinerary for Tuesday is as follows:
  - Mark transect at area immediately below the Parr Dam.
  - Travel to canoe put-in at the Palmetto Trail/railroad trestle. Canoe downstream to establish transects at next general location, indicated on the attached map.
  - Travel to Haltiwanger Island and establish transect at this location.
- You will then travel back to your cars and go home for the day.
- Plan for a full day on Tuesday. **Pack any food you will need throughout the day, as lunch is NOT provided.**

Wednesday

- Please meet at 800 Lake Murray Blvd, Irmo, SC 29063 at **7:30 am** Wednesday morning.
- Wednesday you will be traveling by boat to the final two destinations, at Huffman and Bookman Islands. All travel to and from where you parked will be provided.
- Again, please plan for a full day on Wednesday. **Pack any food you will need throughout the day, as lunch is NOT provided.**

If you are not able to attend this trip, please let me know ASAP.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Gerrit Jobsis
To: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: RE: Inflow Dataset Development: Statistical Methodology
Date: Wednesday, May 28, 2014 4:55:52 PM
Attachments: 001 Parr Reservoir Inflow Data Development_2014-05-13 American River comments.docx

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Kelly,

Please find attached American Rivers comments on the inflow data plan. It is intended to support the Final Parr Fairfield Operations Model Study Plan. That study plan says "The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies." As my comments in the document state, I do not agree that this inflow data set will be usable to evaluate the effects of project operations on habitat and recreation. Project operations via inflow alterations and reservoir fluctuations affect habitat and recreation values on a real time basis (hourly or less) that cannot be estimated using monthly average inflow estimates. Smoothing the data with regression equations removes the hourly and sub-hourly variation that is essential to understanding project effects.

I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.

Gerrit

____
Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114 (M) 803.546.7926

.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Tuesday, May 13, 2014 3:19 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Gerrit Jobsis; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: Inflow Dataset Development: Statistical Methodology

All,

Please find attached for your review and comment the statistical methodology for the development of the Parr inflow dataset. We will finalize the dataset after receiving comments, and provide sufficient detail in the model development report such that the dataset can be replicated.

Please submit any comments or questions by Tuesday, May 27th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Congaree Riverkeeper
To:	Kelly Miller
Subject:	Re: Parr PAD reminder
Date:	Saturday, August 30, 2014 4:41:02 PM
Attachments:	DRAFT Parr PAD CRK Comments.docx

Kelly,

Attached is the draft PAD with the handful of comments and edits I made in track changes. Let me know if you have any questions. Thanks.

--
Bill Stangler
Congaree Riverkeeper

On Wed, Aug 27, 2014 at 8:36 AM, Kelly Miller <Kelly.Miller@kleinschmidtgroup.com> wrote:

> Good morning!
>
> This is a reminder that any comments or edits on the draft PAD for the Parr Relicensing Project are due by August 31st.
>
> Thanks!
>
> Kelly
>
> **Kelly Miller**
>
> **Regulatory Coordinator**
>
> Kleinschmidt
>
> **Office: 803.462.5633**
>
> **www.KleinschmidtGroup.com**

From:	Gerrit Jobsis
To:	Alan Stuart; Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; "Vivianne Vejdani"; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject:	RE: Recreation Study Guidelines update
Date:	Tuesday, July 09, 2013 12:15:13 PM

Thanks for the clarification Alan. I understood the outcome of our discussion differently. We discussed that we don't think the outfitters have great knowledge re flows but that some locals who paddle frequently might. Regardless, I can agree to your approach.

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301
Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

Keep the Bucket Moving! Help remove a dangerous dam at www.AmericanRivers.org/Dam-olition

From: Alan Stuart [mailto:Alan.Stuart@KleinschmidtUSA.com]
Sent: Tuesday, July 02, 2013 9:10 AM
To: Gerrit Jobsis; Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: RE: Recreation Study Guidelines update

Hi Gerrit,

First off, thanks again to you and Erich for the presentations during the Op's meeting. The information was very beneficial to the Op's group.

I wanted to make a slight clarification. I believe our intent was to start with the local outfitters and canoe/kayak clubs to determine what recreation flow information they could provide us (the TWC). I don't believe our intent was to poll landowners unless they are part of one of the above organizations. As you correctly point out , if the first tier groups can't provide the TWC the necessary information we will certainly work towards developing a more robust approach/method to address the recreational flow aspect.

If we need to discuss further, please give me a call.

Thanks !
Alan

PS. Hope everyone has a Happy 4th !

From: Gerrit Jobsis [mailto:gjobsis@americanrivers.org]
Sent: Friday, June 28, 2013 1:57 PM
To: Kelly Miller; Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: RE: Recreation Study Guidelines update

Kelly,

Thanks for the quick turn around on yesterday's meeting summary. My notes differ regarding the last bullet. Here is what I believe we agreed to at the end of yesterday's meeting.

- Identify local paddlers (outfitters, landowners and others) who frequently use the Broad River below Parr Shoals dam.
- Interview them to see if (1) they have a good feel which flow(s) provide quality recreation experiences and (2) if they do, ask them what flow(s) provide quality of recreation experiences.
- Bring the results back to the Recreation TWC to determine if this information is adequate for determining recreation flow needs or if a site specific recreation study is needed.

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301
Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

Keep the Bucket Moving! Help remove a dangerous dam at
www.AmericanRivers.org/Dam-olition

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Friday, June 28, 2013 1:35 PM
To: Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); btrump@scana.com; Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); dhancock@scana.com; Dick Christie (dchristie@comporium.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Gerrit Jobsis; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Kelly Miller; Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); tboozer@scana.com; 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Recreation Study Guidelines update

All,

Stemming from a discussion yesterday between some members of the Recreation TWC, the recreation study guidelines that were developed during the Recreation TWC meeting held on May 14th have been revised to reflect the recommendations of American Rivers. Please see the attached document for these revisions.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Gerrit Jobsis
To: Kelly Miller; Henry Mealing; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject: RE: Study Plans for Review
Date: Wednesday, October 02, 2013 2:55:58 PM
Attachments: 004-Draft RSSL Study Plan.docx

Kelly,

Attached in redline format are my comments on the RSSL plan which relate to 3 things.

- Making sure Frost Shoals is included in the study area ("between" does not "include")
- The plan should include assessment of alternatives to avoid, minimize and mitigate project impacts to lilies unless there will be a separate study plan developed for that purpose.
- The study would be postponed to 2016 if high flows of other conditions during 2015, such as this year, do not allow for a good quality study to be performed.

I will not be commenting on the crayfish study.

Also, are you considering delaying the commenting deadline due to the federal government shutdown?

Thanks

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
1001 Washington Street, Suite 301
Columbia, SC 29201
(O) 803.771.7114 (M) 803.546.7926

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Friday, September 06, 2013 4:59 PM
To: Henry Mealing; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis; Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'
Subject: Study Plans for Review

All,

Attached are the Rocky Shoals Spider Lily Study Plan and Spiny Crayfish Study Plan. Please review these documents and have any comments or edits back to me by Friday, October 4th. We will discuss these plans at the next RT&E TWC meeting, which will be scheduled for sometime in November.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Alison Jakupca
To:	Congaree Riverkeeper
Cc:	Kelly Miller; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); BRESNAHAN, AMY; btrump@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); Dick Christie (christied@dnr.sc.gov); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Greg Mixon (mixong@dnr.sc.gov); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Malcolm Leaphart (mwleapjr@att.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Collins (secollins@scana.com); Steve Summer; tboozer@scana.com; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject:	RE: Updated RUNS Study Plan
Date:	Wednesday, November 12, 2014 4:07:41 PM

Bill,

Thank you for your email and concern for the relicensing RUNS study, and thank you for our phone discussion to clarify your comment. We had not planned to do a "formal" evaluation of recreation use at any sites outside of the Project Boundary, but we do want to pull in other information sources regarding recreation use for downstream activities. We received information from Bill Marshall that the Palmetto Conservation Foundation collects trail counter data at selected areas along the Palmetto Trail near the Broad River at Alston. We will be working with him to see if we can get multiple years of data for that site. We will also contact the Harbison State Forest to see how much and what type of use data they have for their facility. I am also including some "Recreation Use/Access Location" questions for the first Downstream Recreation Flow Focus Group meeting coming up in December (TBA). All of these sources will be compiled and included as an Addendum to the RUNS study.

Hopefully, this clarifies why we did not include it in the RUNS study and how we plan to consolidate current and historic information for the RCG to consider. Please let us know if we need further clarification.

Thanks, Alison

From: Congaree Riverkeeper [mailto:crk@congareeriverkeeper.org]
Sent: Wednesday, November 12, 2014 1:15 PM
To: Alison Jakupca
Cc: Kelly Miller; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); BRESNAHAN, AMY; btrump@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); Dick Christie (christied@dnr.sc.gov); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Greg Mixon (mixong@dnr.sc.gov); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Malcolm Leaphart (mwleapjr@att.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan

(rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Collins (secollins@scana.com); Steve Summer; tboozer@scana.com; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Re: Updated RUNS Study Plan

All,

I am concerned that the RUNS study plan does not include any of the downstream sites we had discussed. After looking through the notes from our LLM and Recreation RCG meeting last year, both Bill Marshal and I requested that the RUNS study attempt to quantify the number of users on the Broad River below the Parr Shoals Dam. I still think the Hwy 213 boat ramp and the Alston canoe/kayak put-in (at the Palmetto Trail) should be included as recreation study sites. Additionally, as Harbison State Forest requires all rivers users that use their facility to file a float plan they should have some valuable, and easy to acquire information.

--
Bill Stangler
Congaree Riverkeeper

On Mon, Nov 10, 2014 at 2:35 PM, Alison Jakupca <Alison.Jakupca@kleinschmidtgroup.com> wrote:
Good Afternoon All,

A little less than a month ago, Kelly shot out an email to the group noting a proposed minor change to the RUN Study Plan (email included below). Kelly had asked for any comments on the proposed change by November 14th. I just wanted to remind everyone of this and note that we plan to go ahead and finalize the study plan after C.O.B., November 14th. If you have any comments on the change, please let us know before then. Thanks, Alison

Alison Jakupca
Regulatory Coordinator
Kleinschmidt Associates
Office: 803.462.5628
www.Kleinschmidtusa.com

From: Kelly Miller
Sent: Monday, October 13, 2014 8:29 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); BRESNAHAN, AMY; btrump@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chuck Hightower (hightocw@dhec.sc.gov); David Haddon (dhaddon@scana.com); Dick Christie (christied@dnr.sc.gov); Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Greg Mixon (mixong@dnr.sc.gov); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Jon Durham (jondurham@bellsouth.net); Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Collins (secollins@scana.com); Steve Summer; tboozer@scana.com;

Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Updated RUNS Study Plan

All,

As you are aware, the Recreation Use and Needs Study Plan describes the various study methodologies to be implemented at Project Area recreation sites. These methodologies include, but are not limited to, traffic counters and exit interviews administered by a survey clerk stationed at the recreation site.

As previously drafted, the study plan called for exit interviews and a traffic counter at the Highway 34 boat ramp. Due to safety reasons, it has been determined that a survey clerk should not be stationed at this site to perform exit interviews. However, a traffic counter will be installed at this site and spot counts will be collected when traffic counter data is downloaded.

An updated study plan, with track changes to reflect this modification, has been attached to this email. If you have any questions or concerns, please let us know by November 14th, at which time the updated study plan will be finalized.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

NOAA CONSULTATION

From:	BARGENTIERI@scana.com
To:	Henry Mealing
Subject:	FW: Parr Hydro Relicensing
Date:	Friday, September 27, 2013 1:26:27 PM

From: ARGENTIERI, WILLIAM R
Sent: Tuesday, July 23, 2013 10:17 AM
To: Karla Reece
Cc: Alan Stuart (Alan.Stuart@KleinschmidtUSA.com)
Subject: RE: Parr Hydro Relicensing

Karla,

I hope you are doing fine.

I am just following up with you since I have not received a response or even an acknowledgement to my inquiry below. Please confirm that you received my request below and let me know if this is something you are working on.

Also, if you are interested, we are having an IFIM Technical Working Committee meeting next Wednesday, July 31 from 9:30 AM to 4:30 PM. If you are interested in participating in this meeting let me know and I will send you an Outlook meeting notice with the conference call access information.

Thank you for your assistance.

Bill

From: ARGENTIERI, WILLIAM R
Sent: Monday, July 08, 2013 10:00 AM
To: Karla Reece
Cc: Alan Stuart (Alan.Stuart@KleinschmidtUSA.com)
Subject: Parr Hydro Relicensing

Karla,

I hope you had a nice holiday.

I am just following up with you regarding the sturgeon discussions during our RT&E meeting on May 16. During that meeting you offered to find out if NMFS had any concerns with shortnose and Atlantic sturgeon associated with the Parr Hydroelectric Project. At the time you thought you might be able to have an answer by late June or early July. Have you been able to find out if the NMFS Protected Resource Branch will be an active participant moving forward in the relicensing process for Parr Hydro? If your group is going to participate, could you please provide us with what you believe will be the level of participation and what information (including potential data needs) you may be seeking? This information will be extremely crucial to us as we begin to prepare the Pre-Application Document in 2014.

If you are still gathering feedback from others in your agency and dont have the answers, that is fine, just let me know when you have something, as we will keep this as an open item.

Thank you for your assistance.

William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

(Physical Address)
100 SCANA Pkwy
Building A, Floor 2
Cayce, SC 29033-3712

Phone - (803) 217-9162
Fax - (803) 933-7849
Cell - (803) 331-0179

From: BARGENTIERI@scana.com
To: Henry Mealing
Subject: FW: Parr Hydro Relicensing
Date: Friday, September 27, 2013 1:25:40 PM

From: ARGENTIERI, WILLIAM R
Sent: Monday, July 08, 2013 10:00 AM
To: Karla Reece
Cc: Alan Stuart (Alan.Stuart@KleinschmidtUSA.com)
Subject: Parr Hydro Relicensing

Karla,

I hope you had a nice holiday.

I am just following up with you regarding the sturgeon discussions during our RT&E meeting on May 16. During that meeting you offered to find out if NMFS had any concerns with shortnose and Atlantic sturgeon associated with the Parr Hydroelectric Project. At the time you thought you might be able to have an answer by late June or early July. Have you been able to find out if the NMFS Protected Resource Branch will be an active participant moving forward in the relicensing process for Parr Hydro? If your group is going to participate, could you please provide us with what you believe will be the level of participation and what information (including potential data needs) you may be seeking? This information will be extremely crucial to us as we begin to prepare the Pre-Application Document in 2014.

If you are still gathering feedback from others in your agency and don't have the answers, that is fine, just let me know when you have something, as we will keep this as an open item.

Thank you for your assistance.

William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

(Physical Address)
100 SCANA Pkwy
Building A, Floor 2
Cayce, SC 29033-3712

Phone - (803) 217-9162
Fax - (803) 933-7849
Cell - (803) 331-0179

From:	Henry Mealing
To:	BARGENTIERI@scana.com; "Steve Summer"; "QUATTLEBAUM, MILTON"; Alison Jakupca; Kelly Miller; Shane Boring; "Randy Mahan (randolph.mahan@scana.com)"; "AMMARELL, RAYMOND R"
Cc:	"Karla Reece - NOAA Federal"
Subject:	FW: SCE&G Parr Fairfield Discussions
Date:	Tuesday, March 11, 2014 2:31:00 PM
Attachments:	image001.png

Hello Folks – I spoke with Karla Reece – NOAA – last week and wanted to share the highlights of our conversation. Karla has reviewed these and asked that I make it clear that she speaks for NOAA on ESA Section 7 issues NOT on Essential Fish Habitat issues.

There are several items that we should include in the Parr Fairfield PAD that will help NOAA understand the relationship of the Project to sturgeon populations in the Broad, Congaree, and Santee-Cooper Rivers. Also, we should have a discussion with Bill Post and Ron Ahle regarding their work with sturgeon in the project area and include that in the PAD.

Henry

Henry Mealing
Kleinschmidt Associates
Fisheries Biologist / Team Leader
Cell: 706-339-3209

From: Henry Mealing
Sent: Monday, March 10, 2014 8:53 PM
To: 'Karla.Reece@noaa.gov'
Subject: SCE&G Parr Fairfield Discussions

Karla,

Thank you for taking the time to talk with me about the Parr Fairfield Relicense effort that South Carolina Electric & Gas Company is currently undertaking. I have attempted to capture the items we talked about in this note – just to make sure that we are all on the same page. Ultimately, I will share these with SCE&G and with our team so that we can address the items included. As you requested I have included that your comments are related back to NOAA interests for ESA Section 7 consultation on threatened and/or endangered species – Not on Essential Fish Habitat issues.

- NOAA concerns at this point are primarily associated with the potential project impacts on Atlantic sturgeon (AS) and shortnose sturgeon (SNS) in the project area and downstream of the project. Karla suggested that SCE&G review and consolidate all of the current information available on distribution of AS and SNS in the Broad River downstream of the Project. Karla and Henry discussed that this information would be presented in the Preliminary Application Document (PAD) and distributed to the agencies and public. Karla suggested that we ask Bill Post and Ron Ahle (South Carolina Dept. of Natural Resources) for any available information.

- NOAA is aware that SNS are present in the Congaree (spawning site) downstream of the

Columbia Hydro Project and in the reservoir of the Santee Cooper Moultrie and Marion Projects. AS and SNS are both located downstream of the Santee Cooper Project in the Santee and Cooper Rivers. Karla is interested in how the Parr Fairfield operations impact each of those populations or if there is no impact from the Parr Fairfield Project. If there are impacts, then we will need to begin informal and formal consultation for the species impacted.

- Henry explained that SCE&G is seeking to use the Traditional Relicensing Process (TLP) and will be filing the Notice of Intent – the PAD – and a request for using the TLP in January 2015. Henry also asked Karla if they would support the use of the TLP. Karla stated that NOAA isn't opposed to using the TLP.

- Karla and NOAA look forward to working with SCE&G on the relicense of the Parr Fairfield Project. Henry told her about the updates that have been posted on the Relicense Website. SCE&G will continually update this site during relicensing as a resource for the agencies and public. The website address is: http://parrfairfieldrelicense.com/

Take a look at these bullets and see if you think it represents our discussion accurately. If not, please send back any additions or deletions. Thanks for your help, and I look forward to meeting you at one of the relicensing meetings.

Henry

Henry Mealing
Fisheries Biologist / Team Leader

204 Caughman Farm Lane
Suite 301
Lexington, SC 29072
706-339-3209
www.KleinschmidtUSA.com

Parr Hydroelectric Project Relicensing

Phone Notes April 24, 2014

Discussion of Potential Project Impacts on Shortnose and Atlantic Sturgeon

Attendees: Shane Boring (Kleinschmidt), Henry Mealing (Kleinschmidt), Chad Holbrook (SCDNR), Bill Post (SCDNR)

Notes:

Shane opened the discussion noting that the meeting purpose would be to review the known upstream extent of shortnose and Atlantic sturgeon in the Santee basin downstream of the Parr Hydro Project. Henry further clarified that he had been consulting with Karla Reece at NOAA Fisheries regarding Section 7 issues related to shortnose and Atlantic sturgeon, and that Karla had essentially deferred to SCDNR diadromous staff regarding whether or not these species occur in the project vicinity and could potentially be affected by continued operations.

Bill Post noted that, currently, shortnose are known to occur upstream in the Congaree River to approximately the City of Columbia, as documented in Finney (2006[1]), Leech and Cook (2004[2]), Collins et al. (2003[3]), and several Santee Diadromous Fish Accord Studies and SCNDR reports. He noted that Finney tracked a single fish to approximately the Blossom St. Bridge, but that was based on a single occurrence and that generally most of documented occurrences have been below the old Granby Lock and Dam. He noted that Collins et al. (2003) documented a spawning aggregation just downstream of the I-77 Bridge. In summary it was noted that no fish have been documented in recent history entering the Broad River or the Columbia Fishway.

---

[1] **Finney, S.T., J.J. Isely and, D.W. Cooke. 2006. Upstream migration of two pre-spawning shortnose sturgeon passed upstream of Pinopolis Dam, Cooper River, South Carolina. Southeastern Naturalist 5:369-375.**

[2] **Cooke, D.W. and S.D. Leach. 2004. Movement of Shortnose Sturgeon in the Santee Cooper Lake System. Submitted to Santee Cooper, Moncks Corner, SC.**

[3] **Collins, M.R., D. Cooke, B. Post, J. Crane, J. Bulak, T. Smith, T.W. Greig and J.M. Quattro. 2003. Shortnose Sturgeon in the Santee – Cooper Reservoir System, South Carolina. Transactions of the American Fisheries Society 132:1244-1250.**

In regards to Atlantic sturgeon, Bill noted sporadic occurrences in the Santee-Cooper Lakes, including a few Atlantics on the upstream side of the dam during a fish kill that occurred in the 1980-1990 range, as well as a single Atlantic in the fish lift at St. Stephens in 2007. Bill noted they have done lots of netting in the vicinity of the Congaree/Wateree confluence and would have expected to capture juvenile or sub-adult Atlantics if they are there. None have been captured. SCDNR staff noted that the upstream extent of Atlantics is currently thought to be limited by passage at the Santee-Cooper dams. Atlantics have not been documented in the Congaree River or in upstream reaches in recent history, with the exception of a single fish in the Columbia Canal around 1936.

Henry then inquired as to whether SCDNR diadromous staff had concerns regarding any potential impacts of Parr Hydroelectric project operations on shortnose or Atlantic sturgeon. Bill noted that their primary concern would likely be related to downstream flows. For example, if peaking would have any effect on water levels in the Upper Congaree during the spring spawning season. Shane noted that the Parr Project doesn't have significant storage capacity to likely cause such an effect and that any peaking effects are likely dampened by reregulation of the flow by the Columbia Hydro Project. Henry added that flows are typically higher in spring anyway, making it unlikely that any such peaking flows would be significant downstream of the Columbia Hydro Project. Acknowledging that flow impacts to the Upper Congaree are unlikely, Kleinschmidt staff noted that level-loggers are being deployed throughout the reach of the Broad below the project and that an operations model is being developed to determine the extent of the downstream peaking "wave." It was determined that, if operations modeling efforts suggest that water level/flow effects extend downstream of the Columbia Hydro Project, then there may be a need to reinitiate consultation regarding potential sturgeon impacts; otherwise, there are no concerns. Bill and Chad were agreeable to this approach.

Bill Post provided the following clarifications during review of an earlier draft of these notes:

- **The Atlantic sturgeon found in the St Stephens fish lift in 2007 was found upstream of the St Stephens Dam and most likely did not pass through the fish lift.**
- **It should be noted that SCDNR is currently studying the movements of shortnose and Atlantic sturgeon in cooperation with NOAA Fisheries - NMFS. Information obtained from this study will help resource agencies develop reasonable restoration and management goals and objectives. However, since both sturgeon species are endangered, NOAA Fisheries - NMFS has the sole regulatory authority to manage the species as warranted under Section 7.**

From:	Pace Wilber - NOAA Federal
To:	Gerrit Jobsis
Cc:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject:	Re: Inflow Dataset Development: Statistical Methodology
Date:	Wednesday, May 28, 2014 9:45:12 PM

Hi Kelly. I agree with the comments from FWS and American Rivers that short-term variation important for assessing project effects on fishes and riverine habitat may be masked by using monthly average flows as model inputs. I also agree there are much better ways to judge the similarity of flows between subwatersheds than "eyeballing" the histograms in figures 2 and 3. A correlation matrix may be a more rigorous way to make the comparisons. Pace

On Wed, May 28, 2014 at 4:53 PM, Gerrit Jobsis <gjobsis@americanrivers.org> wrote:

> Kelly,
>
> Please find attached American Rivers comments on the inflow data plan. It is intended to support the Final Parr Fairfield Operations Model Study Plan. That study plan says "The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies." As my comments in the document state, I do not agree that this inflow data set will be usable to evaluate the effects of project operations on habitat and recreation. Project operations via inflow alterations and reservoir fluctuations affect habitat and recreation values on a real time basis (hourly or less) that cannot be estimated using monthly average inflow estimates. Smoothing the data with regression equations removes the hourly and sub-hourly variation that is essential to understanding project effects.
>
> I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.
>
> Gerrit
>
> ______________________________________
>
> Gerrit Jöbsis, American Rivers
>
> Senior Director, Southeast Conservation Programs
>
> 215 Pickens Street

Columbia, SC 29205

(O) 803.771.7114   (M) 803.546.7926

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From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Tuesday, May 13, 2014 3:19 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Gerrit Jobsis; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net)

Subject: Inflow Dataset Development: Statistical Methodology

All,

Please find attached for your review and comment the statistical methodology for the development of the Parr inflow dataset. We will finalize the dataset after receiving comments, and provide sufficient detail in the model development report such that the dataset can be replicated.

Please submit any comments or questions by Tuesday, May 27th.

Thanks,

Kelly

Kelly Miller

Regulatory Coordinator

Kleinschmidt

Office: 803.462.5633

www.KleinschmidtGroup.com

--

Pace Wilber, Ph.D.
HCD Atlantic Branch Supervisor
NOAA Fisheries Service
219 Ft Johnson Road
Charleston, SC 29412

Voice: 843-762-8601
FAX: 843-953-7205
Pace.Wilber@noaa.gov

SCDHEC CONSULTATION

From:	Wenerick, William "Rusty"
To:	Kelly Miller
Subject:	DHEC comments on draft WQ report
Date:	Thursday, October 17, 2013 8:32:07 AM

Kelly,

Below are comments on the draft WQ report. After the comments we provided links to help you find information. We would be glad to meet with you to discuss anything or help you in any way we can.

Sincerely,
Rusty Wenerick

Should include any available WQ data from upstream (B-046) and downstream of the project

Should include nutrients and metals data when available

Reference DHEC standards and 2012 303(d) list

When possible highlight excursions and discuss - contact DHEC Surface Water Monitoring Program for help interpreting standards

Figures leave out several DHEC stations - please use interactive mapper to find all DHEC stations in project area - see link below

Several stations reported as no longer being sampled are still active - see monitoring strategy - see link below

By the way, RL11031=RL04370, data is pooled for 303(d) list

language about budget constraints, not fully supported, and no longer monitored is incorrect - see monitoring strategy - you may have mixed up 303(d) language with whether a site is active or not?

discuss compliance with 401 conditions

B-047, B-327 & B-345 - what about TP and Chlorophyll-a?

Tables 3-1 & 3-3 have some incorrect units - data in storet has been corrected

should redo download of all data from storet to get updated and new data (additional years and months), and additional stations

Discuss compliance with NPDES permit as temperature data indicates more than 5 degrees difference at times between intake and discharge uplake called intake?

Nitrogen - Total Nitrogen? How calculated?

"Presence of metals in reservoirs a mainstay" - be specific and discuss/explain - reference DHEC standards

Copper excursions at B-236 occurred on 2/4/04 and 8/2/04 - what was going on then that may explain?

DHEC Surface Water Monitoring Program web page
http://www.scdhec.gov/environment/water/surface.htm
Under the heading
"Accessing DHEC Water Quality Data From USEPA STORET"
you will find the following links to instructions for downloading current data
http://www.scdhec.gov/environment/water/docs/fw_STORETdownloadInstructions.pdf
http://www.scdhec.gov/environment/water/docs/fw_dataElementsReport.pdf

Interactive Mapper that shows monitoring sites
http://www.scdhec.gov/environment/water/SFW_MON_Map.htm
for finding all sites near the project - get site numbers here, then search for them in 303(d) list, then download data and report
try a different browser if it does not work

State of SC Monitoring Strategy for 2013
http://www.scdhec.gov/environment/water/docs/strategy.pdf
lists active and inactive sites

Link for downloading spreadsheet for EPA-approved DHEC 2012 303(d) list
http://www.scdhec.gov/environment/water/tmdl/docs/tmdl_12-303d.xls
the above link came from this page
http://www.scdhec.gov/environment/water/tmdl/

--
William "Rusty" Wenerick
DHEC Bureau of Water
2600 Bull Street
Columbia, SC 29201-1708
Room 4464
Phone: (803) 898-4266
Fax: (803) 898-7344
Rusty.Wenerick@dhec.sc.gov
https://www.scdhec.gov/environment/water/401.htm
https://www.scdhec.gov/environment/water/navwater.htm
http://link.springer.com/article/10.1007/s00267-013-0158-x

From:	Wenerick, William "Rusty"
To:	Kelly Miller
Subject:	PAD comments from DHEC
Date:	Tuesday, September 02, 2014 7:47:36 AM
Attachments:	DHECcomments001-DRAFT Parr PAD_072814.docx

attached in track changes

William R. "Rusty" Wenerick, Project Manager
DHEC Bureau of Water
2600 Bull Street, Columbia, SC 29201
Phone: (803) 898-4266
Fax: (803) 898-7344
Email: Rusty.Wenerick@dhec.sc.gov
401/WQC
Website: http://www.scdhec.gov/environment/WaterQuality/401Certification/Overview/
Nav Waters Website: http://www.scdhec.gov/environment/WaterQuality/NavigableWaters/
Research: http://link.springer.com/article/10.1007/s00267-013-0158-x

From: Kelly Miller
To: Wenerick, William "Rusty"
Cc: ARGENTIERI, WILLIAM R; Henry Mealing
Subject: RE: DHEC comments on draft WQ report
Date: Monday, October 21, 2013 8:59:00 AM

Rusty,

Thank you for your comments on the Parr/Fairfield Baseline Water Quality Report. We have included our responses to your requests and comments below. We are not clear on all of the requests and would therefore like to schedule a meeting with SCDHEC, SCE&G, and Kleinschmidt on November 1st or November 8th to discuss these further. Please let us know your availability on these days. We would also like to clarify any additional study requests that SCDHEC will be making as part of the water quality 401 certification process. We are developing our study plans for 2015 and need to identify these by January 2014 for inclusion in the Preliminary Application Document that will be filed with the FERC at the kick-off for relicensing.

Thank you for your participation and cooperation.
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Wenerick, William "Rusty" [mailto:weneriwr@dhec.sc.gov]
Sent: Thursday, October 17, 2013 8:32 AM
To: Kelly Miller
Subject: DHEC comments on draft WQ report

Kelly,

Below are comments on the draft WQ report. After the comments we provided links to help you find information. We would be glad to meet with you to discuss anything or help you in any way we can.

Sincerely,
Rusty Wenerick

Should include any available WQ data from upstream (B-046) and downstream of the project
The B-046 site is located upstream near the USGS Carlisle gage. This Carlisle data, including temperature, DO, conductivity and pH, has already been incorporated into the updated? water quality report and it should provide sufficient information to characterize the river upstream of the

project. Water quality data from the USGS gage downstream of the Parr Shoals dam is also included in the report.

Should include nutrients and metals data when available

Metals and nutrients data is already included in the report. Additional metals data was added after the last WQ TWC meeting.

Reference DHEC standards and 2012 303(d) list

I originally included USEPA standards, but will go back and include DHEC standards instead. I will also include excursions within the project reported in the 2012 303(d) list.

When possible highlight excursions and discuss - contact DHEC Surface Water Monitoring Program for help interpreting standards

Excursions reported in the 303(d) list will be included in the report.

Figures leave out several DHEC stations - please use interactive mapper to find all DHEC stations in project area - see link below

The fixed monitoring sites that are in the Project Boundary were included in the report. These sites were chosen because they are able to track changes or trends over time. The other DHEC stations are random sites, which are only monitored for a period of one year, so these sites were not included in the report since we couldn't track trends or changes in water quality parameters.

Several stations reported as no longer being sampled are still active - see monitoring strategy - see link below

According to the Monitoring Strategy, sites B-047, B-327 and B-345 are listed as being active. The WQ report incorrectly lists site B-047 as being inactive. This will be corrected, however data for this site was only available through 2004. Site B-328 is inactive and is described as such in the report. However, wording will be changed to reflect the wording used in the DHEC monitoring strategy. As mentioned above, the random monitoring sites listed as active in the 2013 DHEC monitoring strategy will not be included in the report.

By the way, RL11031=RL04370, data is pooled for 303(d) list

Excursions from this site will be covered in the review of the 303(d) list.

language about budget constraints, not fully supported, and no longer monitored is incorrect - see monitoring strategy - you may have mixed up 303(d) language with whether a site is active or not?

This will be adjusted per the wording in the 2013 DHEC monitoring strategy or other wording provided by your department.

discuss compliance with 401 conditions

The current 401 WQC for the Parr Fairfield Hydro Project will be included as an appendix in the revised water quality report.

B-047, B-327 & B-345 - what about TP and Chlorophyll-a?

This information will be added to the revised report.

Tables 3-1 & 3-3 have some incorrect units - data in storet has been corrected

The revised report will be updated according to the corrections made in STORET.

should redo download of all data from storet to get updated and new data (additional years and months), and additional stations

We are not clear on your request. Are you saying all of the data in STORET was incorrect and was updated recently? Which additional years and months are you interested in? Which additional stations are you interested in? The data (stations and parameters) provided in the original summary report was agreed upon in one of our initial WQ TWC meetings. In order for us to get a better understanding of what you want included in the revised report, we would like to schedule a meeting to discuss this request with DHEC.

Discuss compliance with NPDES permit as temperature data indicates more than 5 degrees difference at times between intake and discharge

This was discussed at the last WQ TWC meeting held in September 2013. This request has already been incorporated into the revised report and the NPDES permit will be included as an appendix to the final revised water quality report.

uplake called intake?

There are three SCANA monitoring sites located on Lake Monticello, called “intake”, “uplake”, and “discharge”. These are three separate sites which are depicted in a figure in the original report and their locations are described within the report text.

Nitrogen - Total Nitrogen? How calculated?

This information was collected by DHEC and their process will be added (how calculated) and clarified (total nitrogen) in the revised report.

"Presence of metals in reservoirs a mainstay" - be specific and discuss/explain - reference DHEC standards

We would like to discuss this in our face-to-face meeting with you.

Copper excursions at B-236 occurred on 2/4/04 and 8/2/04 - what was going on then that may explain?

We are not sure that we can identify this excursion 10 years ago, but would like to discuss this item with you in our meeting.

DHEC Surface Water Monitoring Program web page
http://www.scdhec.gov/environment/water/surface.htm
Under the heading

"Accessing DHEC Water Quality Data From USEPA STORET"

you will find the following links to instructions for downloading current data
http://www.scdhec.gov/environment/water/docs/fw_STORETdownloadInstructions.pdf
http://www.scdhec.gov/environment/water/docs/fw_dataElementsReport.pdf

Interactive Mapper that shows monitoring sites

http://www.scdhec.gov/environment/water/SFW_MON_Map.htm
for finding all sites near the project - get site numbers here, then search for them in 303(d) list, then download data and report
try a different browser if it does not work

State of SC Monitoring Strategy for 2013
http://www.scdhec.gov/environment/water/docs/strategy.pdf
lists active and inactive sites

Link for downloading spreadsheet for EPA-approved DHEC 2012 303(d) list
http://www.scdhec.gov/environment/water/tmdl/docs/tmdl_12-303d.xls
the above link came from this page
http://www.scdhec.gov/environment/water/tmdl/

--
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https://www.scdhec.gov/environment/water/401.htm
https://www.scdhec.gov/environment/water/navwater.htm
http://link.springer.com/article/10.1007/s00267-013-0158-x

From: Eargle, David A.
To: Kelly Miller
Cc: Glover, James
Subject: Re: draft Monticello Mussel Study Plan for review
Date: Friday, October 04, 2013 12:54:57 PM

Kelly,

I read over the study plan. Unless I'm missing something, this sounds like just what we need. We can talk more about it at the next meeting.
Thanks!

David

On Fri, Oct 4, 2013 at 11:55 AM, Kelly Miller <Kelly.Miller@kleinschmidtusa.com> wrote:

> All,
>
> Attached is the draft Monticello Mussel Study Plan. Please review this document and have any comments or edits back to me by Friday, October 18th. We will discuss this study plan at the upcoming RT&E TWC meeting, scheduled for Tuesday, October 22nd.
>
> Thanks,
>
> Kelly
>
> **Kelly Miller**
>
> **Regulatory Coordinator**
>
> Kleinschmidt
>
> **Office: 803.462.5633**
>
> **www.KleinschmidtUSA.com**

--
David A. Eargle

Aquatic Biologist
South Carolina Department of Health and Environmental Control
(803) 898-4145

SCDNR CONSULTATION

From:	Bill Marshall
To:	Kelly Miller; Henry Mealing
Cc:	"Dick Christie"
Subject:	Broad River Recreational flows committee
Date:	Thursday, October 24, 2013 3:03:42 PM

Kelly and Henry,
Dick Christie polled DNR staff for suggested anglers who may be suited to the proposed Focus Group to address downstream flows for recreation on the Broad River below Parr. Our collective response of suggestions include four individuals who are listed (names underlined at bullets) below for your consideration.
We hope this is helpful.

Bill Marshall
SCDNR

Our suggestions:

- Trout Unlimited, particularly Malcolm Leaphart would be an appropriate and knowledgeable choice because he and other members regularly fish for smallmouth bass on the Broad River. I think you already have contact info for Malcolm.

- Stuart Greeter, retired DNR staff, former Congaree Riverkeeper, part time employee at Congaree National Park as guide. Not sure with what group he should be affiliated but Stuart is the most avid recreational user (angler and boater) of the Broad River that I (Bill) know and he would be a knowledgeable contributor to the Focus Group. Contact Stuart at sgreeter77@earthlink.net or 803-331-7064. Mailing address is 404 Clark St., Cayce, SC 29033.

Other DNR staff suggestions:

From Hal Beard --

The only "guide" I'm aware of on the lower section of the Broad is the contact below:

- Lt. Dave Williams (employed with Greenville County Sheriff's Office)
  Cell 864-630-1583
  Home 864-295-0292
  Office Cell 864-303-9431

Business Email is Dave@allroverssouth.com and website www.AllRiversSouth.com.

From Jason Bettinger --

- Mike McSwain is an active guide on the lower Broad River. He'd probably be interested in participating. His email is mcswain@comcast.net

From:	Bill Marshall
To:	Kelly Miller
Cc:	Scott Harder
Subject:	Comments on Draft Hydraulic & Project Operations Model, Parr Hydro Project
Date:	Wednesday, January 15, 2014 3:04:37 PM

Hi Kelly,

DNR hydrology staff have reviewed the draft operations model study plan and we are providing comments and questions for consideration as the RCG continues developing the plan and prepares for meeting on Jan 30. DNR comments and questions are as follows:

1. In a prior Parr-FF operations committee meeting, there was a discussion about determining the effects of the Parr Hydro on the Congaree National Park. However, from the draft report, models will only be used to assess operations to approximately 20 miles downstream. Is the study component to address Congaree NP still on the table?

2. Refer to the discussion of metrics in section 2.4. Though we generally support the use of metrics to facilitate the reviews of various scenarios, metrics should be modified or added as needed during the scenario review process. As we have seen in other modeling efforts, defining initial metrics (or more appropriately when a given metric value denotes a significant change or impact) without reviewing the baseline and a few scenario outputs can be problematic. If metrics aren't defined carefully, then discerning the differences between two scenarios can be difficult.

3. We are was pleased to see the Enoree Gages will be used to evaluate regional relationships between runoff and drainage area, as we would recommend use of these gages to help develop an inflow data set. Appropriate error analysis should accompany the determination of the regional alpha and gamma coefficients presented in section 4.1.

4. In section 4.1.2, it is unclear whether or not the back calculation of the inflow hydrograph will be done or not.

5. There is no mention of incorporating water use projections in the modeling process. We would recommend water use projections be included. It may be possible to build on previous projections done for the basin by Duke Energy (and any projections done by North Carolina, if available).

> Note: If Duke's projections were used they would need to be carefully reviewed and likely modified because -- (1) the projections are somewhat dated (2006), (2) experience with projections by Duke energy in the Catawba basin within the past 10 years indicate they tend to overestimate water use projections, and (3) changes in energy sources (and perhaps demand) over the past several years in the energy industry could have a large impact on future water needs for energy in the basin that may not be accounted for the in the Duke projections.

6. We request the SCDNR (and other stakeholders) be provided with the baseline HEC Res Sim operations model and the HEC-RAS hydraulic model and have the ability to independently run the models and review outputs. Any proposed scenarios should be carefully documented so that SCDNR

staff can independently make appropriate edits to the model (or alternatively, the consultants can provide updated models with loaded scenarios on a periodic basis). In addition, we would request a one day seminar or training session be scheduled for stakeholders to introduce the baseline models and provide limited training on use and running of the models.

7. Though we understand the challenges or producing an operations model that can mimic all historic operations, we would request the consultants to elaborate on any criteria used to determine whether the model is functioning adequately enough. For example, in section 4.3.1 at the end of the first paragraph, what is meant by the average expected system response?

Thank you for consideration of our comments and questions.

Bill Marshall
SCDNR

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Monday, December 16, 2013 8:56 AM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (dchristie@comporium.net); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: draft Project Operations Model Study Plan

All,

Attached for your review is the draft Project Operations Model Study Plan for the Parr/Fairfield Project. Please have any comments or edits back to me by Wednesday, January 15th. We will discuss this study plan at the upcoming Operations RCG meeting, scheduled for Thursday, January 30th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Kelly Miller
To:	Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard (BeardH@dnr.sc.gov); Jim Glover (gloverjb@dhec.sc.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Sam Stokes (stokess@dnr.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); "Vivianne Vejdani"
Subject:	FW: Draft Parr/Fairfield Baseline Fisheries Report
Date:	Friday, August 23, 2013 11:36:06 AM
Attachments:	002-Parr FF Baseline Fisheries Report w track changes.docx

All,

Please see Ron Ahle's comments and edits on the Fisheries Report, as discussed at yesterday's Fisheries TWC meeting.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Ron Ahle [mailto:AhleR@dnr.sc.gov]
Sent: Wednesday, August 14, 2013 4:54 PM
To: Kelly Miller
Cc: Hal Beard; Dick Christie; Bill Marshall; Vivianne Vejdani
Subject: RE: Draft Parr/Fairfield Baseline Fisheries Report

Hi Kelly,

As I mentioned previously, I will not be able to attend the TWC meeting on Aug 22nd. So, I'm sending in some comments (that do not necessarily represent the position of the DNR) that can be used for discussion purposes. Attached is the draft w/ track changes that I am purposing. In addition to these recommendations, I have the following discussion bullets:

1) A review of the fishery resources for the sub-impoundment should be included in the Lake Monticello portion of the document.
2) A description of the fishery resources of the Broad River should be mentioned. In particular, a short summary of the unique smallmouth bass fishery that is hatchery supported by SCDNR should be discussed. After all, the smallmouth bass is a target species for the IFIM study.
3) Only a brief mention of the Columbia Fishway was given in the text. This is an important factor influencing the fish community of the Lower Broad River. A short paragraph is needed describing the fishway and possibly a summary of the fish data collected to date.

4) On the same note, no mention was made about the diadromous fish accord, collective American eel efforts, or the Robust Redhorse cooperative. The Lower Broad River is an integral part of these efforts to restore these various fish populations. Therefore, some mention of these various programs needs to be in the report.
5) It would also be nice to have a sentence in the report that establishes the nexus between the diverse fish community and the abundance and diversity of fresh water mussels in the Lower Broad River.
6) And finally, when looking at and commenting to the fish community changes in the reservoirs from the 80's to the present, a lot of weight was placed on the white perch. The factor that may have enabled the white perch to flourish while centrachid and clupeid populations suffered was the long term effects of the pumpback operation. A pumpback operation can affect a fish community in a number of different ways including entrainment, disruption of shoreline habitat due to frequent pool elevation fluctuations, and re-suspension of sediments thereby increasing turbidity. Clupieds, being an open water species, are susceptible to entrainment and centrachids are sensitive to shoreline disturbances that disrupt spawning and nursery habitat such as frequent pool elevation fluctuations. The white perch, though know to compete with other similar sized fish species, will flourish in the absence of competition from a healthy centrachid population, plus they are fairly tolerant of turbid waters.

I hope these comments are useful for the group. One last thing that I wanted to mention is that part of the data on the Broad River Study that I sent was not used in the document probably because it is pretty far downstream. I'm not recommending that you add that information to the report, but just wanted to let you know that I will be talking about that other information in future meetings. I am also willing to give a presentation on my Broad River Study if the group is interested.

Thanks for the opportunity to comment on the draft. Also, a note of appreciation for the good work in putting together the first draft.

Sincerely,

Ron Ahle
Freshwater Fisheries Biologist
South Carolina Department of Natural Resources
2728 Fish Hatchery Road
West Columbia, SC 29172
Phone# 803-755-9345

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Thursday, July 25, 2013 10:55 AM
To: Alan Stuart; BARGENTIERI@scana.com; Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard; Jim Glover (gloverjb@dhec.sc.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Robert Stroud; Ron Ahle; Sam Stokes Jr.; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject: Draft Parr/Fairfield Baseline Fisheries Report

Good morning all!

Attached is the draft Baseline Fisheries Report for the Parr/Fairfield Relicensing Project. Please review and have any edits or comments ready for discussion at our upcoming Fisheries TWC meeting, scheduled for Thursday, August 22nd.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Bret Hoffman
To:	Scott Harder
Cc:	BARGENTIERI@scana.com; Henry Mealing; Kelly Miller
Subject:	Harder_Comments-Parr-Inflow-Methodology_06_23_14_KA_response (2)
Date:	Monday, June 23, 2014 4:48:01 PM
Attachments:	Harder_Comments-Parr-Inflow-Methodology_06_23_14_KA_response (2).docx

Good afternoon Scott,

Thanks again for your comments on the inflow methodology, we have prepared responses to discuss during the meeting, and wanted to send ahead of time.

-Bret

Bret R. Hoffman, P.E.
Senior Engineer
Kleinschmidt
Office: 803.462.5623
www.KleinschmidtGroup.com

From: Bill Marshall
To: Kelly Miller
Subject: RE: draft Operations RCG meeting notes - 1/30/14
Date: Friday, March 21, 2014 10:21:16 AM

H Kelly
Scott Harder had a couple comments of the Meeting summary. Sorry this is late.

Regarding his first comment: It may help to specify somewhere in the summary an action to be taken such as -- Study Report will include a description of how the inflow dataset was prepared. His second comment is clarifying interest in seeing a model demo of both HEC-Res and HEC-RAS

Thanks,
Bill

> From Scott:
>
> In the section addressing Question 3 -
> I thought we agreed that there would be a report written up on how the inflow dataset was prepared. It does not say explicitly that there will be a report.
>
> In the section addressing Question 6 -
> Though I am more interested in the HEC-Res model demonstration, I would like to see a demonstration on the HEC-RAS as well. I thought i said that I still wanted to see both demonstrations.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Tuesday, March 04, 2014 5:09 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: draft Operations RCG meeting notes - 1/30/14

All,

Attached are the draft meeting notes from the Operations RCG meeting, held on January 30, 2014. Please review and submit any comments or edits by Tuesday, March 18th.

Thanks,

Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
[**www.KleinschmidtUSA.com**](http://www.KleinschmidtUSA.com)

From:	Bill Marshall
To:	Kelly Miller; BARGENTIERI@scana.com; Elizabeth Johnson (emjohnson@scdah.state.sc.us); Frank_Henning@nps.gov; QUATTLEBAUM, MILTON; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; tboozer@scana.com; Alison Jakupca; Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Dick Christie; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Jon Durham (jondurham@bellsouth.net); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); Mark Caldwell (mark_caldwell@fws.gov); Mel Jenkins (greenpalmetto@yahoo.com); Pace Wilber (Pace.Wilber@noaa.gov); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Sam Stokes Jr.; Scott Castleberry (castlews@dhec.sc.gov); Scott Harder; Shane Boring; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net); btrump@scana.com; David Haddon (dhaddon@scana.com); Erich Miarka (erich.miarka@gillscreekwatershed.org); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); rammarell@scana.com; Robert Stroud; Scott Collins (secollins@scana.com); William Hendrix (hendrixwb@dot.state.sc.us); Bret Hoffman; Bruce Halverson; Dick Christie (dchristie@comporium.net); Terri Hogan (terri_hogan@nps.gov)
Subject:	RE: draft Parr Hydroelectric Project PAD
Date:	Saturday, August 30, 2014 12:08:39 PM
Attachments:	DRAFT Parr PAD_072814 (DNR Comments).docx

Hi Kelly,
DNR staff comments and suggested edits regarding the draft PAD for Parr-Fairfield hydroelectric project are attached, provided in Tack Changes format within the draft document. We appreciate the ongoing opportunities to provide input to this process.

Bill Marshall
SCDNR
803-734-9096

From: Kelly Miller [Kelly.Miller@KleinschmidtGroup.com]
Sent: Monday, July 28, 2014 3:54 PM
To: BARGENTIERI@scana.com; Elizabeth Johnson (emjohnson@scdah.state.sc.us); Frank_Henning@nps.gov; Kelly Miller; QUATTLEBAUM, MILTON; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; tboozer@scana.com; Alison Jakupca; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Dick Christie; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Jon Durham (jondurham@bellsouth.net); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); Mark Caldwell (mark_caldwell@fws.gov); Mel Jenkins (greenpalmetto@yahoo.com); Pace Wilber (Pace.Wilber@noaa.gov); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Sam Stokes Jr.; Scott Castleberry (castlews@dhec.sc.gov); Scott Harder; Shane Boring; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net); btrump@scana.com; David Haddon (dhaddon@scana.com); Erich Miarka (erich.miarka@gillscreekwatershed.org); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); rammarell@scana.com; Robert Stroud; Scott Collins (secollins@scana.com); William Hendrix (hendrixwb@dot.state.sc.us); Bret Hoffman; Bruce Halverson; Dick Christie (dchristie@comporium.net); Terri Hogan (terri_hogan@nps.gov)
Subject: draft Parr Hydroelectric Project PAD

Good afternoon all!

Attached is the draft Parr Hydroelectric Project Pre-Application Document (PAD). Please review and have any comments or edits to me by August 31st. Please note that the appendices will be included with the final document.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Bill Marshall
To:	Kelly Miller
Cc:	Dick Christie
Subject:	RE: Draft Reservoir Fluctuation Study Plan
Date:	Thursday, March 27, 2014 2:05:53 PM
Attachments:	011-Draft Reservoir Fluctuations Study Plan 022514 (DNR-comments-edits).docx

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Hi Kelly, sorry we missed the March 14 deadline. Attached are comments and suggestions from DNR staff regarding the draft Reservoir Fluctuation Study.

Thank you.

Bill

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Tuesday, February 25, 2014 9:17 AM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard; Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud; Ron Ahle; Sam Stokes Jr.; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject: Draft Reservoir Fluctuation Study Plan

All,

Attached is the draft Reservoir Fluctuation Study Plan. Please review and submit any comments or questions by Friday, March 14th. We will be discussing this study plan at the next Fisheries TWC meeting.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From:	Scott Harder
To:	"Pace Wilber - NOAA Federal"; Gerrit Jobsis
Cc:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject:	RE: Inflow Dataset Development: Statistical Methodology
Date:	Thursday, May 29, 2014 9:17:00 AM

Hi. I am still working on DNR's comments, but thought I should go ahead and make some preliminary comments given the past several emails. I have some of the same concerns as American Rivers, FW and NOAA, however, there may be some confusion as to what the inflow development methodology is providing. The monthly averaged data is only being used to develop the regional coefficient and regional exponent. These parameters I am assuming will be applied to daily (and hourly?) flows at the gaging stations to compute daily inflow to Parr. The way some have described the inflow in the previous emails makes it sound like we are using a monthly time step when we do the reservoir modeling, which is incorrect. Maybe I am misunderstanding some of the comments, but I thought I should make this clarification in case there was some confusion.
That being said, I still think there are potential issues with the inflow methodology - how well it will model low flows and how much of the daily or evenly hourly variation may be reduced by using parameters that were developed from monthly averages.
I agree with the other agencies that a meeting is necessary to work through some of these issues.
I hope to have my complete comments available within the next day or so.
Thanks,
scott

From: Pace Wilber - NOAA Federal [mailto:pace.wilber@noaa.gov]
Sent: Wednesday, May 28, 2014 9:45 PM
To: Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: Re: Inflow Dataset Development: Statistical Methodology

Hi Kelly. I agree with the comments from FWS and American Rivers that short-term variation important for assessing project effects on fishes and riverine habitat may be masked by using monthly average flows as model inputs. I also agree there are much better ways to judge the similarity of flows between subwatersheds than "eyeballing" the histograms in figures 2 and 3. A correlation matrix may be a more rigorous way to make the comparisons.
Pace

On Wed, May 28, 2014 at 4:53 PM, Gerrit Jobsis <gjobsis@americanrivers.org> wrote:
Kelly,

Please find attached American Rivers comments on the inflow data plan. It is intended to support the Final Parr Fairfield Operations Model Study Plan. That study plan says "The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies." As my comments in the document state, I do not agree that this inflow data set will be usable to evaluate the effects of project operations on habitat and recreation. Project operations via inflow alterations and reservoir fluctuations affect habitat and recreation values on a real time basis (hourly or less) that cannot be estimated using monthly average inflow estimates. Smoothing the data with regression equations removes the hourly and sub-hourly variation that is essential to understanding project effects.

I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114 (M) 803.546.7926

.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Tuesday, May 13, 2014 3:19 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Gerrit Jobsis; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net)

Subject: Inflow Dataset Development: Statistical Methodology

All,

Please find attached for your review and comment the statistical methodology for the development of the Parr inflow dataset. We will finalize the dataset after receiving comments, and provide sufficient detail in the model development report such that the dataset can be replicated.

Please submit any comments or questions by Tuesday, May 27th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

--
Pace Wilber, Ph.D.
HCD Atlantic Branch Supervisor
NOAA Fisheries Service
219 Ft Johnson Road
Charleston, SC 29412

Voice: 843-762-8601
FAX: 843-953-7205
Pace.Wilber@noaa.gov

From:	Henry Mealing
To:	Scott Harder; "Pace Wilber - NOAA Federal"; Gerrit Jobsis
Cc:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject:	RE: Inflow Dataset Development: Statistical Methodology
Date:	Thursday, May 29, 2014 1:05:47 PM

Scott,

Thanks for jumping in to clarify what the inflow dataset is for. Brett and Bruce will be pulling together all of your comments next week. If you have specific comments to the Word file, please make those in track changes and send them in. We will also consolidate your "email" comments into a list and will work towards developing specific answers for them. At that point, we will figure out the best way to share those answers and work through the information with the TWC.

Thanks again,

Henry

Henry Mealing
Kleinschmidt Associates
Fisheries Biologist / Team Leader
Cell: 706-339-3209

From: Scott Harder [mailto:HarderS@dnr.sc.gov]
Sent: Thursday, May 29, 2014 9:17 AM
To: 'Pace Wilber - NOAA Federal'; Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: RE: Inflow Dataset Development: Statistical Methodology

Hi. I am still working on DNR's comments, but thought I should go ahead and make some preliminary comments given the past several emails. I have some of the same concerns as American Rivers, FW and NOAA, however, there may be some confusion as to what the inflow development methodology is providing. The monthly averaged data is only being used to develop the regional coefficient and regional exponent. These parameters I am assuming will be applied to daily (and hourly?) flows at the gaging stations to compute daily inflow to Parr. The way some have described the inflow in the previous emails makes it sound like we are using a monthly time step when we do the reservoir modeling, which is incorrect. Maybe I am misunderstanding some of the comments, but I thought I should make this clarification in case there was some confusion.

That being said, I still think there are potential issues with the inflow methodology - how well it will model low flows and how much of the daily or evenly hourly variation may be reduced by using parameters that were developed from monthly averages.
I agree with the other agencies that a meeting is necessary to work through some of these issues.
I hope to have my complete comments available within the next day or so.
Thanks,
scott

From: Pace Wilber - NOAA Federal [mailto:pace.wilber@noaa.gov]
Sent: Wednesday, May 28, 2014 9:45 PM
To: Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: Re: Inflow Dataset Development: Statistical Methodology

Hi Kelly. I agree with the comments from FWS and American Rivers that short-term variation important for assessing project effects on fishes and riverine habitat may be masked by using monthly average flows as model inputs. I also agree there are much better ways to judge the similarity of flows between subwatersheds than "eyeballing" the histograms in figures 2 and 3. A correlation matrix may be a more rigorous way to make the comparisons.
Pace

On Wed, May 28, 2014 at 4:53 PM, Gerrit Jobsis <gjobsis@americanrivers.org> wrote:
Kelly,

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I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205

(O) 803.771.7114 (M) 803.546.7926

Keep up on the latest river news and info: www.americanrivers.org/updates
Please consider the environment before printing this e-mail.
.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Tuesday, May 13, 2014 3:19 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Gerrit Jobsis; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net)

Subject: Inflow Dataset Development: Statistical Methodology

All,

Please find attached for your review and comment the statistical methodology for the development of the Parr inflow dataset. We will finalize the dataset after receiving comments, and provide sufficient detail in the model development report such that the dataset can be replicated.

Please submit any comments or questions by Tuesday, May 27th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

--
Pace Wilber, Ph.D.
HCD Atlantic Branch Supervisor
NOAA Fisheries Service
219 Ft Johnson Road
Charleston, SC 29412

Voice: 843-762-8601
FAX: 843-953-7205
Pace.Wilber@noaa.gov

From:	Scott Harder
To:	Henry Mealing; "Pace Wilber - NOAA Federal"; Gerrit Jobsis
Cc:	Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject:	RE: Inflow Dataset Development: Statistical Methodology
Date:	Friday, May 30, 2014 2:59:35 PM
Attachments:	Harder_Comments-Parr-Inflow-Methodology_05_30_14.docx

Hi. Please see attached comments from SCDNR.
My main conclusion is that the inflow dataset is probably ok , but we should meet and discuss further before we commit to anything.
Enjoy,
Scott

From: Henry Mealing [mailto:Henry.Mealing@KleinschmidtGroup.com]
Sent: Thursday, May 29, 2014 1:06 PM
To: Scott Harder; 'Pace Wilber - NOAA Federal'; Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: RE: Inflow Dataset Development: Statistical Methodology

Scott,

Thanks for jumping in to clarify what the inflow dataset is for. Brett and Bruce will be pulling together all of your comments next week. If you have specific comments to the Word file, please make those in track changes and send them in. We will also consolidate your "email" comments into a list and will work towards developing specific answers for them. At that point, we will figure out the best way to share those answers and work through the information with the TWC.

Thanks again,

Henry

Henry Mealing
Kleinschmidt Associates
Fisheries Biologist / Team Leader
Cell: 706-339-3209

From: Scott Harder [mailto:HarderS@dnr.sc.gov]
Sent: Thursday, May 29, 2014 9:17 AM

To: 'Pace Wilber - NOAA Federal'; Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: RE: Inflow Dataset Development: Statistical Methodology

Hi. I am still working on DNR's comments, but thought I should go ahead and make some preliminary comments given the past several emails. I have some of the same concerns as American Rivers, FW and NOAA, however, there may be some confusion as to what the inflow development methodology is providing. The monthly averaged data is only being used to develop the regional coefficient and regional exponent. These parameters I am assuming will be applied to daily (and hourly?) flows at the gaging stations to compute daily inflow to Parr. The way some have described the inflow in the previous emails makes it sound like we are using a monthly time step when we do the reservoir modeling, which is incorrect. Maybe I am misunderstanding some of the comments, but I thought I should make this clarification in case there was some confusion.
That being said, I still think there are potential issues with the inflow methodology - how well it will model low flows and how much of the daily or evenly hourly variation may be reduced by using parameters that were developed from monthly averages.
I agree with the other agencies that a meeting is necessary to work through some of these issues.
I hope to have my complete comments available within the next day or so.
Thanks,
scott

From: Pace Wilber - NOAA Federal [mailto:pace.wilber@noaa.gov]
Sent: Wednesday, May 28, 2014 9:45 PM
To: Gerrit Jobsis
Cc: Kelly Miller; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie; Frank_Henning@nps.gov; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Malcolm Leaphart (mwleapjr@att.net); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani; Wayne and Ginny Boland (wayneboland@bellsouth.net)
Subject: Re: Inflow Dataset Development: Statistical Methodology

Hi Kelly. I agree with the comments from FWS and American Rivers that short-term variation important for assessing project effects on fishes and riverine habitat may be masked by using monthly average flows as model inputs. I also agree there are much better ways to judge the similarity of flows between subwatersheds than “eyeballing” the histograms in figures 2 and 3. A correlation matrix may be a more rigorous way to make the comparisons.
Pace

On Wed, May 28, 2014 at 4:53 PM, Gerrit Jobsis <gjobsis@americanrivers.org> wrote:
Kelly,

Please find attached American Rivers comments on the inflow data plan. It is intended to support the Final Parr Fairfield Operations Model Study Plan. That study plan says “The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies.” As my comments in the document state, I do not agree that this inflow data set will be usable to evaluate the effects of project operations on habitat and recreation. Project operations via inflow alterations and reservoir fluctuations affect habitat and recreation values on a real time basis (hourly or less) that cannot be estimated using monthly average inflow estimates. Smoothing the data with regression equations removes the hourly and sub-hourly variation that is essential to understanding project effects.

I received USFWS comments which also raise some important questions. It would useful to convene a call among those interested to answer some of the questions raised in our respective comments.

Gerrit

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114 (M) 803.546.7926

Keep up on the latest river news and info: www.americanrivers.org/updates

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From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Tuesday, May 13, 2014 3:19 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bret Hoffman; Bruce Halverson; Byron Hamstead (Byron_hamstead@fws.gov); Dick Christie (christied@dnr.sc.gov); Frank_Henning@nps.gov; Gerrit Jobsis; Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jay Maher; Joe Wojcicki; Kelly Miller; Malcolm Leaphart (mwleapjr@att.net); Pace Wilber (Pace.Wilber@noaa.gov); rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Scott Harder; Steve Summer; Terri Hogan (terri_hogan@nps.gov); Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net)

Subject: Inflow Dataset Development: Statistical Methodology

All,

Please find attached for your review and comment the statistical methodology for the development of the Parr inflow dataset. We will finalize the dataset after receiving comments, and provide sufficient detail in the model development report such that the dataset can be replicated.

Please submit any comments or questions by Tuesday, May 27th.

Thanks,
Kelly

Kelly Miller

Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
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--

Pace Wilber, Ph.D.
HCD Atlantic Branch Supervisor
NOAA Fisheries Service
219 Ft Johnson Road
Charleston, SC 29412

Voice: 843-762-8601
FAX: 843-953-7205
Pace.Wilber@noaa.gov

From:	Bill Marshall
To:	Kelly Miller; Shane Boring
Cc:	Ron Ahle; "Dick Christie"; Vivianne Vejdani
Subject:	RE: Mesohabitat Study Plan
Date:	Friday, September 06, 2013 1:44:26 PM

Kelly and Shane, the study plan looks okay to me. I had only one question that may present a need for clarification of a term as presented in the following...

On Page 2, 1st paragraph, the next to last sentence says, *Upstream and downstream boundaries of each mesohabitat patch will be documented with a Global Position System, and field observations regarding dominant substrate, overall cover quality, and approximate channel width and slope recorded*. Please provide explanation of what is meant by the term "cover quality."

Thanks,
Bill

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtUSA.com]
Sent: Thursday, August 29, 2013 2:23 PM
To: Alan Stuart; Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Brandon Kulik; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net); Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle; Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject: FW: Mesohabitat Study Plan

All,

Please submit any suggested edits or comments to the attached memo via email. If you have no edits, please submit your approval of the study plan to me by Friday, September 6th.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

From: Kelly Miller
Sent: Thursday, August 29, 2013 11:15 AM
To: Alan Stuart; Alison Jakupca; ARGENTIERI, WILLIAM R; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Brandon Kulik; Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Dick Christie (dchristie@comporium.net);

Frank_Henning@nps.gov; Gerrit Jobsis (gjobsis@americanrivers.org); Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Ley, Amanda; Pace Wilber (Pace.Wilber@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Harder; Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'
Subject: Mesohabitat Study Plan

All,

For your information, attached is a memo regarding the Mesohabitat Study Plan, reflecting points discussed at the previous Instream Flows TWC meeting, held on July 31st.

Thanks,
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtUSA.com

SHPO CONSULTATION

From: Johnson, Elizabeth
To: Kelly Miller
Subject: RE: Parr PAD reminder
Date: Thursday, August 28, 2014 8:41:20 AM

Ms. Miller:

Thank you for your email providing the draft Parr Hydroelectric Project Pre-Application Document (PAD) and requesting review and comments. The State Historic Preservation Office will be providing comments to the Federal Energy Regulatory Commission pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR 800. Consultation with the SHPO is not a substitution for consultation with Tribal Historic Preservation Offices, other Native American tribes, local governments, or the public. As noted in the PAD, consultation was initiated with our office by SCE&G in 2013.

We recently reviewed the revised draft report entitled ***Cultural Resource Investigations for the Parr Hydroelectric Project, Fairfield and Newberry Counties, South Carolina*** prepared by S&ME of Columbia. We concurred with S&ME�s determinations of eligibility for the National Register of Historic Places and management recommendations. These are summarized in Table 4-34 of the PAD.

We look forward to continuing consultation on this project and to the development of a Programmatic Agreement and Management Plan(s) that outline steps to protect historic properties. As noted in Section 4.9.5, the management and operations of the Project may adversely affect historic properties in the form of erosion, construction of recreational facilities and development along the shoreline. Identification efforts and measures to protect historic properties will need to be developed. As noted in 4.9.6, a Programmatic Agreement developed by FERC under Section 106 will include stipulations for the management of historic properties, and a shoreline management plan and historic properties management plan will also be developed. Specific recommendations and management actions will be outlined in these documents.

Thank you for the opportunity to review the draft PAD. If you have any questions please feel free to contact me at 803-896-6168, emjohnson@scdah.state.sc.us.

Best regards,

Elizabeth

Elizabeth M. Johnson
State Historic Preservation Office
SC Department of Archives and History
8301 Parklane Road, Columbia, SC 29223
ph: 803-896-6168 fax: 803-896-6167
email: emjohnson@scdah.state.sc.us web: http://shpo.sc.gov

To sign up to receive our monthly newsletter, News and Notes from the State Historic Preservation Office, please send me an email with your name and organizational affiliation, with News and Notes in the subject line.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Wednesday, August 27, 2014 8:37 AM
To: (msgentry@columbiasc.net); Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bob Perry; Bret Hoffman; btrump@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Cathy Tortorici (Cathy.tortorici@noaa.gov); Chad Altman (altmankc@dhec.sc.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Johnson, Elizabeth; Elizabeth LeMaster; Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); John Grego (jrgrego@pop.mindspring.com); Jon Durham (jondurham@bellsouth.net); Kamau Marcharia (marcharia@aol.com); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Larry Newton (LNewton@sc.rr.com); Malcolm Leaphart (mwleapjr@att.net); Mark Caldwell (mark_caldwell@fws.gov); Mark Cantrell (mark_a_cantrell@fws.gov); Mark Davis (mdavis@scprt.com); Mel Jenkins (greenpalmetto@yahoo.com); Merrill McGregor (merrillm@scccl.org); Mike Mastry (Mike.Mastry@noaa.gov); Mike McSwain (mcswain@comcast.net); Pace Wilber (Pace.Wilber@noaa.gov); Phil Gaines (pgaines@scprt.com); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Scott Collins (secollins@scana.com); Scott Harder; Shane Boring; 'Sherer, Jonathan'; Steve Summer; SUMMER, MICHAEL C; tboozer@scana.com; Theresa Powers; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Parr PAD reminder

Good morning!

This is a reminder that any comments or edits on the draft PAD for the Parr Relicensing Project are due by August 31st.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

TLP Letters

United States Department of the Interior

FISH AND WILDLIFE SERVICE
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

September 29, 2014

Mr. William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

Re: Use of the Traditional Licensing Process for the Relicensing of the Parr Hydroelectric Project (FERC No. 1894) Newberry and Fairfield Counties, South Carolina
FWS Log No. 2012-CPA-0163

Dear Mr. Argentieri:

The U.S. Fish and Wildlife Service (Service) has received your e-mail dated August 14, 2014, outlining why the South Carolina Electric & Gas Company (SCE&G) will request the use of the Traditional Licensing Process (TLP) to obtain a subsequent license for the Parr Hydroelectric Project (Project). Additionally, SCE&G requested a letter of support or of no objection to the use of the TLP for the Project to be submitted to the Federal Energy Regulatory Commission along with the Notice of Intent and Pre-Application Document (PAD).

The SCE&G began early consultation (pre-PAD) with natural resource agencies and made substantial effort to ensure relicense of the Project before the current license expires in June 30, 2020. During this early investment, SCE&G began conducting studies to address information needs and to assess impacts to natural resources. Moreover, the Service reviewed and provided numerous comments on a draft PAD for the Project. Therefore, we foresee minimal controversy during relicensing. We are familiar with this process as it has been used for the relicense of other FERC projects of comparable size in South Carolina. For these reasons, we have no objections to using the TLP for the Project.

The Service appreciates the opportunity to participate in the relicensing of the Project and look forward to working with SCE&G throughout the process to meet our collective goals. If you have any questions, please contact Mr. Byron Hamstead at (843) 727-4707 ext. 205, and reference FWS No. 2012-CPA-0163.

Sincerely,

Thomas D. McCoy

Thomas D. McCoy
Acting Field Supervisor

TDM/BAH

cc: Mr. Bill Marshall, SCDNR, Columbia, SC
Mr. Dick Christie, SCDNR, Lancaster, SC
Ms. Alicia Rowe, SCDHEC, Columbia, SC
Mr. Pace Wilber, NOAA, Charleston, SC
Mr. Wilson Laney, USFWS, Raleigh, NC

AMERICAN WHITEWATER
Kevin Colburn
National Stewardship Director
PO Box 1540
Asheville, NC 28806
828-712-4825
www.americanwhitewater.org
kevin@americanwhitewater.org

October 23, 2014

William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

Re: Support for Traditional Licensing Process (p-1894)

Dear Mr. Argentieri,

American Whitewater is a national non-profit organization with a mission of protecting and restoring our nations whitewater resources and enhancing opportunities to enjoy them safely. We routinely engage in hydropower relicensing processes where dams affect river-based kayaking, canoeing or rafting opportunities. We intend to participate in the relicensing of the Parr Hydroelectric Project (FERC No. 1894).

We understand that you are interested in utilizing the Traditional Licensing Process. We feel that either the TLP or the ILP can work well when Licensees proactively engage with stakeholders and seek mutual-gain outcomes that balance power and non-power uses of rivers. We have a long and positive working relationship with SCE&G, and are confident that you can utilize the Traditional Licensing Process to reach the best-adapted plan for the river in a timely manner. Therefore, we support your proposal to use the Traditional Licensing Process on the relicensing of the Parr Hydroelectric Project.

Sincerely,

Kevin Colburn
American Whitewater
National Stewardship Director
PO Box 1540
Cullowhee, NC 28723
kevin@americanwhitewater.org

Charlene Coleman
Regional Coordinator

October 27, 2014

William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

Re: Traditional Licensing Process for Parr/Fairfield Hydro Relicensing

Mr. Argentieri,

I am writing to express Congaree Riverkeeper's support for the Traditional Licensing Process (TLP) in the relicensing of the Parr Hydroelectric Project (FERC No. 1894). We feel that the TLP's more flexible deadlines, combined with a robust stakeholder process, should result in the timely issuance of a license that all parties can support. Additionally, many of the same stakeholders involved in this relicensing recently used the TLP with great success in the Saluda relicensing process (FERC No. 516).

We appreciate this opportunity to comment and look forward to our continued participation in the relicensing process.

Sincerely,

Bill Stangler

Bill Stangler
Congaree Riverkeeper

Post Office Box 5294 • Columbia, South Carolina 29250
(803) 760-3357 • www.congareeriverkeeper.org

South Carolina Department of
Natural Resources

1000 Assembly Street
PO Box 167
Columbia, SC 29202
803-734-9096 - Office
marshallb@dnr.sc.gov

Alvin A. Taylor
Director

Robert D. Perry
Director, Office of
Environmental Programs

October 1, 2014

Mr. William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

REFERENCE: Use of the Traditional Licensing Process (TLP) for the relicensing of the Parr Hydroelectric Project (FERC No. 1894)

Dear Mr. Argentieri:

The South Carolina Department of Natural Resources (DNR) has reviewed your e-mail of August 14, 2014 presenting the reasons and intentions of South Carolina Electric & Gas Company (SCE&G) to request the use of the TLP to obtain a new license for the Parr Hydroelectric Project. Your e-mail requested the DNR and other stakeholder to provide a letter sharing our positions with respect to the use of the TLP.

DNR is supportive of using the TLP for the Parr Hydro Project because of the greater flexibility it affords for the stakeholders and the licensee. In addition, as participants in the early consultations already initiated by SCE&G with resources agencies and other stakeholders in preparation of the pre-application documents, we believe the relicensing time schedules, complexity of issues, and information needs for the Parr Project can and will be adequately addressed using the TLP as coordinated by SCE&G.

DNR appreciates the opportunity to participate in the relicensing of the Parr Hydro Project and we look forward to continued cooperative work with SCE&G to protect and manage resources at the Project.

Sincerely,

Bill Marshall

Bill Marshall
FERC Projects Coordinator

cc: Bob Perry
Dick Christie

From:	Pace Wilber - NOAA Federal
To:	BARGENTIERI@scana.com
Cc:	Fritz Rohde
Subject:	Re: TLP Support Request
Date:	Friday, October 10, 2014 1:17:55 PM

***This is an EXTERNAL email. Please do not click on a link or open any attachments unless you are confident it is from a trusted source.

Hi Bill. NMFS is going to be neutral on the license process used for Parr. Our national hydropower team often discusses the merits of each license process. Based on that discussion, its seems a neutral stance is best for Parr. Thanks again for making a remote option available for yesterday's PAD review. I am impressed by thoroughness of the draft PAD. Pace

On Thu, Aug 14, 2014 at 4:54 PM, ARGENTIERI, WILLIAM R <BARGENTIERI@scana.com> wrote:

> All,
>
> I hope this finds you doing well.
>
> I wanted to share two items with you today. First, we hope that you have had a chance to begin your review of the Preliminary Application Document (PAD) for the Parr Hydroelectric Project (FERC No. 1894) (Project). Please be sure to contact Kelly Miller if you have any questions on that document. We look forward to receiving your comments by August 29, 2014 (since August 31 is a Sunday) and resolving issues that you identify during your review for the final filing with FERC.
>
> Second, as discussed during several of our stakeholder meetings (and in Section 2.0 of the PAD) SCE&G intends to request that FERC authorize us to use the Traditional Licensing Process (TLP) for the Project relicensing. As many of you are already aware, there are three distinct processes available to applicants when embarking on a hydroelectric project relicensing. The default process is known as the Integrated Licensing Process (ILP); however, the TLP and the Alternative Licensing Process (ALP) are options that may also be used for relicensing. Federal regulations state that FERC authorization is required for an applicant to employ a relicensing process other than the ILP.
>
> When considering process selection, there are several aspects for each of the processes to keep in mind. The ILP and the TLP are the most frequently used relicensing processes. The ALP has been used infrequently since the development of the ILP, as it contains many of the same aspects of the ILP. The ILP is "front-loaded" and involves significant early consultation among the

applicant, stakeholders and FERC and has stringent prescribed deadlines for process steps for agencies, NGO's and the applicant. Issues scoping by FERC, as required under the National Environmental Policy Act (NEPA), occurs prior to the filing of a License Application. Overall, the use of the ILP generally serves to intensify the schedule at the start of the process and set specific dates with regards to studies, filing comments, and filing of the application.

The TLP provides much more flexibility for both the applicant and stakeholders during the initial stages of relicensing. The TLP is broken up into 3 stages of consultation which include: issuance of the PAD and study consultation; performing studies and draft application preparation, and; submittal of the final license application. Although there are several FERC deadlines that must be met during the pre-filing stage (and are related to the expiration date of the current license), SCE&G and the stakeholders would have greater flexibility in guiding the relicensing process to fit the needs of the Project. Moreover, this pre-filing flexibility would allow SCE&G and stakeholders to work towards the development of a Settlement Agreement for filing with the Project License Application.

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William R. Argentieri

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Mail Code A221

220 Operation Way

Cayce, SC 29033-3701

(Physical Address)

100 SCANA Pkwy

Building A, Floor 2

Cayce, SC 29033-3712

Phone - (803) 217-9162

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Pace Wilber, Ph.D.
HCD Atlantic Branch Supervisor
NOAA Fisheries Service
219 Ft Johnson Road
Charleston, SC 29412

Voice: 843-762-8601
FAX: 843-953-7205
Pace.Wilber@noaa.gov

From: Gerrit Jobsis
To: BARGENTIERI@scana.com
Cc: Henry Mealing
Subject: RE: TLP Support Request Reminder
Date: Tuesday, October 21, 2014 5:52:56 PM
Attachments: AmericanRiversTLP comments.pdf

***This is an EXTERNAL email. Please do not click on a link or open any attachments unless you are confident it is from a trusted source.

Here you are Bill.

____

Gerrit Jöbsis, American Rivers
Senior Director, Southeast Conservation Programs
215 Pickens Street
Columbia, SC 29205
(O) 803.771.7114   (M) 803.546.7926

Vote for American Rivers and help us win $20,000 to protect endangered rivers!
www.AmericanRivers.org/KIND
Please consider the environment before printing this e-mail.
.

From: ARGENTIERI, WILLIAM R [mailto:BARGENTIERI@scana.com]
Sent: Tuesday, October 21, 2014 9:42 AM
To: Frank_Henning@nps.gov; Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis; Jim Glover (gloverjb@dhec.sc.gov); Jon Durham (jondurham@bellsouth.net); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); Mel Jenkins (greenpalmetto@yahoo.com); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Wayne and Ginny Boland (wayneboland@bellsouth.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@sccl.org); William Hendrix (hendrixwb@dot.state.sc.us); Terri Hogan (terri_hogan@nps.gov); Elizabeth LeMaster
Cc: Henry Mealing; Alison Jakupca - KA; Kelly Miller
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Sent: Thursday, August 14, 2014 4:55 PM
To:
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From:	LeMaster, Elizabeth -FS
To:	BARGENTIERI@scana.com
Subject:	RE: TLP Support Request Reminder
Date:	Tuesday, October 21, 2014 6:44:38 PM

***This is an EXTERNAL email. Please do not click on a link or open any attachments unless you are confident it is from a trusted source.

No objections from the USFS.

From: ARGENTIERI, WILLIAM R [mailto:BARGENTIERI@scana.com]
Sent: Tuesday, October 21, 2014 9:42 AM
To: Frank_Henning@nps.gov; Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); cheetahtrk@yahoo.com; Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Jim Glover (gloverjb@dhec.sc.gov); Jon Durham (jondurham@bellsouth.net); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); Mel Jenkins (greenpalmetto@yahoo.com); Rusty Wenerick (weneriwr@dhec.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Wayne and Ginny Boland (wayneboland@bellsouth.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; Mark Davis (mdavis@scprt.com); Merrill McGregor (merrillm@scccl.org); William Hendrix (hendrixwb@dot.state.sc.us); Terri Hogan (terri_hogan@nps.gov); LeMaster, Elizabeth -FS
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Cc:
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Cell - (803) 331-0179

From: Johnson, Elizabeth
To: BARGENTIERI@scana.com
Subject: RE: TLP Support Request
Date: Wednesday, August 27, 2014 8:13:27 AM

***This is an EXTERNAL email. Please do not click on a link or open any attachments unless you are confident it is from a trusted source.

Bill:

The SC State Historic Preservation does not have any objections to SCE&G using the Traditional Licensing Process for the Parr Hydroelectric Process (FERC No. 1894).

Thanks for keeping us informed about the process and please let me know if you have any questions.

Best wishes,

Elizabeth

Elizabeth M. Johnson
State Historic Preservation Office
SC Department of Archives and History
8301 Parklane Road, Columbia, SC 29223
ph: 803-896-6168 fax: 803-896-6167
email: emjohnson@scdah.state.sc.us web: http://shpo.sc.gov

To sign up to receive our monthly newsletter, News and Notes from the State Historic Preservation Office, please send me an email with your name and organizational affiliation, with News and Notes in the subject line.

From: ARGENTIERI, WILLIAM R [mailto:BARGENTIERI@scana.com]
Sent: Thursday, August 14, 2014 4:55 PM
To: Johnson, Elizabeth; Frank_Henning@nps.gov; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); Charlene Coleman (cheetahtrk@yahoo.com); Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard (BeardH@dnr.sc.gov); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jim Glover (gloverjb@dhec.sc.gov); Jon Durham (jondurham@bellsouth.net); Ley, Amanda; Malcolm Leaphart (mwleapjr@att.net); Mark Caldwell (mark_caldwell@fws.gov); Mel Jenkins (greenpalmetto@yahoo.com); Pace Wilber (Pace.Wilber@noaa.gov); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Scott Harder; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); Erich Miarka (erich.miarka@gillscreekwatershed.org); Jeff Carter (jmcarter00@sc.rr.com); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); Mark Davis

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TOWN HALL-1830

TOWN OF WINNSBORO

207 North Congress Street • P.O. Box 209 • Winnsboro, S.C. 29180
Telephone: (803) 635-4041 • Fax No: (803) 635-3697

August 27, 2014

William R. Argentieri
South Carolina Electric & Gas Company
Mail Code A221
220 Operation Way
Cayce, SC 29033-3701

Re: Parr Hydro Electric Project
FERC Project: 1894

Dear Mr. Argentieri:

On behalf of The Town of Winnsboro, as a stake-holder in the development of SCE&G's Pre-Application Document (PAD), for re-licensing the Parr Hydro Electric Project [FERC Project: 1894], I write today to acknowledge Winnsboro's support for SCE&G's request that FERC use the "Traditional" FERC re-licensing process [TLP] for the Parr Hydro Electric Project on the Broad River.

Our Town appreciates the cooperation and support that SCE&G has given our town and county as a corporate citizen over the years and invites you to use this letter of support in any manner that will aid SCE&G in its re-licensing efforts.

Yours truly,

Roger Gaddy, Mayor

110004/Wholesale Water and Restructuring Project/Parr Project-SCE&G/Mayor Gaddy-TLP Support ltr/8-26-14

USFS CONSULTATION

From:	LeMaster, Elizabeth -FS
To:	Kelly Miller
Cc:	Riley, Jeanne -FS
Subject:	RE: Parr PAD reminder
Date:	Thursday, August 28, 2014 9:23:04 AM
Attachments:	Beth LeMaster.vcf

Kelly, it doesn't appear that this project directly affects any major are of the Sumter NF. Based on the expertise involved from other federal and state agencies, we will not have any additional comments on the project. If you feel there is a section we should review or focus on, please advise us.

Thanks, Beth

Beth LeMaster
Francis Marion & Sumter NFs
Natural Resources Staff Officer
USDA Forest Service
803-561-4083 Work

864-426-5754 Mobile
elemaster@fs.fed.us
4931 Broad River Road
Columbia, SC 29212

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Wednesday, August 27, 2014 8:37 AM
To: (msgentry@columbiasc.net); Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Bob Perry; Bret Hoffman; btrump@scana.com; Byron Hamstead (Byron_hamstead@fws.gov); Cathy Tortorici (Cathy.tortorici@noaa.gov); Chad Altman (altmankc@dhec.sc.gov); cheetahtrk@yahoo.com; Chris Johnston (JohnstonWC@gmail.com); Chuck Hightower (hightocw@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Dick Christie (christied@dnr.sc.gov); Elizabeth Johnson (emjohnson@scdah.state.sc.us); LeMaster, Elizabeth -FS; Erich Miarka (erich.miarka@gillscreekwatershed.org); Frank_Henning@nps.gov; Fritz Rohde (Fritz.Rohde@noaa.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Hal Beard (BeardH@dnr.sc.gov); Henry Mealing; J. Hagood Hamilton Jr. (jhamilton@scana.com); Jaclyn Daly (Jaclyn.Daly@noaa.gov); Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Joe Wojcicki; John Fantry (jfantry@bellsouth.net); John Grego (jrgrego@pop.mindspring.com); Jon Durham (jondurham@bellsouth.net); Kamau Marcharia (marcharia@aol.com); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; Kerry Castle (castlek@dnr.sc.gov); Larry Newton (LNewton@sc.rr.com); Malcolm Leaphart (mwleapjr@att.net); Mark Caldwell (mark_caldwell@fws.gov); Mark_A_Cantrell@fws.gov; Mark Davis (mdavis@scprt.com); Mel Jenkins (greenpalmetto@yahoo.com); Merrill McGregor (merrillm@scccl.org); Mike Mastry (Mike.Mastry@noaa.gov); Mike McSwain (mcswain@comcast.net); Pace Wilber (Pace.Wilber@noaa.gov); Phil Gaines (pgaines@scprt.com); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Robert Stroud (StroudR@dnr.sc.gov); Ron Ahle; Rusty Wenerick (weneriwr@dhec.sc.gov); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Scott Collins (secollins@scana.com); Scott Harder; Shane Boring; 'Sherer, Jonathan'; Steve Summer; SUMMER, MICHAEL C; tboozer@scana.com; Theresa Powers; Tom McCoy (thomas_mccoy@fws.gov); 'Vivianne Vejdani'; Wayne and Ginny Boland (wayneboland@bellsouth.net); William Hendrix (hendrixwb@dot.state.sc.us)
Subject: Parr PAD reminder

Good morning!

This is a reminder that any comments or edits on the draft PAD for the Parr Relicensing Project are due by August 31st.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

USFWS CONSULTATION

From: LeMaster, Elizabeth -FS
To: Kelly Miller
Cc: Riley, Jeanne -FS
Subject: RE: Parr PAD reminder
Date: Thursday, August 28, 2014 9:23:04 AM
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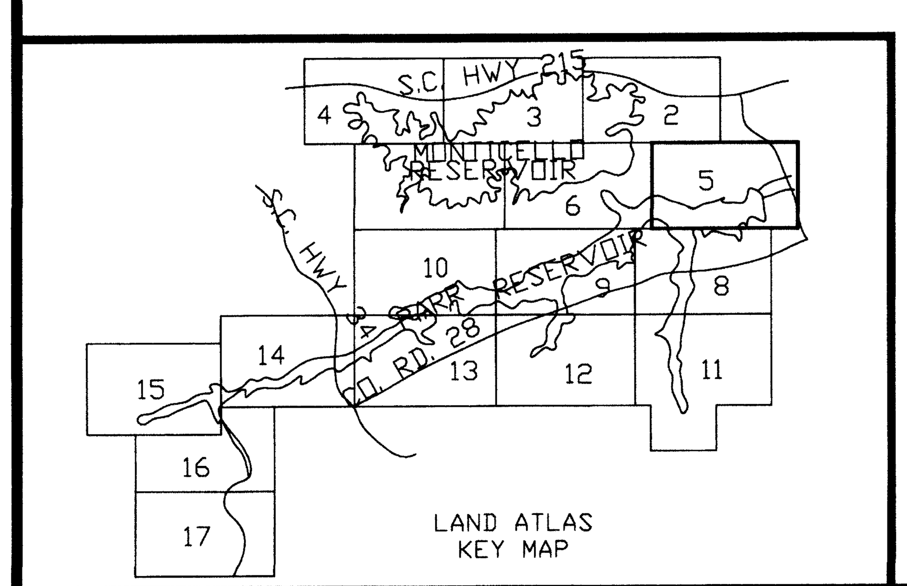
APPENDIX D

EXHIBIT G (CURRENTLY EXHIBIT K) – PROJECT BOUNDARY MAPS

EXHIBIT K
SHEET 5



ORIGINAL NOTES:
1. ALL PROPERTY WITHIN THE PROJECT BOUNDARY LINE IS OWNED IN FEE SIMPLE BY S.C.E. & G. CO. UNLESS OTHERWISE SHOWN ON EXHIBIT "F".

2. ALL PROPERTIES & PROPERTY LINES WERE SHOWN OUTSIDE P.B.L. AS A CONVENIENCE FOR HISTORICAL PURPOSES FOR S.C.E.&G.

3. DETAILED DESCRIPTION FOR PROJECT BOUNDARY LINE IS SHOWN FOR SHEETS K-18 THRU K-20.

4. LAND PARCELS ARE KEYED FOR EXHIBIT "F" BY ENCIRCLED NUMBERS. EX 33

5. LANDS ABUTTING P.B.L. ON THE EXTERIOR ARE IN PRIVATE OWNERSHIP UNLESS SHOWN OTHERWISE ON EXHIBIT "F".

6. CO-ORDINATES SHOWN ARE BASED ON THE STATE GRID SYSTEM (NAD27)

7. ELEVATIONS SHOWN ARE BASED ON THE U.S.C.&G.S. DATA (M.S.L.)

8. THE P.B.L. AROUND PARR RESERVOIR IS GENERALLY ALONG THE CONTOUR OF THE FLOOD OF RECORD AS ADJUSTED TO ACCOUNT FOR THE INFLUENCE OF PARR DAM, AS INDICATED ON EXHIBIT K-1.

9. ALL ISLANDS ARE TO REMAIN IN THEIR NATURAL STATE.

10. SOUTHERN R.R. R/W IS EXCLUDED FROM PROJECT, EXCEPT TO THE EXTENT OF FLOWAGE RIGHTS. SEE EXHIBIT "F"

NOTES:
THIS EXHIBIT DRAWING WAS ORIGINALLY ISSUED AND SIGNED BY W. E. MOORE, MANAGER-HYDRO & ENVIRONMENTAL ENGINEERING AND G. C. MEETZE, EXECUTIVE VICE-PRESIDENT AS PART OF THE APPLICATION FOR AMENDMENT OF LICENSE MADE ON JUNE 26, 1981.

I, BRIAN B. BONDS, A PROFESSIONAL LAND SURVEYOR IN THE STATE OF SOUTH CAROLINA, P.L.S. 28582, HAVE REPRODUCED THIS PORTION OF THE PARR HYDRO PROJECT 1894 PROJECT BOUNDARY SHOWN HEREIN. THE LICENSEE EITHER OWNS IN FEE SIMPLE OR POSSESSES EASEMENTS OVER THE LANDS SHOWN ON THE MAP THAT ARE INSIDE THE PROJECT BOUNDARY. THE PROJECT BOUNDARY LINES THAT ARE NOT CONTOUR LINES WERE BASED ON SCE&G DESIGN AND CONSTRUCTION DRAWINGS.

PROPERTY LINES DEPICTED ON THIS EXHIBIT DERIVED FROM DEEDS AND PLATS OF RECORD. NO ACTUAL FIELD SURVEY WAS CONDUCTED FOR PREPARING THIS MAP. THIS EXHIBIT IS NOT A PROPERTY BOUNDARY SURVEY. ALL PROPERTY LINE LOCATIONS SUBJECT TO FULL BOUNDARY SURVEY OF THE DEPICTED PARCEL.

LEGEND
- ARCHAEOLOGICAL SITES
- CEMETERIES
- HISTORICAL SITES
- U.S. FORESTRY LAND TO BE FLOODED
- RECREATIONAL LAND AREA
- SUMTER NATIONAL FOREST BOUNDARY
- PROJECT BOUNDARY LINE
- U.S.C.&G.S. BENCH MARK
- U.S.G.S. BENCH MARK
- WATERFOWL SUB-IMPOUNDMENTS
- REFERENCE POINTS

TRANSMISSION LINES
PROPOSED
EXISTING

DETAIL MAP OF PROJECT AREA

SHEET 5 OF 20
PARR HYDROELECTRIC PROJECT NO.1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SCALE : 1 INCH = 500 FEET
0 500' 1000' 1500' 2000' 2500' 3000'

SURVEYED BY GLENN ASSOCIATES SURVEYING, INC.
P.O. BOX 12 JENKINSVILLE, S.C. 29065 telephone (803) 345-5297

BRIAN B. BONDS ; S.C.P.L.S. # 28582

GLENN ASSOCIATES SURVEYING, INC.

SURVEYORS SEAL
2-20-12

SURVEYORS SEAL
SOUTH CAROLINA PROFESSIONAL LAND SURVEYOR 28582 BRIAN B. BONDS

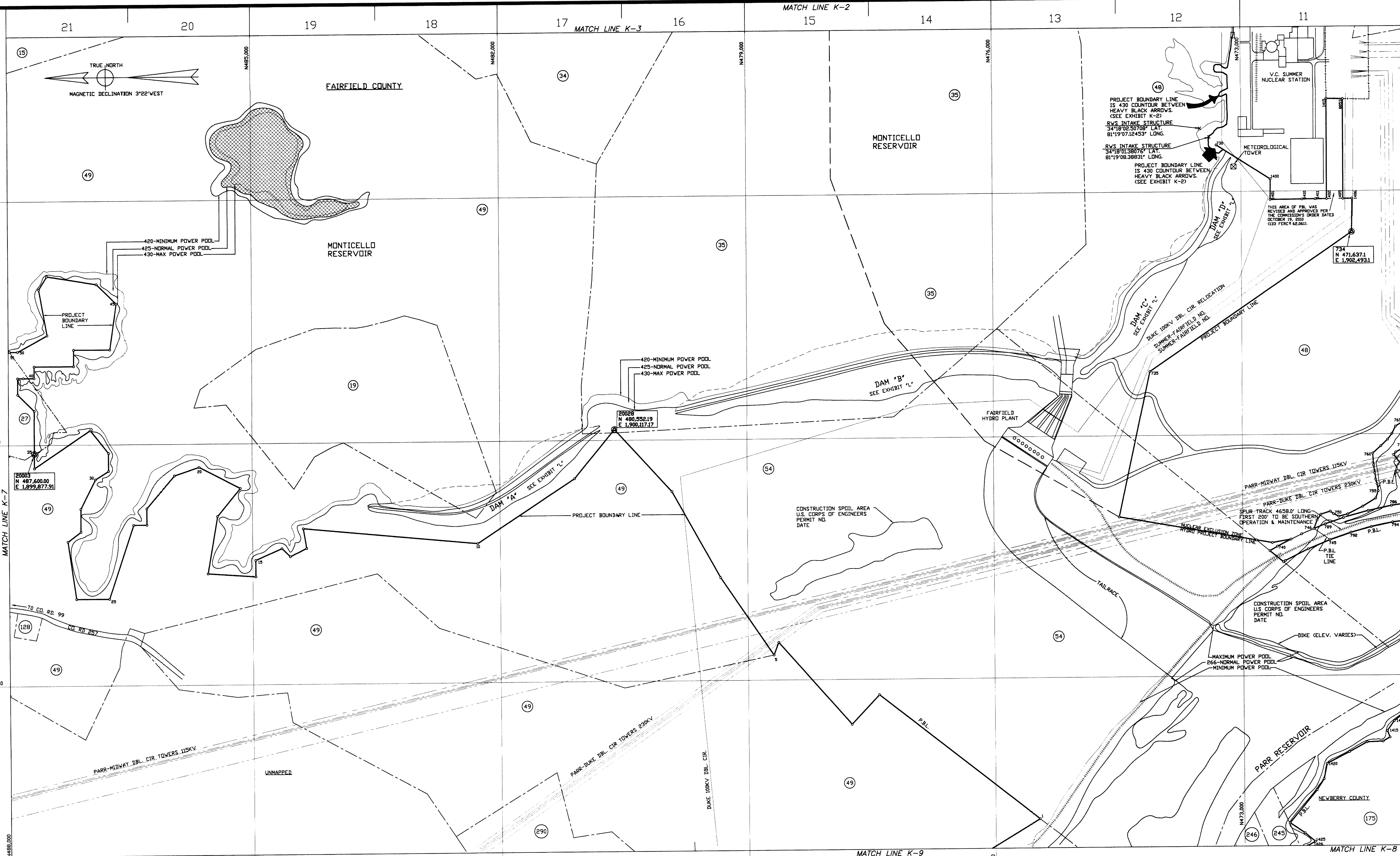
C.O.A. SEAL
SOUTH CAROLINA GLENN ASSOCIATES SURVEYING INC. No.C02238 CERTIFICATE OF AUTHORIZATION

REVISION SCHEDULE

NO.	DATE	DESCRIPTION	CHECKED
1	2/20/12	REVISED PER FERC ORDER 137 FERC ¶ 62,033	BBB

1894-110

EXHIBIT K
SHEET 6



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7. ELEVATIONS SHOWN ARE BASED ON THE U.S.C.&G.S. DATA (M.S.L.)

8. PB.L. FOR MONTICELLO RESERVOIR IS GENERALLY A MAXIMUM OF 200 FEET FROM 425 CONTOUR EXCEPT IN RECREATION AREAS OR AS DEEMED NECESSARY BY FIELD INSPECTION. THE P.B.L. AROUND PARR RESERVOIR IS GENERALLY ALONG THE CONTOUR OF THE FLOOD OF RECORD AS ADJUSTED TO ACCOUNT FOR THE INFLUENCE OF PARR DAM, AS INDICATED ON EXHIBIT K-1

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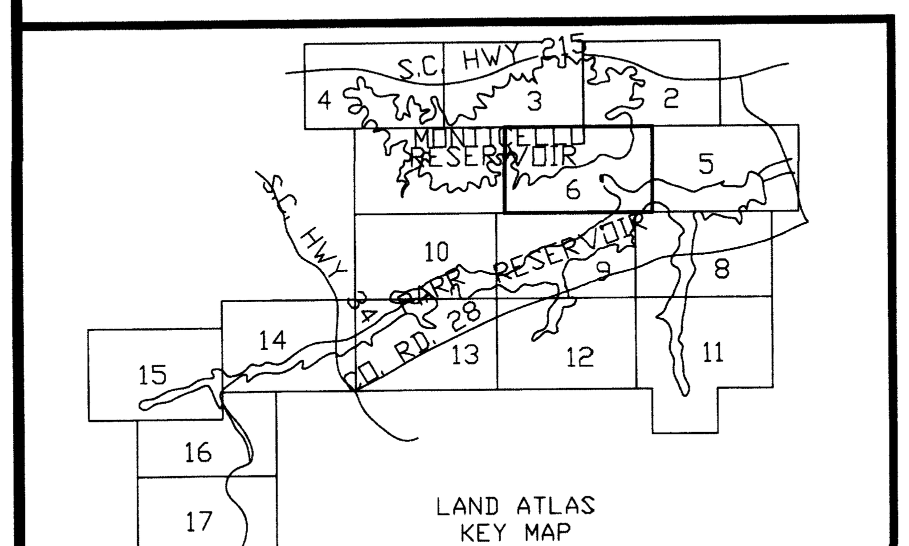
10. SOUTHERN R.R. R/W IS EXCLUDED FROM PROJECT, EXCEPT TO THE EXTENT OF FLOWAGE RIGHTS. SEE EXHIBIT 'F'



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TRANSMISSION LINES
PROPOSED
EXISTING

DETAIL MAP OF PROJECT AREA

SHEET 6 OF 20
PARR HYDROELECTRIC PROJECT NO.1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SCALE : 1 INCH = 500 FEET
0 500' 1000' 1500' 2000' 2500' 3000'

SURVEYED BY GLENN ASSOCIATES SURVEYING, INC.
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C.O.A. SEAL
SOUTH CAROLINA GLENN ASSOCIATES SURVEYING INC. No.C02238 CERTIFICATE OF AUTHORIZATION

REVISION SCHEDULE

NO.	DATE	DESCRIPTION	CHECKED
1	2/20/12	REVISED PER FERC ORDER 137 FERC ¶ 62,033	BBB

1894-111

APPENDIX E

BASELINE WATER QUALITY REPORT

WATER QUALITY REPORT

PARR FAIRFIELD HYDROELECTRIC PROJECT
FERC No. 1894

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

May 2014

WATER QUALITY REPORT

PARR FAIRFIELD HYDROELECTRIC PROJECT
FERC No. 1894

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

May 2014

WATER QUALITY REPORT

PARR FAIRFIELD HYDROELECTRIC PROJECT
FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project (FERC No. 1894) ("Parr Fairfield Project" or "Project"), owned and operated by the South Carolina Electric & Gas Company ("SCE&G" or "Licensee"), is currently licensed by the Federal Energy Regulatory Commission ("FERC" or "the Commission") through June 2020. In anticipation of relicensing, this water quality report has been prepared utilizing existing water quality data available for the waters associated with the Parr Fairfield Project including Parr Reservoir, Monticello Reservoir, the downstream reach of the Broad River, located below the Parr Shoals Dam, and a site located upstream of Parr Reservoir, on the Broad River near Carlisle.

The Parr Reservoir, located in Fairfield County, South Carolina, is a 4,400 acre impoundment formed by the Broad River and the Parr Shoals Dam and serves as the lower reservoir for the Fairfield Pumped Storage Development. Monticello Reservoir, a 6,800 acre impoundment is formed by a series of four earthen dams and serves as the upper reservoir for the pumped storage development. While the Broad River upstream and downstream of the Parr Reservoir is not included in the Project Boundary Line (PBL), this report will also examine the water quality at select sites to evaluate potential effects from Project operations.

It should be noted that the V. C. Summer Nuclear Station (VCSNS) is located on the south end of Monticello Reservoir, but is not part of the Parr Fairfield Project. However, the two projects do share Monticello Reservoir, with VCSNS utilizing lake waters as a coolant for its single nuclear unit, Unit #1. Currently the VCSNS is being expanded to include two more nuclear units, 2 and 3, which will utilize the Parr Reservoir as a coolant upon completion of the project.

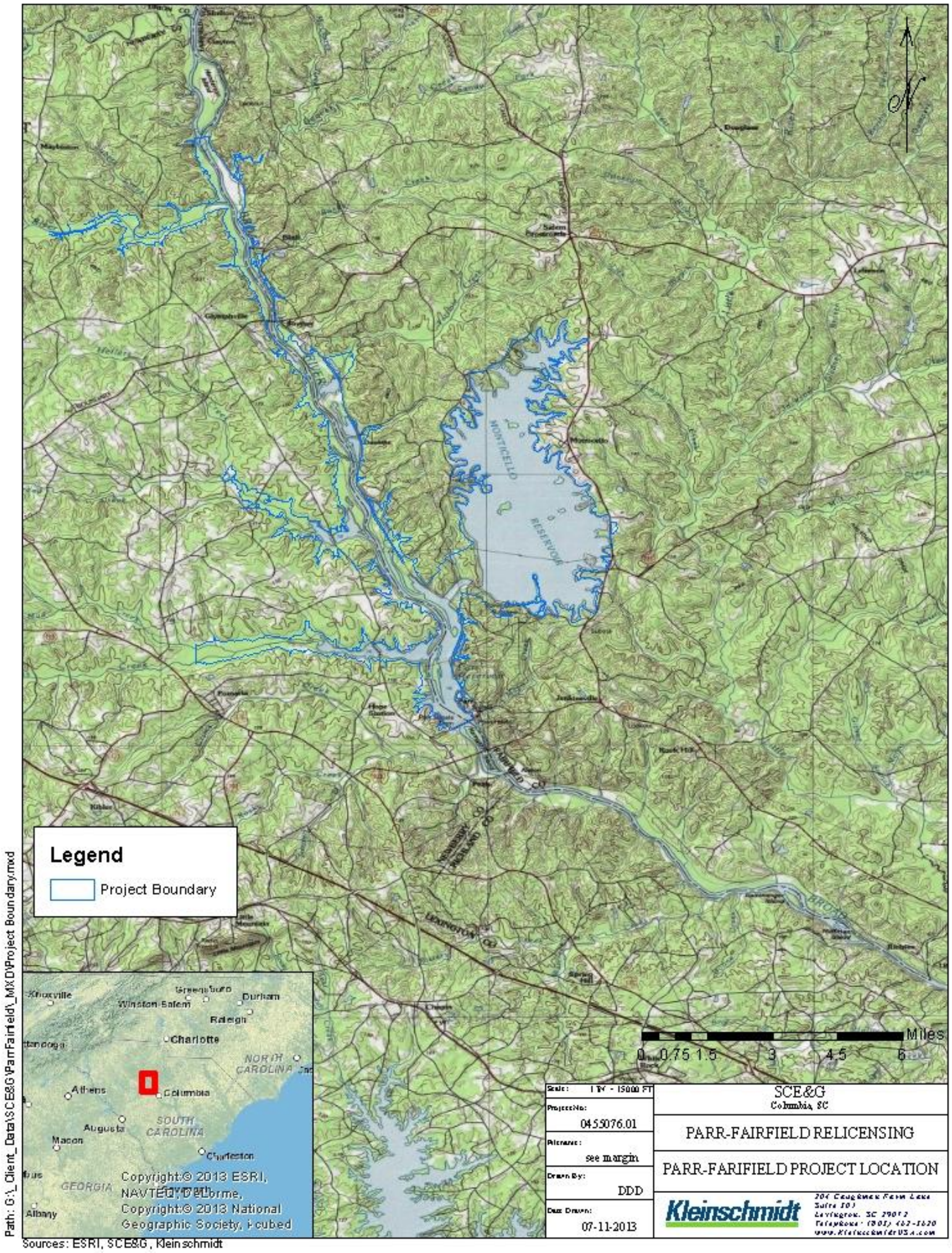


FIGURE 1-1 PARR FAIRFIELD PROJECT BOUNDARY LINE

1.1 GOALS AND OBJECTIVES

The goal of this water quality report is to collect and present existing data for the Parr Reservoir, Monticello Reservoir, and select upstream and downstream sites on the Broad River above Parr Reservoir and below the Parr Shoals Dam to accurately describe the past and current water quality of these areas. In addition, this report serves to establish a water quality baseline for the Project, as well as identify any potential water quality trends which may be associated with effects from Project operations.

1.2 BACKGROUND WATER QUALITY INFORMATION

While there are many ways to evaluate the health of a river or lake, this report focuses on a few common water quality indicators such as water temperature, dissolved oxygen, conductivity and pH, among others, to best describe the health of the Parr Fairfield Project waters. General information on the parameters utilized in this report, along with an explanation of why they are commonly used water quality indicators, is included below.

Dissolved oxygen

Oxygen found in water is measured in its dissolved form as dissolved oxygen, or DO. DO in water is consumed by aquatic animals, decomposition of organic matter and various other chemical reactions, making it an extremely important resource within lakes, streams and rivers. DO levels fluctuate seasonally, as well as diurnally. Aquatic biota can be vulnerable to low DO levels which naturally occur on early mornings of hot summer days, when stream flows are low, water temperatures are high and aquatic plants have not been producing oxygen since sunset the day before (USEPA 1997).

Conductivity

As defined by the United States Environmental Protection Agency (USEPA or EPA), conductivity is a measure of the ability of water to pass an electrical current, and is affected by the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate, and phosphate anions or sodium, magnesium, calcium, iron and aluminum cations. Temperature also has an effect on conductivity, where the warmer the water, the higher the conductivity, which is why conductivity is typically reported at 25^{o}C. The geology of the area through which the river flows will have a large impact on the conductivity of the water. A range of 50 to 1500 µS/cm is typical of rivers throughout the United States. Waters with a conductivity measurement outside of this range may indicate that the river is not suitable for various species of fish and macroinvertebrates (USEPA 1997).

pH

Another indicator of water quality is pH, a term used to indicate the alkalinity or acidity of a substance as ranked on a scale from 1.0 to 14.0. As the acidity in a water sample increases, the pH decreases. The pH for pure water is 7.0. The pH of a river or lake affects many chemical and biological processes occurring in the water, allowing for different organisms to flourish or deteriorate within different pH ranges. Typically, a majority of aquatic animals prefer a pH range of 6.5-8.0. Low pH can allow for toxic elements and compounds to become available for uptake by aquatic plants and animals, producing lethal conditions for many species (USEPA 1997).

Turbidity

The measurement of water clarity is known as turbidity. Materials suspended in water, such as soil particles, algae, plankton and microbes typically ranging in size from 0.004mm to 1.0mm, can decrease the passage of light through water. Since the suspended particles absorb heat, high turbidity can increase water temperatures, and thus decrease DO concentrations. High turbidity will also reduce the amount of light that is able to penetrate the water, which in turn inhibits photosynthesis and the production of DO. Increased tubidity's reduction of light penetration also has a potential affect in mediating algal blooms. Suspended materials that might cause high turbidity can also clog fish gills, reducing a fish's ability to resist disease, as well as lowering fish growth rates and negatively affect egg and larval development (USEPA 1997).

Nitrogen and Phosphorus

Nitrogen is found in several different forms in aquatic ecosystems, including ammonia, nitrates (NO_3) and nitrites (NO_2). Phosphorus usually exists in nature as part of a phosphate molecule (PO_4) and is found in aquatic systems as organic and inorganic phosphate. While nitrogen and phosphorus in their various forms are essential plant nutrients, excessive amounts can cause significant water quality issues. When combined with phosphorus, nitrates in excess amounts can accelerate eutrophication, which causes extreme increases in aquatic plant growth and changes in the types of plants and animals that inhabit a body of water. Dissolved oxygen, temperature and other water quality indicators are also affected (USEPA 1997).

Chlorophyll-a

Chlorophyll-a is the primary photosynthetic pigment in algae and cyanobacteria. Chlorophyll-a is measured to determine the amount of algae present in a water body. High algae concentrations can cause a variety of water quality issues, such as decreased dissolved oxygen and increased nutrient pollution (USEPA 1997).

Metals

While some metals at specific concentrations are essential for good water quality, the presence of other metals is extremely dangerous and toxic to aquatic life. The “heavy metals” such as cadmium, chromium, mercury and lead are the most toxic to aquatic organisms.

2.0 METHODOLOGY

2.1 OVERVIEW

This report covers four separate bodies of water as they relate to the Parr Fairfield Project, including the Parr Reservoir, Monticello Reservoir, the Broad River upstream of Parr Reservoir, and the Broad River downstream of the Parr Shoals Dam. This report also focuses mainly on common water quality indicators such as temperature, dissolved oxygen, pH and conductivity, along with additional data when available, on turbidity, nitrogen, phosphorus, chlorophyll-a and metals. Existing data, extending back to 1999, were assembled for each area from several different sources at several different collection sites. Water quality data were compiled from several sources including the US Geological Service (USGS), the South Carolina Department of Health and Environmental Control (SCDHEC), the South Carolina Department of Natural Resources (SCDNR), and SCANA Corporate Environmental Services (parent company to SCE&G). Figure 2-1 depicts the USGS, SCDHEC, and SCANA water quality monitoring sites utilized in this report.

Sediment from the Parr Reservoir was sampled and analyzed for various metals by SCANA in 2012 and the findings from this study are also included in this report.

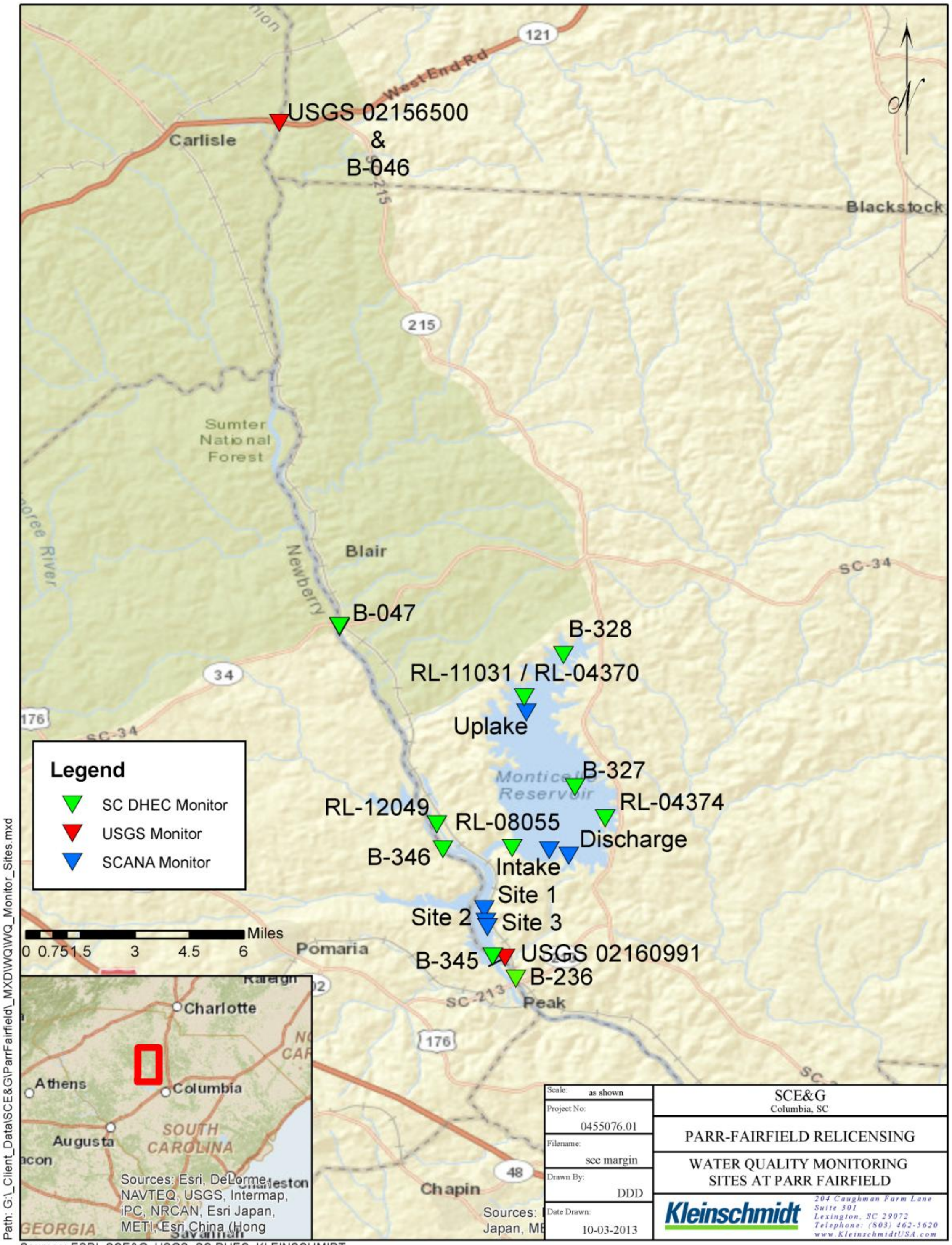


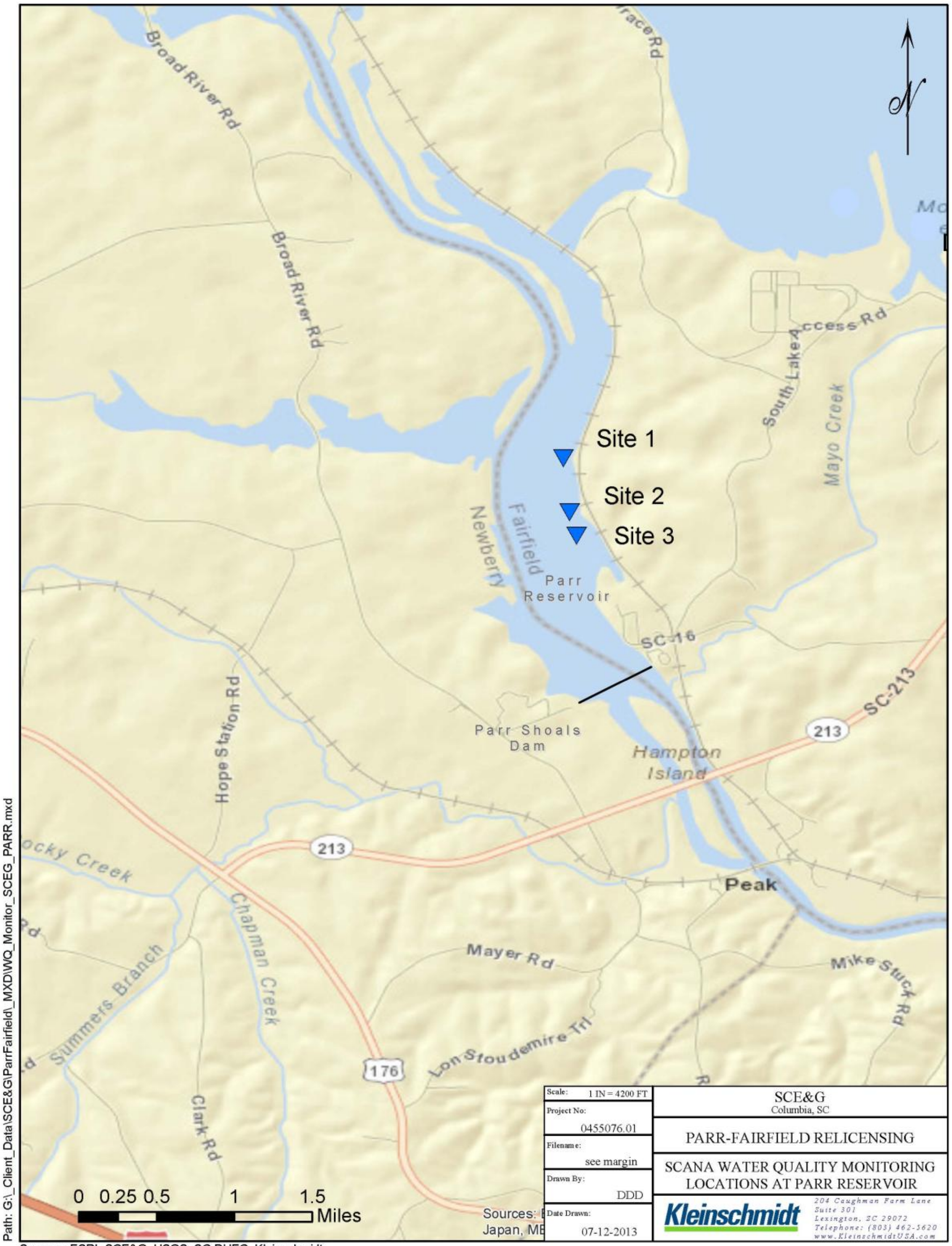
FIGURE 2-1 MAP OF WATER QUALITY MONITORING LOCATIONS FOR THE PARR FAIRFIELD HYDRO PROJECT

2.2 PARR RESERVOIR DATA COLLECTION METHODS

2.2.1 PARR RESERVOIR WATER QUALITY DATA

Data used within this report to describe water quality conditions for the Parr Reservoir were compiled from SCANA and SCDHEC.

SCANA collects vertical profile water quality data at three locations within Parr Reservoir in accordance with the provisions of the Section 401 certification of the Clean Water Act issued to SCE&G by SCDHEC. Sampling locations include the vicinity of the combined discharge of the cooling tower blowdown and other liquid waste streams from the two new nuclear units (2 and 3) that are being constructed adjacent to the Parr Reservoir as part of the V. C. Summer Nuclear Station expansion. The parameters of temperature, dissolved oxygen, specific conductivity, and pH are collected on a monthly basis beginning in 2011 and continuing for five years after the nuclear units 2 and 3 are fully operational. Data included in this report were collected from January 2011 through December 2013. This vertical profile data are currently collected at three locations in the Parr Reservoir, including Site 1, located approximately 500 yards upstream of the proposed discharge site for the new nuclear units 2 and 3; Site 2, located at the proposed discharge site for the new nuclear units 2 and 3; and Site 3, located approximately 300 yards downstream of the proposed discharge site. Figure 2-2 shows the exact monitoring locations in the Parr Reservoir.



Sources: ESRI, SCE&G, USGS, SC DHEC, Kleinschmidt

FIGURE 2-2 SCANA MONITORING SITES ON THE PARR RESERVOIR

Data are collected by SCANA employees using a YSI 650 MDS Water Quality Logger that is equipped with a YSI 600XL Sonde or instrumentation of equivalent capabilities and accuracy. The meters used for data collection were calibrated following SCANA SCDHEC approved calibration procedures prior to data collection. To establish a vertical profile of the water quality at each specific site, data were collected at each location beginning at the surface and at one meter intervals to the reservoir bottom. Total depth at each sampling site varies depending on the operation of the Fairfield Pumped Storage and river flow at the time of sampling.

SCANA also collected metals data near Site 2 in the Parr Reservoir (see Figure 2-2). Surface grab samples were collected once a month from June 2007 through April 2008 and sent to an outside lab for analysis.

SCDHEC has several monitoring stations located within the Parr Reservoir. Permanent sites are labeled as B-047, B-346 and B-345. Additionally one randomly selected site was monitored by SCDHEC in 2012 and this site is labeled as RL-12049. The exact locations of these sites are shown in Figure 2-3. Samples are collected at these monitoring sites by way of grab samples on a monthly or bi-monthly basis depending on site and year. Over the years the SCDHEC monitoring schedule has undergone several changes, and therefore monitoring has not occurred continuously at all sites. Also, site B-346 was listed as inactive beginning in 2005. SCDHEC water quality data included in this report were retrieved from the EPA’s data warehouse, STORET.

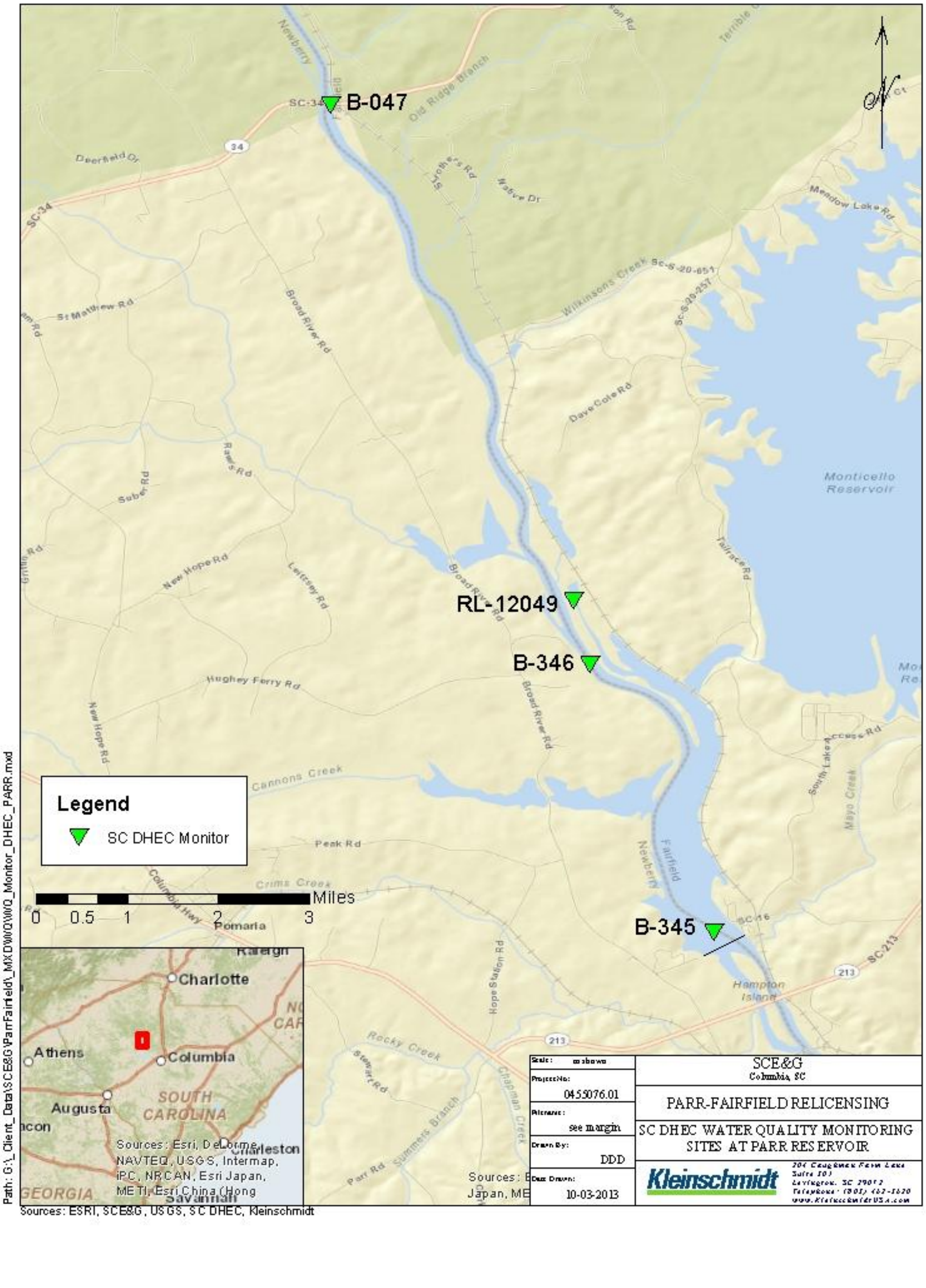


FIGURE 2-3 SCDHEC MONITORING STATIONS ON PARR RESERVOIR

2.2.2 PARR RESERVOIR SEDIMENT DATA

In accordance with provisions of the Clean Water Act Section 401 Water Quality Certification (WQC) issued to SCE&G by SCDHEC, SCANA began annual collections of sediment samples from two locations in the Parr Reservoir for analysis of the following metals (total): aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, strontium, thallium and zinc. Total phosphorus was also measured.

Sediment samples were collected from two transects located within Parr Reservoir. The first transect was located just north of the Heller's Creek confluence approximately 4 miles upstream of the discharge location. The second transect was located approximately 200 yards downstream of the cooling water discharge location. Sampling at each transect consisted of collection of one grab sample from each of five sample points along each transect. One sample was collected from each end of the transect (eastern shore and western shore). The third sample point was located at the mid-point of each transect. The remaining two sample points were located equidistant from the mid-point sample location and each end of each transect. All sample points are constantly inundated at the reservoir's low pool elevation (256ft msl; NGVD 29). The five grab samples were composited and thoroughly homogenized to form one discrete sample from each transect. Basic water quality parameters including temperature, DO, conductivity and temperature were also collected, using a YSI 650 MDS Water Quality Logger equipped with a YSI 600XL Sonde or instrumentation of equivalent capabilities and accuracy at each transect. Figure 2-4 shows the exact location of the two transects.

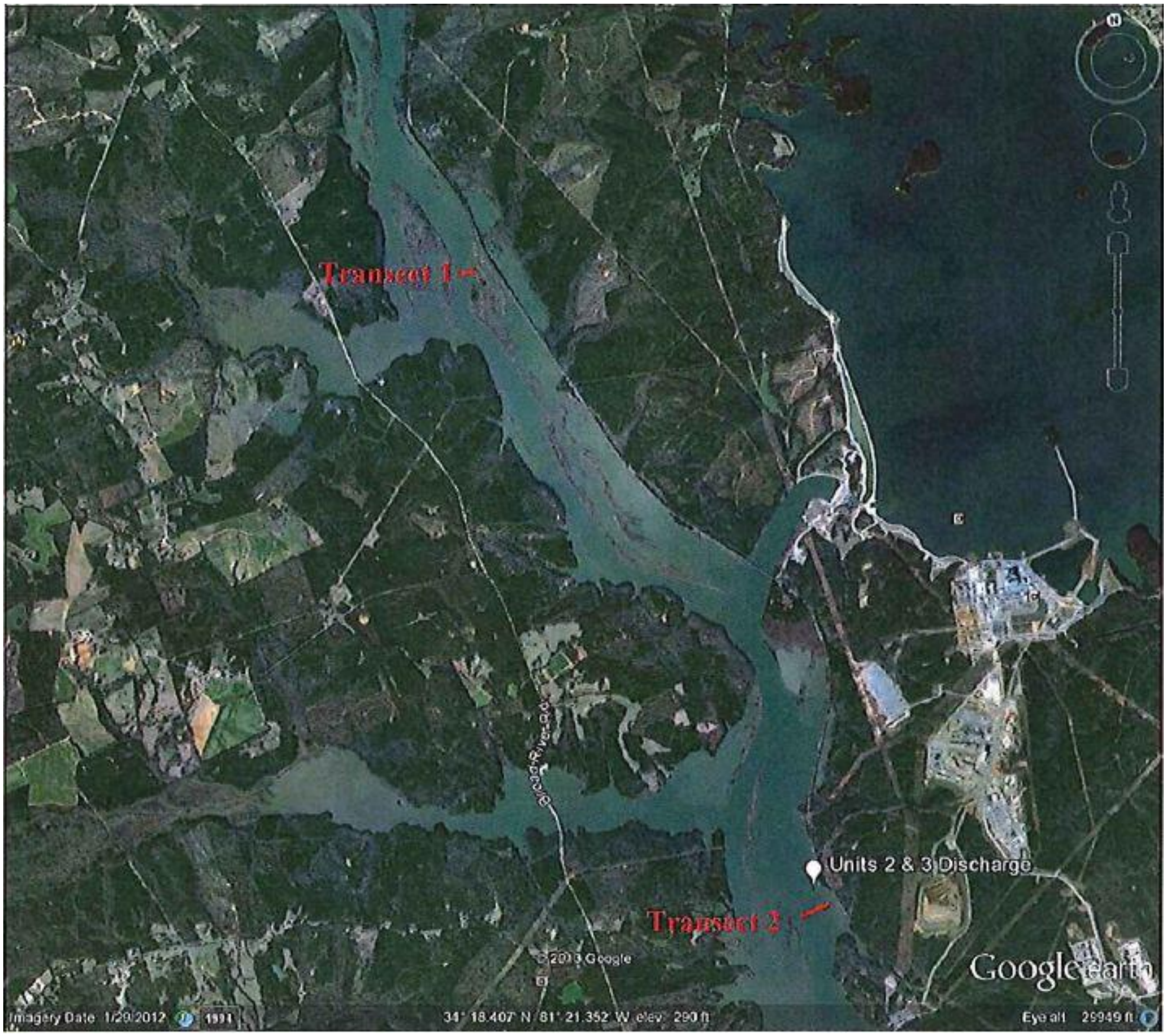
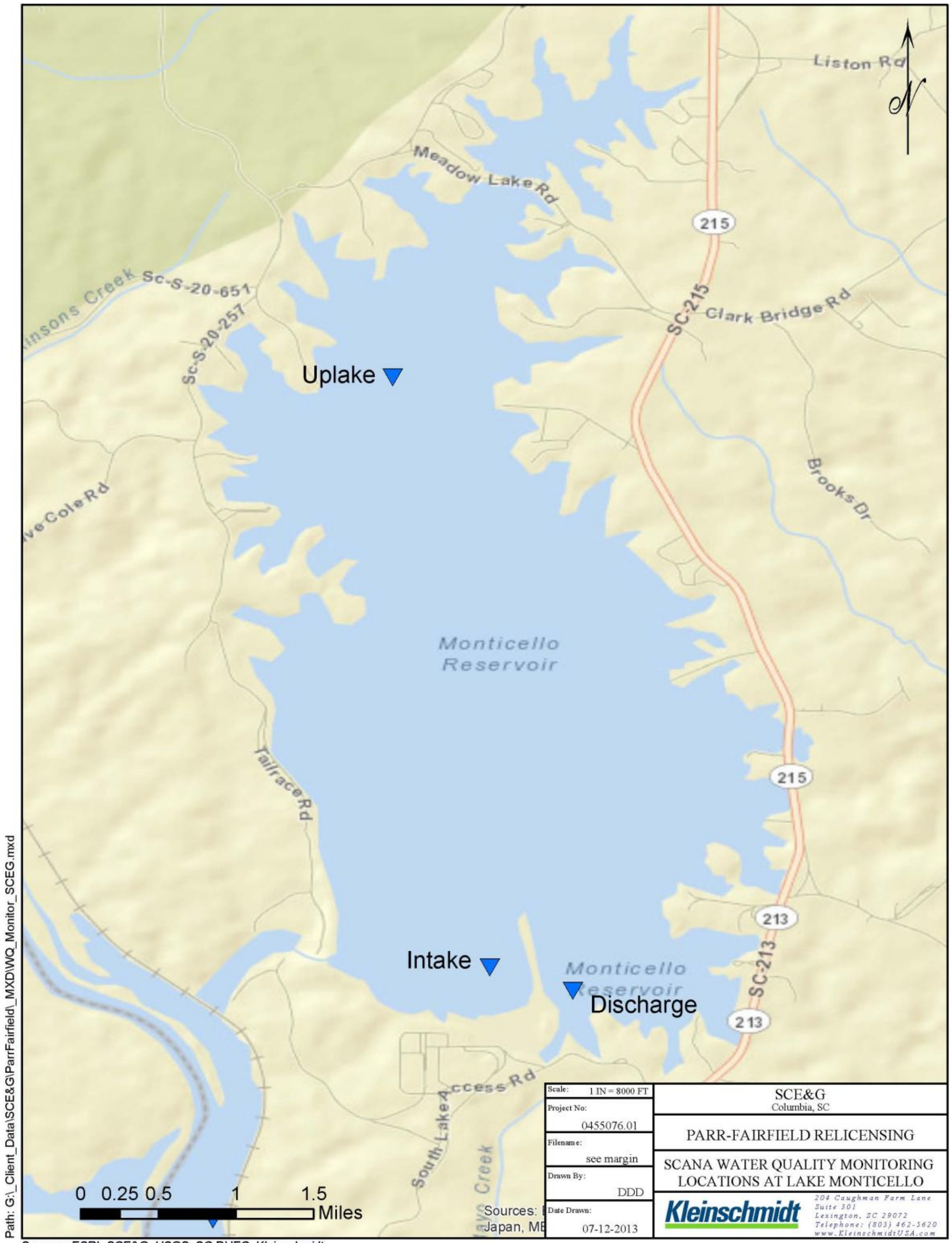


FIGURE 2-4 TRANSECTS FOR PARR RESERVOIR SEDIMENT INVESTIGATION REPORT 2012

2.3 MONTICELLO RESERVOIR DATA COLLECTION METHODS

Data used within this report to describe water quality conditions for Monticello Reservoir were compiled from SCANA and SCDHEC.

SCANA collects vertical profile water quality data in accordance with the provisions of the Section 401 WQC in the vicinity of the intake and discharge of the VCSNS on Monticello Reservoir. The parameters of temperature, dissolved oxygen, specific conductivity, and pH are collected on a monthly basis, with 10 years of data included here, beginning in January 2003 and ending in December 2012. Vertical profile data are currently collected at three locations on Monticello Reservoir, including the site known as “intake,” located in the channel near the circulating water intake for the VCSNS; the site known as “discharge,” located just outside the northern end of the circulating water discharge canal for VCSNS; and the site known as “uplake,” located near the northern end of the reservoir. Figure 2-5 shows the exact monitoring locations on Monticello Reservoir.



Sources: ESRI, SCE&G, USGS, SC DHEC, Kleinschmidt

FIGURE 2-5 SCANA MONITORING SITES ON MONTICELLO RESERVOIR

Data were collected using a YSI 650 MDS Water Quality Logger that is equipped with a YSI 600XL Sonde or instrumentation of equivalent capabilities and accuracy. The meters used for data collection were calibrated following SCANA procedures prior to data collection. To establish a vertical profile of the water quality at each specific site, field measurements were collected at each location beginning at the surface and at one meter intervals to the reservoir bottom. Total depth at each sampling site varies depending on the operation of the Fairfield Pumped Storage and river flow at the time of sampling.

SCANA also collected metals data near the Intake site on Monticello Reservoir (see Figure 2-5). Surface grab samples were collected once a month from June 2007 through April 2008 and sent to an outside lab for analysis.

SCDHEC has two permanent monitoring stations located on Monticello Reservoir, identified as B-327 and B-328. Additionally four randomly selected sites were monitored by SCDHEC in 2004, 2008, and 2011; these sites are labeled as RL-04370, RL-04374, RL-08055, and RL-11031. The exact location of these sites is shown in Figure 2-6. As previously mentioned, the SCDHEC monitoring schedule has undergone several changes over the last 15 years, and therefore monitoring has not occurred continuously at all sites. Data are collected at these monitoring sites by way of grab samples on a monthly or bi-monthly basis depending on individual site and year. Site B-328 was listed as inactive in 2005. SCDHEC water quality data included in this report was downloaded from the EPA's data warehouse, STORET.

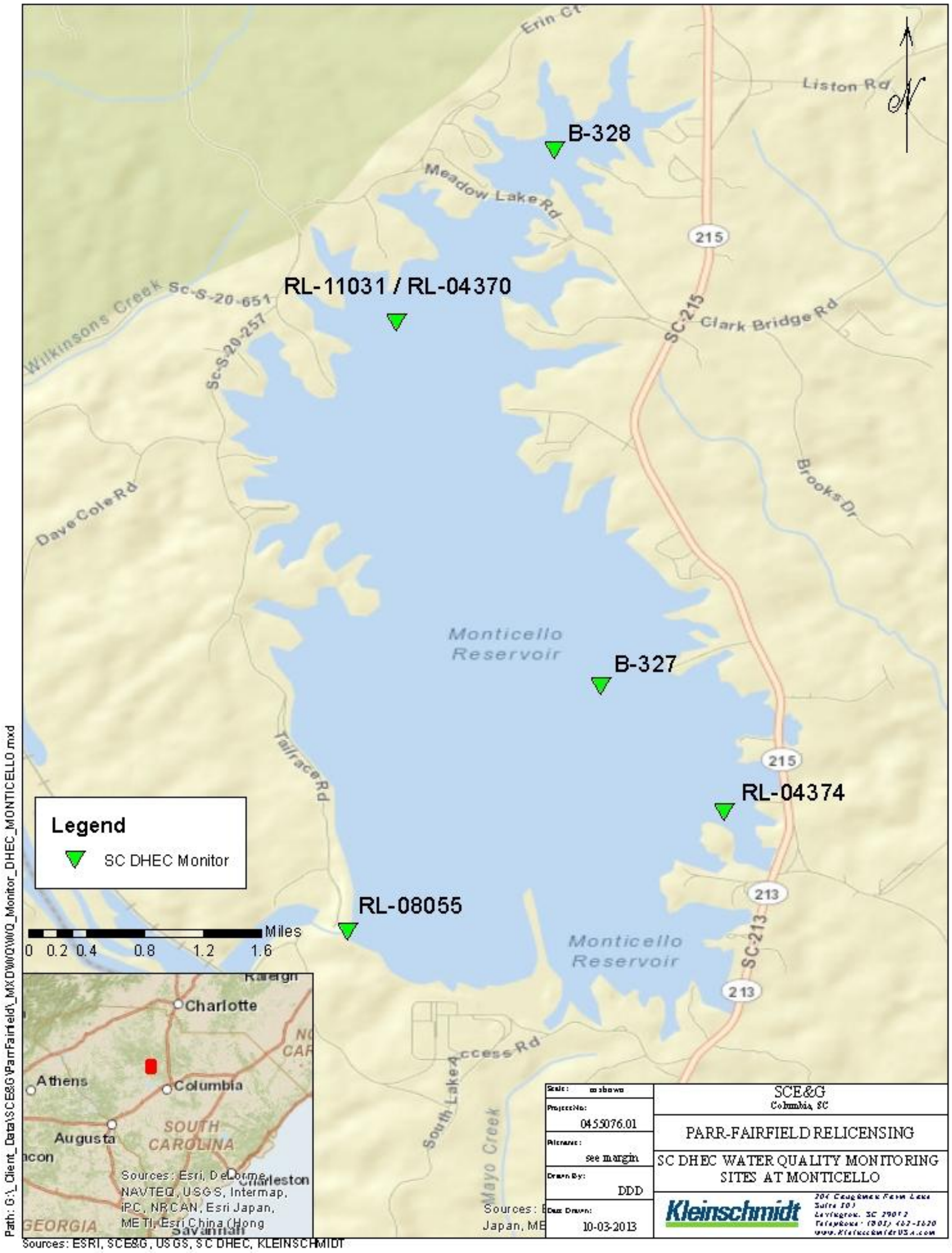


FIGURE 2-6 SCDHEC MONITORING STATIONS ON MONTICELLO RESERVOIR

2.4 BROAD RIVER UPSTREAM OF PARR RESERVOIR DATA COLLECTION METHODS

Data used within this report to describe water quality conditions for the reach of the Broad River upstream of the Parr Reservoir were compiled from USGS, SCDHEC and SCDNR.

The USGS gage 02156500, at the Broad River near Carlisle, SC collects instantaneous data on gage height, specific conductivity, DO, temperature, and pH. For the purposes of this report, only daily averaged data from the last ten years for conductivity, DO, temperature, and pH were used. See Figure 2-7 for a map showing the exact location of the USGS gage.

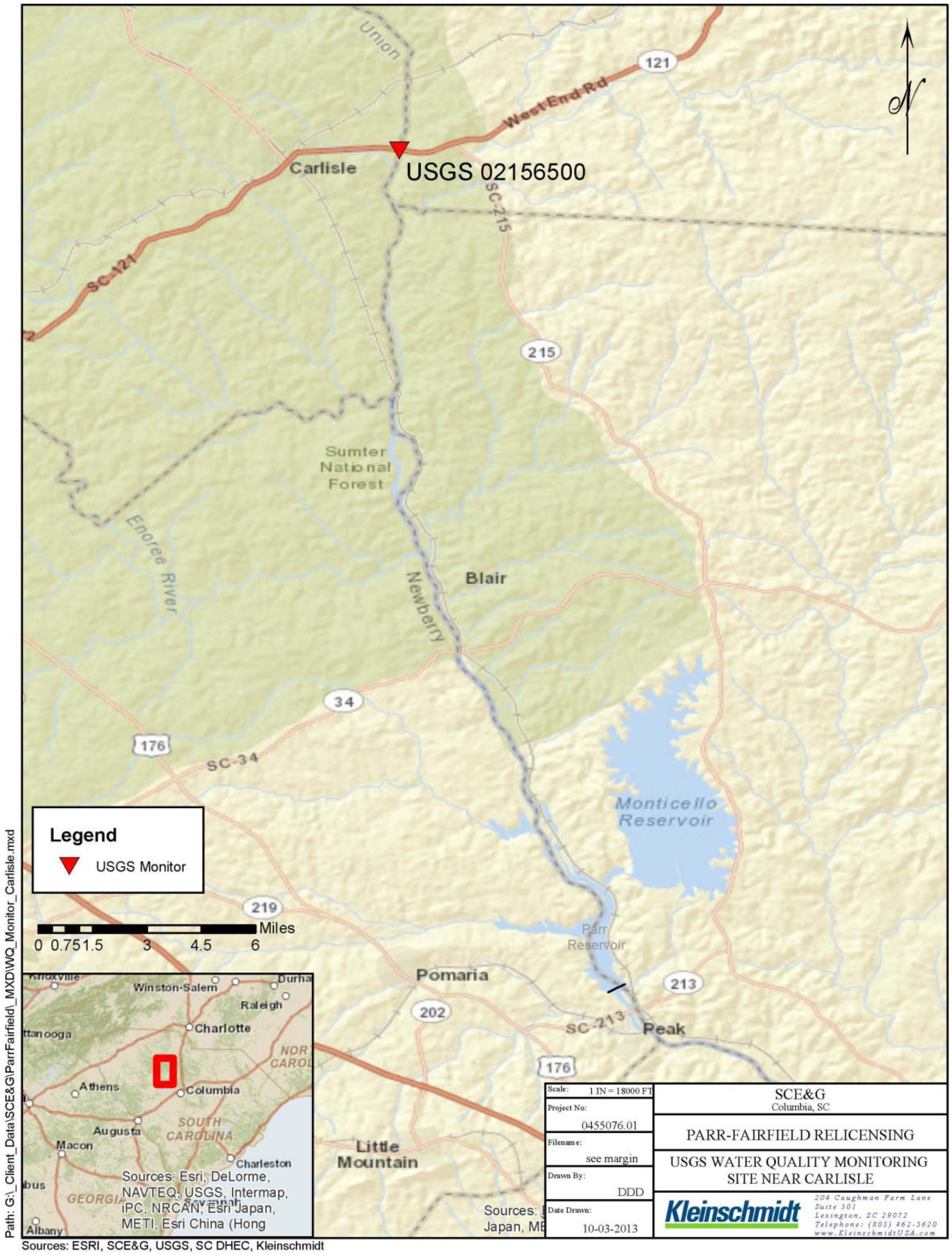


FIGURE 2-7 LOCATION OF USGS GAGE 02156500

SCDHEC has a permanent monitoring site located upstream of the Parr Reservoir near the USGS gage 02156500, labeled as B-046. The exact location of this site is shown in Figure 2-8. Data were collected at this monitoring site by way of grab samples on a monthly basis until late 2009 and bi-monthly thereafter. SCDHEC water quality data for monitoring site B-046 was downloaded from the EPA's data warehouse, STORET.

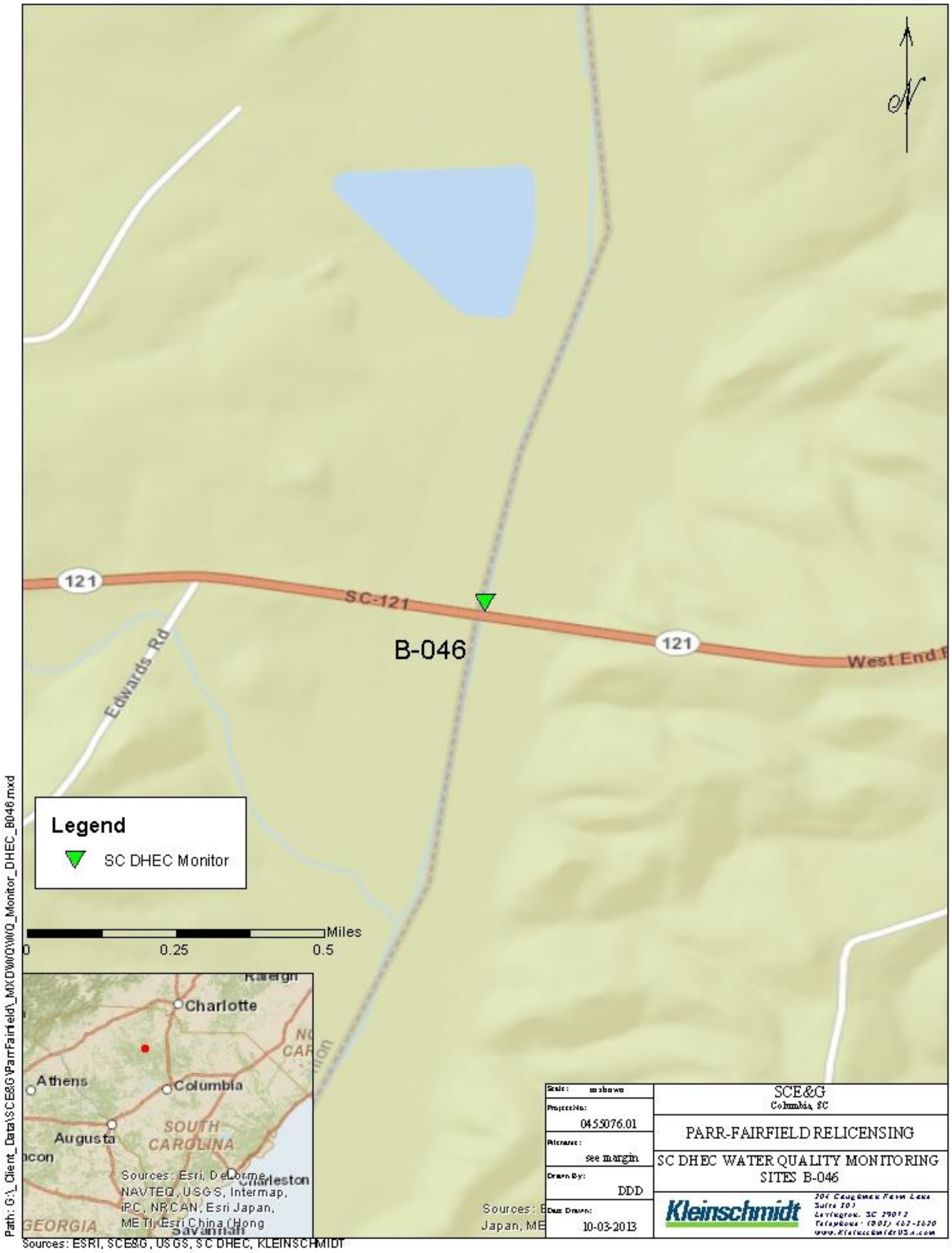


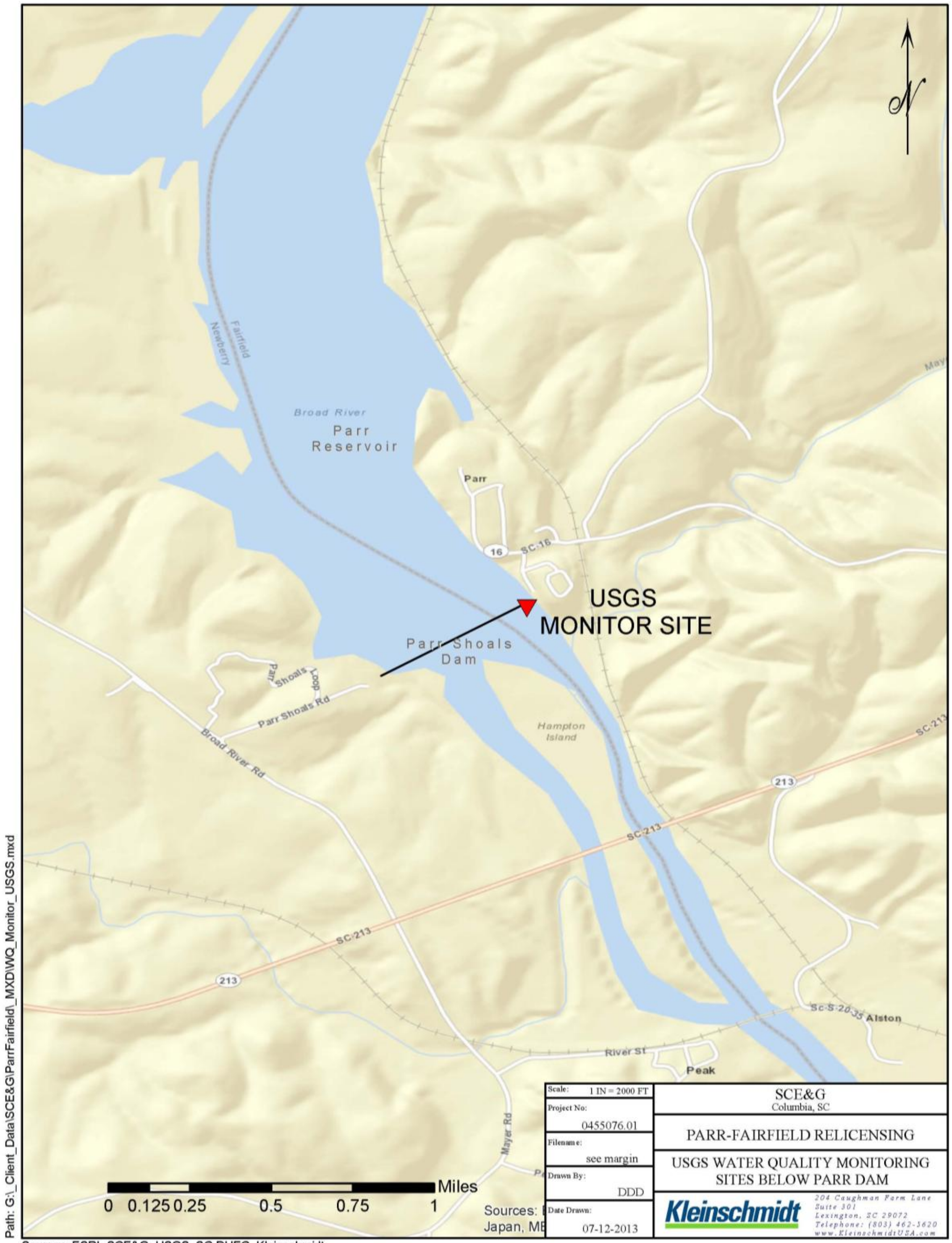
FIGURE 2-8 LOCATION OF SCDHEC MONITORING STATION B-046

Additionally, the South Carolina Geological Survey (SCGS), a division of SCDNR contributed turbidity data that were collected at the USGS gage 02156500 from June of 2012 through August 2013 as part of a four year project funded by the Broad River Mitigation Trust Fund, entitled "Developing sediment management guidelines to enhance habitat and aquatic resources in the Broad River Basin, South Carolina." Water samples were collected with a USGS DH-74 with weight attached to a bridge board, reel and cable. Samples were retrieved using calculated transit rates descending and ascending through the water column to collect depth integrated isokinetic samples. The equal-width-increment (EWI) method was used. Water samples were taken back to the lab and composited. Turbidity was measured with a LaMotte 2020we benchtop turbidity meter. Three individual measurements were taken for each sample and averaged. Water samples were then wet- sieved through a 63um sieve to separate coarse sediment from fine sediment. These two sub-samples were then filtered individually to produce grain size data for in-situ sediment. A third subsample was processed to determine total mass.

2.5 BROAD RIVER DOWNSTREAM OF PARR SHOALS DAM DATA COLLECTION METHODS

Data used within this report to describe water quality conditions for the reach of the Broad River immediately downstream of the Parr Shoals Dam were compiled from USGS, SCDHEC and SCDNR.

The USGS gage 02160991, at the Broad River near Jenkinsville, SC collects instantaneous data on gage height, specific conductivity, DO, temperature and pH. For the purposes of this report, only daily averaged data from the last ten years for conductivity, DO, temperature and pH were used. A map showing the exact location of the USGS gage is shown in Figure 2-9.



Sources: ESRI, SCE&G, USGS, SC DHEC, Kleinschmidt

FIGURE 2-9 LOCATION OF USGS GAGE 02160991

SCDHEC has a permanent monitoring site located downstream of the Parr Shoals Dam and the USGS gage 02160991, labeled as B-236. The exact location of this site is shown in Figure 2-10. Data were collected at this monitoring site by way of grab samples on a monthly basis, however data were only available for years 1999 and 2004. This site was listed as inactive in 2005. SCDHEC water quality data for monitoring site B-236 were downloaded from the EPA's data warehouse, STORET.

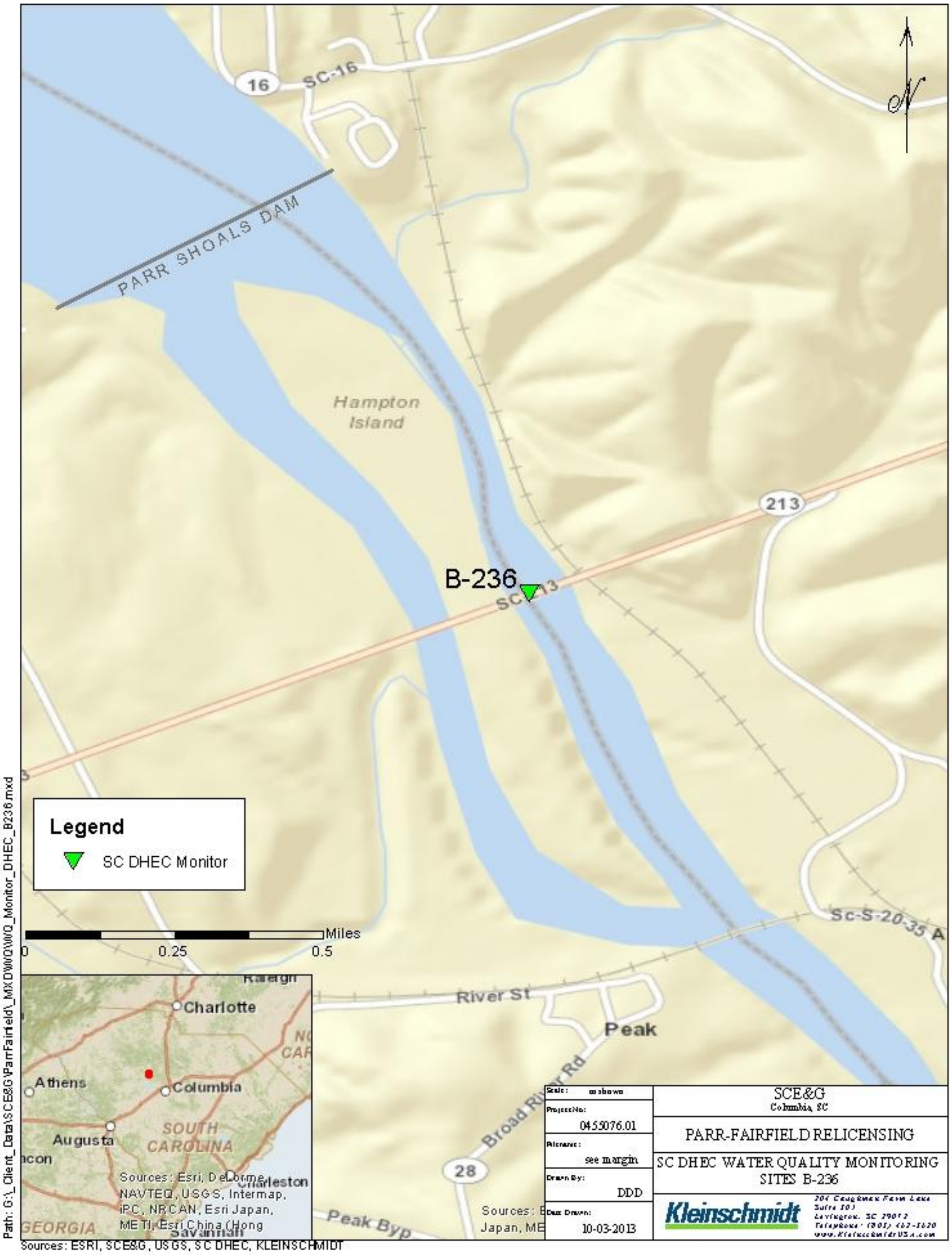


FIGURE 2-10 LOCATION OF SCDHEC MONITORING STATION B-236

SCDNR also contributed water quality data collected over the last few years as part of ongoing fisheries research in the area of the Broad River downstream of the Parr Shoals Dam. It is important to note that these data are currently unpublished and is being collected as part of an ongoing Lower Broad River Fish Community Study being conducted by SCDNR Region 3 Fisheries. Data collections include temperature, DO, conductivity, and salinity measurements using a YSI-85, pH measurements with an Oakton pH11 Series, and turbidity with a La Motte 2020*e*. Data included in this report were collected from three general areas along the Broad River, below the Parr Shoals Dam. Description of these locations are as follows; Reach 1, the first mile below Parr Shoals Dam, from the dam to the railroad crossing; Reach 2A, the pristine middle reach extending from the railroad crossing to the top of Bookman Shoals; and Reach 2B, the pristine middle reach extending from the top of Bookman Shoals to Boatwright Island. Figure 2-11 shows these three reaches of the Broad River.

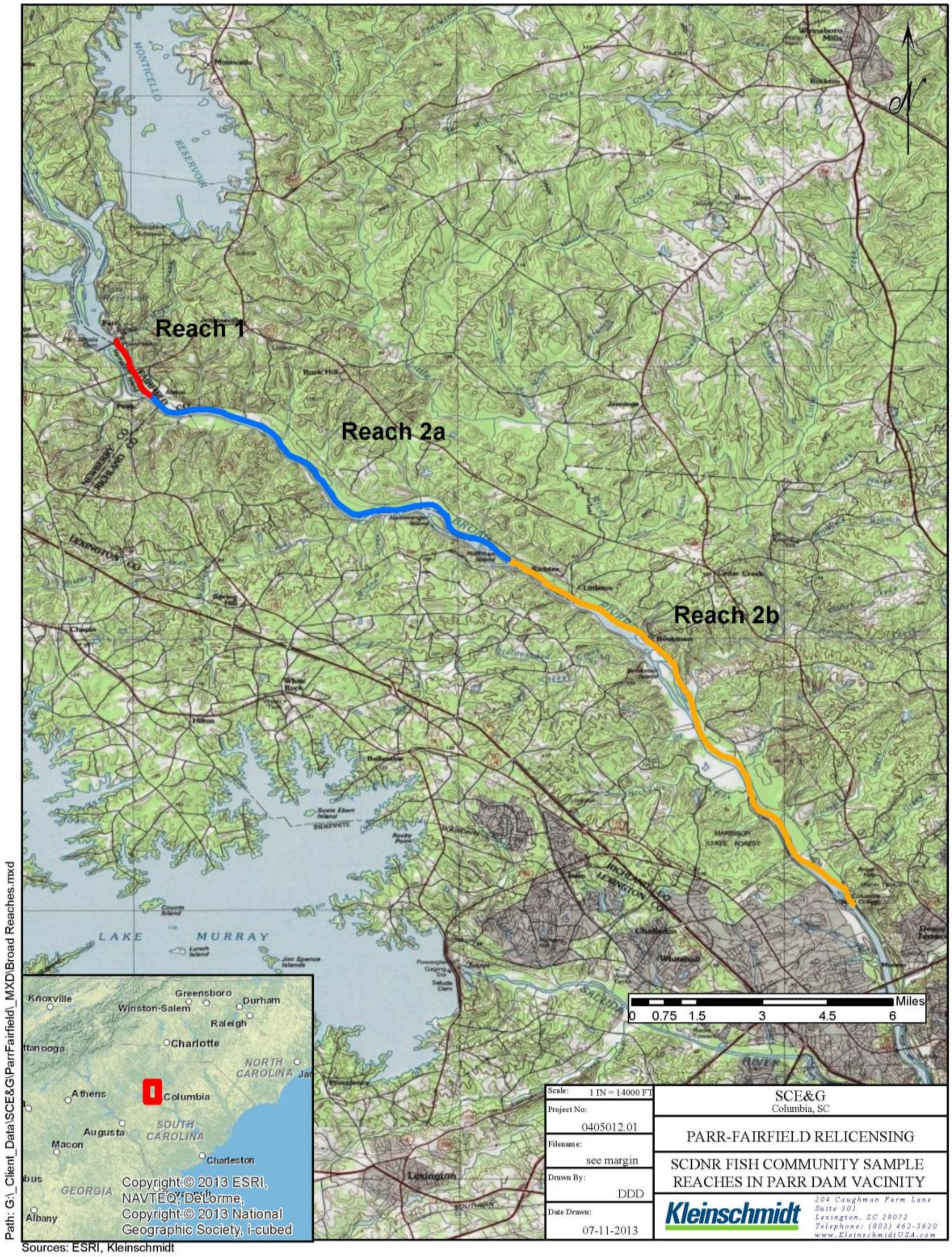


FIGURE 2-11 THREE REACHES OF THE BROAD RIVER DOWNSTREAM OF THE PARR SHOALS DAM

2.6 SCDHEC Water Quality Standards for Freshwaters

SCDHEC identifies freshwaters (FW) as the following; suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with SCDHEC requirements; suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and suitable for industrial and agricultural uses. All waters associated with the Project are classified as FW by SCDHEC. Listed below in Table 2-1 and Table 2-2 are the SCDHEC water quality standards for FW as they apply to the parameters examined in this report. For SCDHEC standards of metals, see the SCDHEC Regulations 61-68, Water Classifications & Standards.

Table 2-1 SCDHEC Water Quality Standards for Freshwaters

Parameter	Standard
Temperature	The water temperature of all Freshwaters which are free flowing shall not be increased more than 5°F (2.8°C) above natural temperature conditions and shall not exceed a maximum of 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard as provided for in C.12. has been established, a mixing zone as provided in C.10. has been established, or a Section 316(a) determination under the Federal Clean Water Act has been completed.
pH	Between 6.0 and 8.5.
Dissolved Oxygen	Daily average not less than 5.0mg/l with a low of 4.0 mg/l.
Turbidity (reservoirs only)	Not to exceed 25 NTUs provided existing uses are maintained
Turbidity (excluding reservoirs)	Not to exceed 50 NTUs provided existing uses are maintained.

Table 2-2 SCDHEC Nutrient Standards for Waters in the Piedmont and Southeastern Plains Ecoregions

Parameter	Standard
Total Nitrogen	≤ 1.50 mg/l
Total Phosphorus	≤ 0.06 mg/l
Chlorophyll a	≤ 40 ug/l

SCDHEC has also identified several metals that they consider to be essential in indicating the ability of a body of water to support aquatic life. These core indicator metals are listed below in Table 2-3.

TABLE 2-3 SCDHEC CORE INDICATOR METALS FOR AQUATIC LIFE SUPPORT USE

CORE INDICATORS METALS
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Zinc

3.0 RESULTS

3.1 PARR RESERVOIR

3.1.1 SCE&G VERTICAL PROFILE DATA

3.1.1.1 TEMPERATURE

Water temperatures depicted in the graphs below are an average of monthly readings collected by SCE&G personnel, beginning in January of 2011 to December of 2013. Site 1 refers to the monitoring site located approximately 500 yards upstream of the proposed discharge site for the new nuclear units 2 and 3. Site 2 refers to the monitoring site located at the proposed discharge site for the new nuclear units 2 and 3. Site 3 is the monitoring site located approximately 300 yards downstream of the proposed discharge site.

General trends in the water temperature of the Parr Reservoir include increasing temperatures during the summer, peaking at approximately 30^{o}C during the months of July and August, and decreasing temperatures with increasing depth in the reservoir.

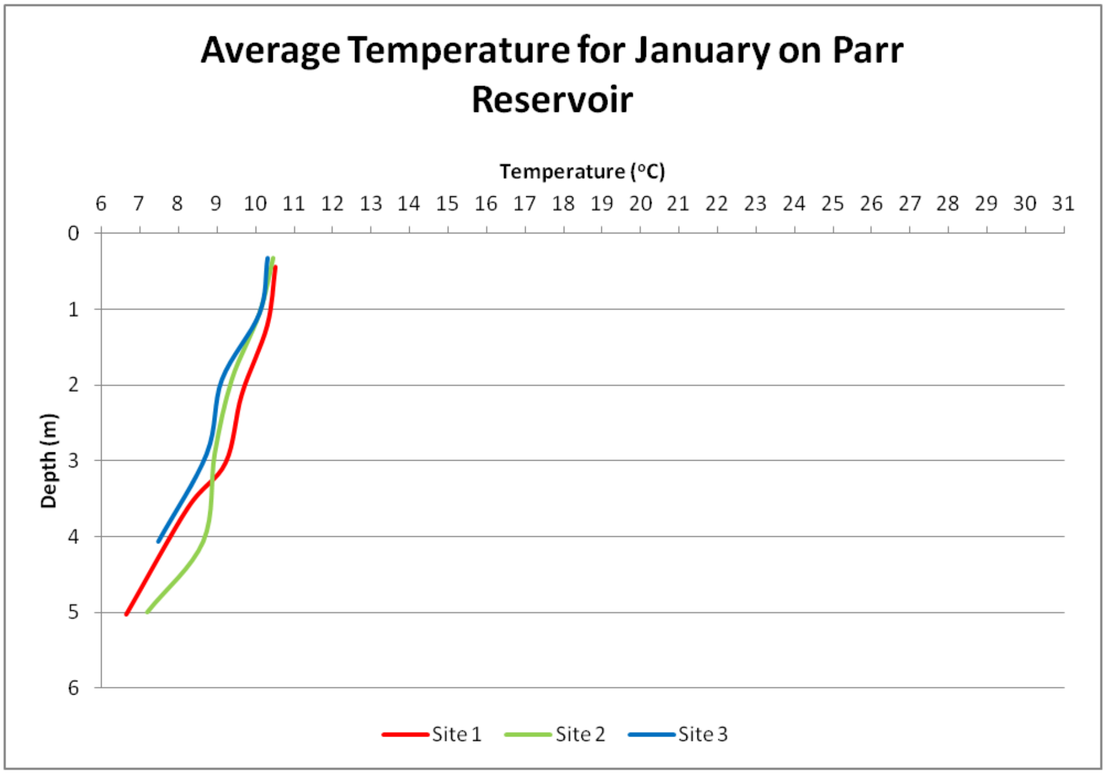


FIGURE 3-1 **AVERAGE TEMPERATURE FOR JANUARY ON PARR RESERVOIR**

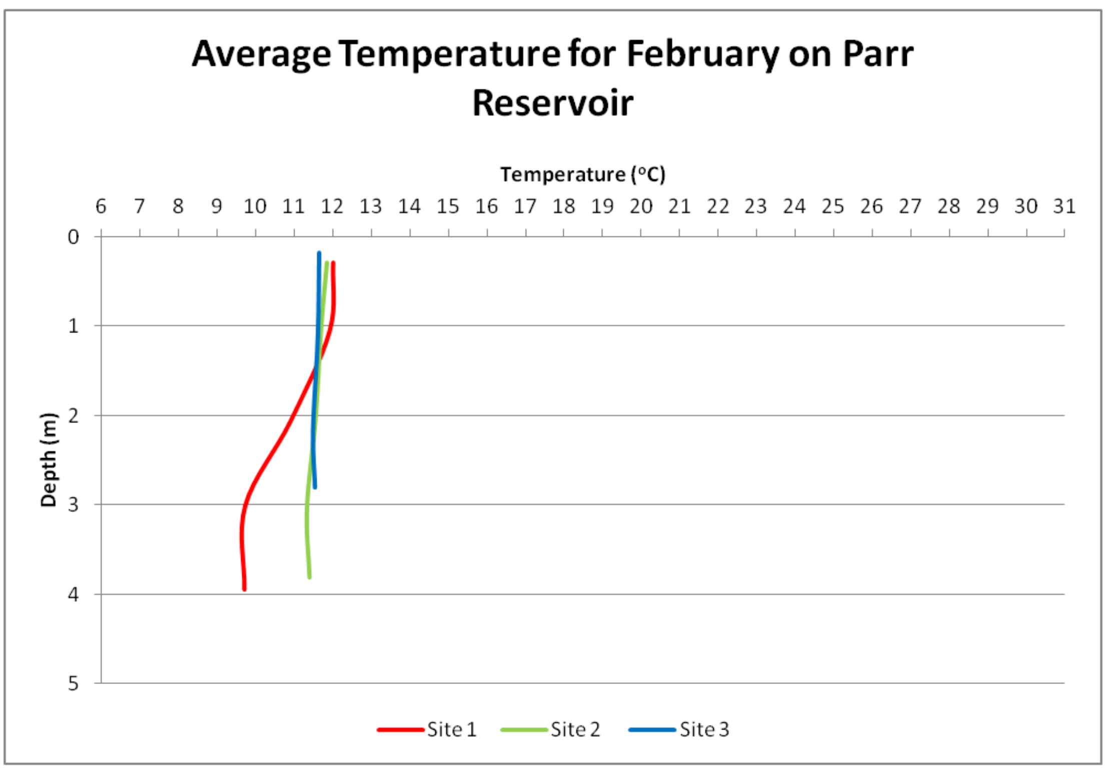


FIGURE 3-2 **AVERAGE TEMPERATURE FOR FEBRUARY ON PARR RESERVOIR**

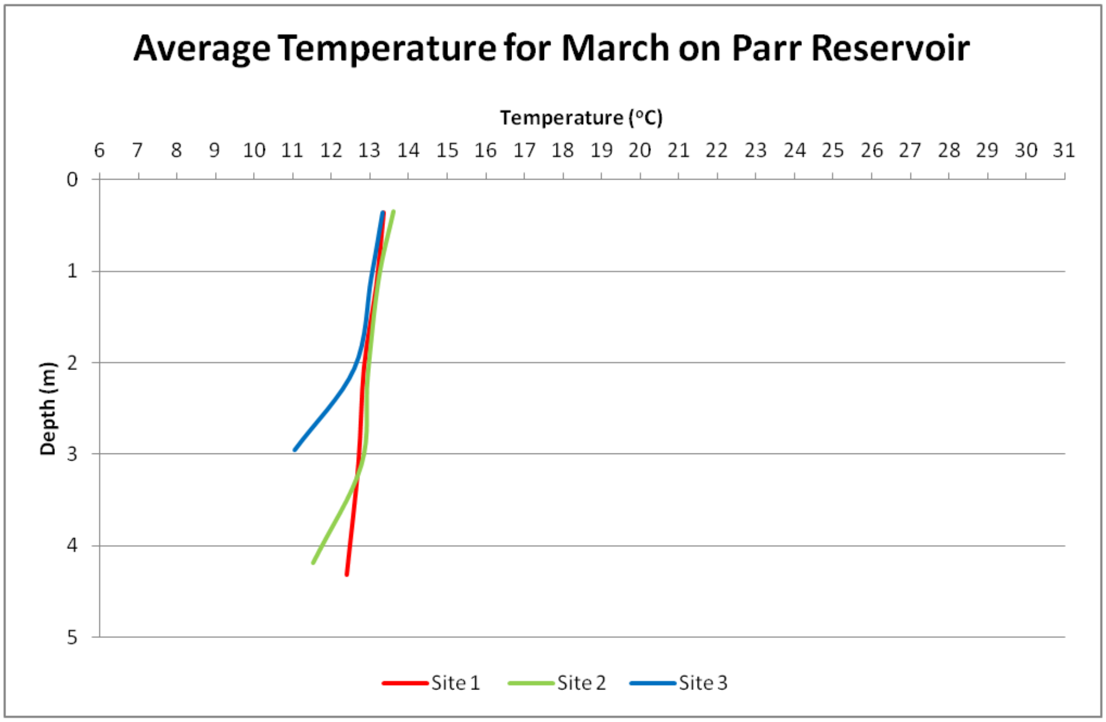


FIGURE 3-3 **AVERAGE TEMPERATURE FOR MARCH ON PARR RESERVOIR**

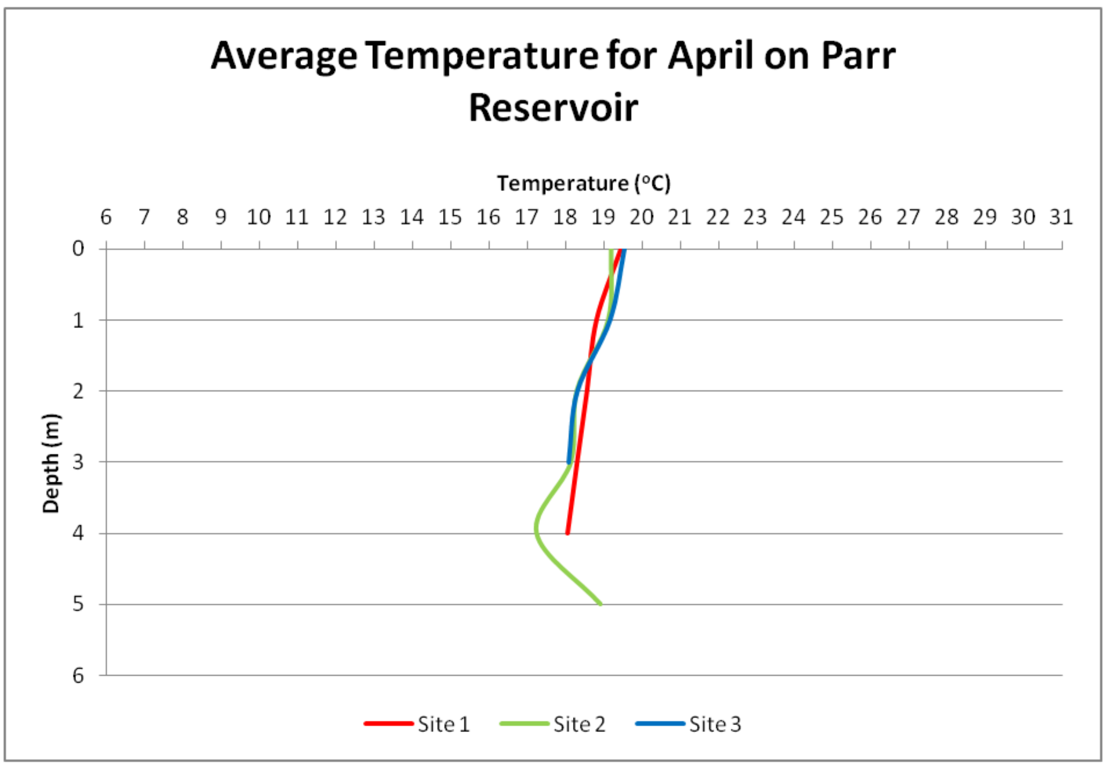


FIGURE 3-4 **AVERAGE TEMPERATURE FOR APRIL ON PARR RESERVOIR**

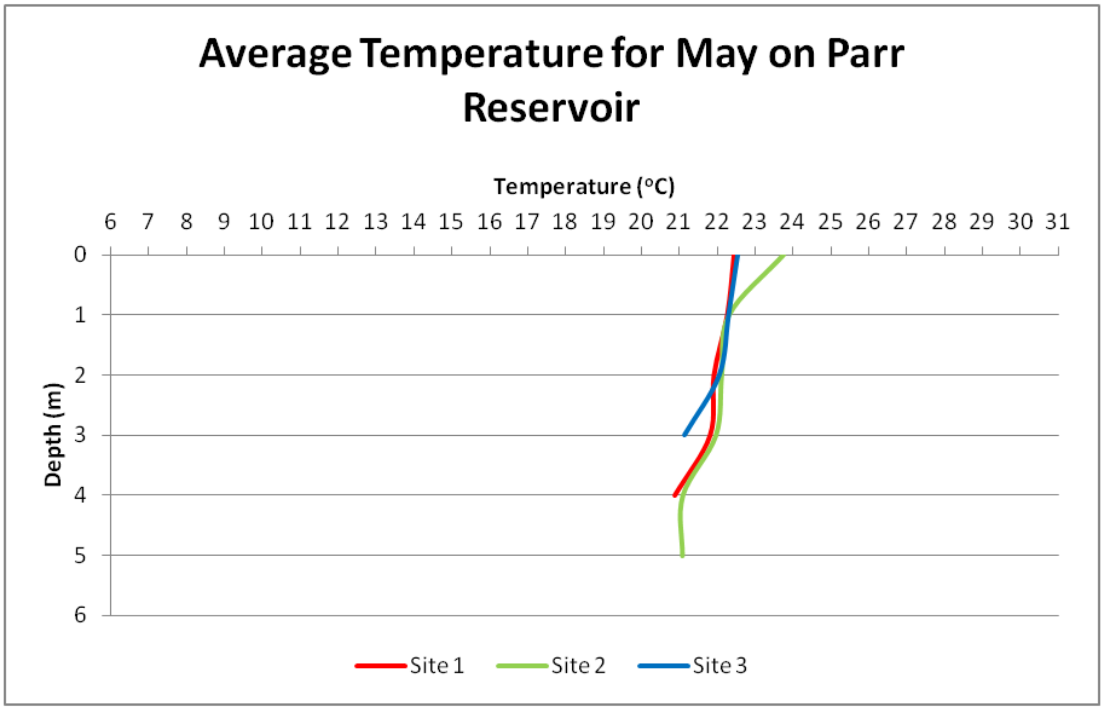


FIGURE 3-5 AVERAGE TEMPERATURE FOR MAY ON PARR RESERVOIR

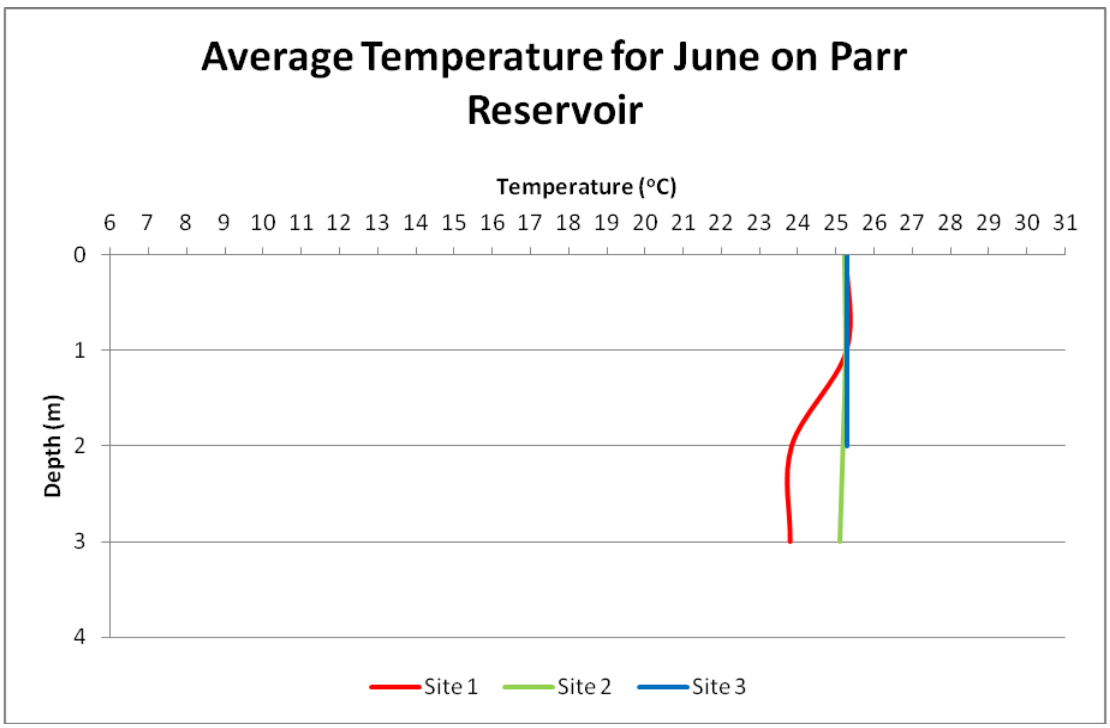


FIGURE 3-6 AVERAGE TEMPERATURE FOR JUNE ON PARR RESERVOIR

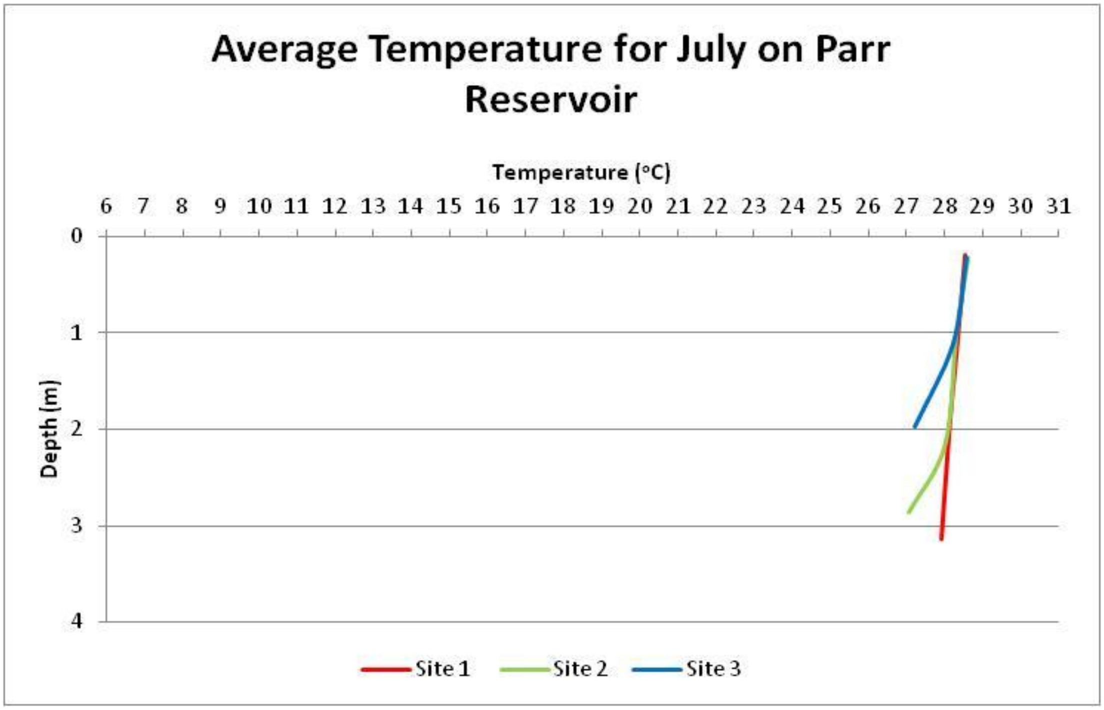


FIGURE 3-7 AVERAGE TEMPERATURE FOR JULY ON PARR RESERVOIR

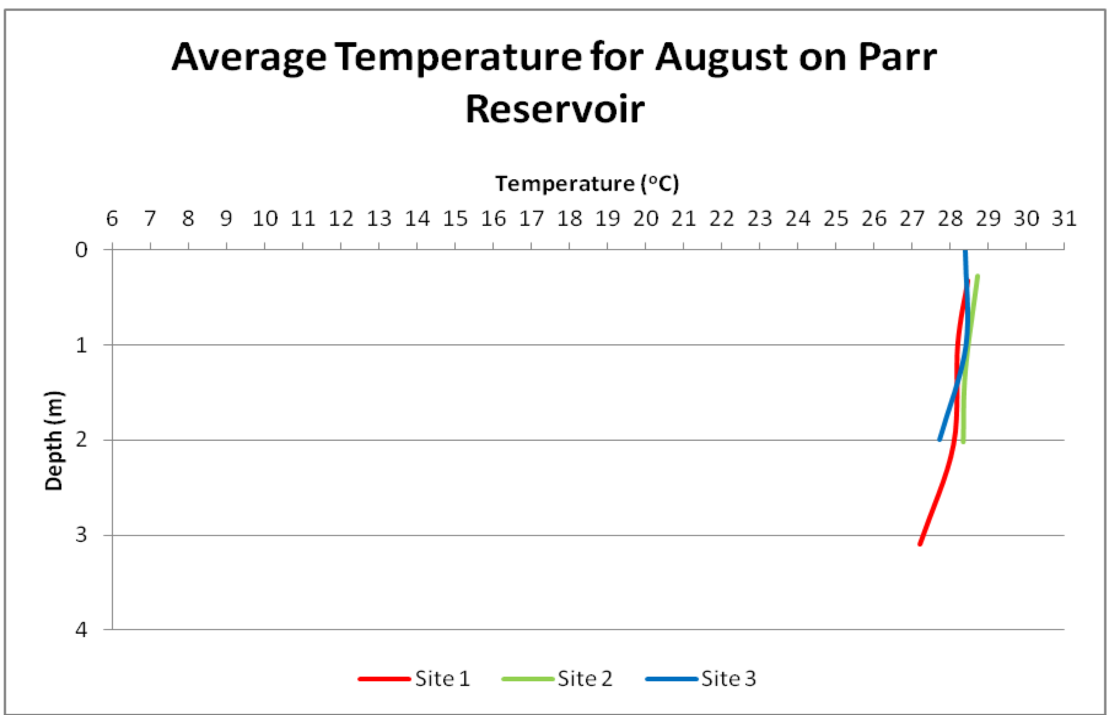


FIGURE 3-8 AVERAGE TEMPERATURE FOR AUGUST ON PARR RESERVOIR

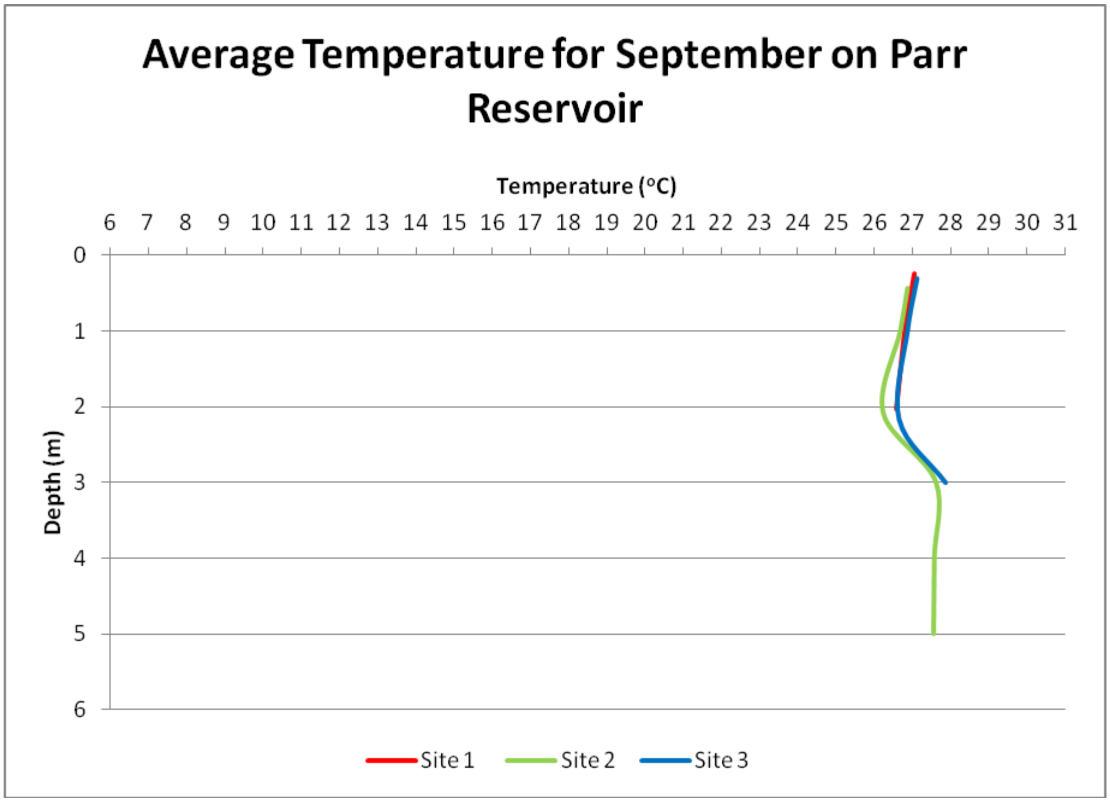


FIGURE 3-9 AVERAGE TEMPERATURE FOR SEPTEMBER ON PARR RESERVOIR

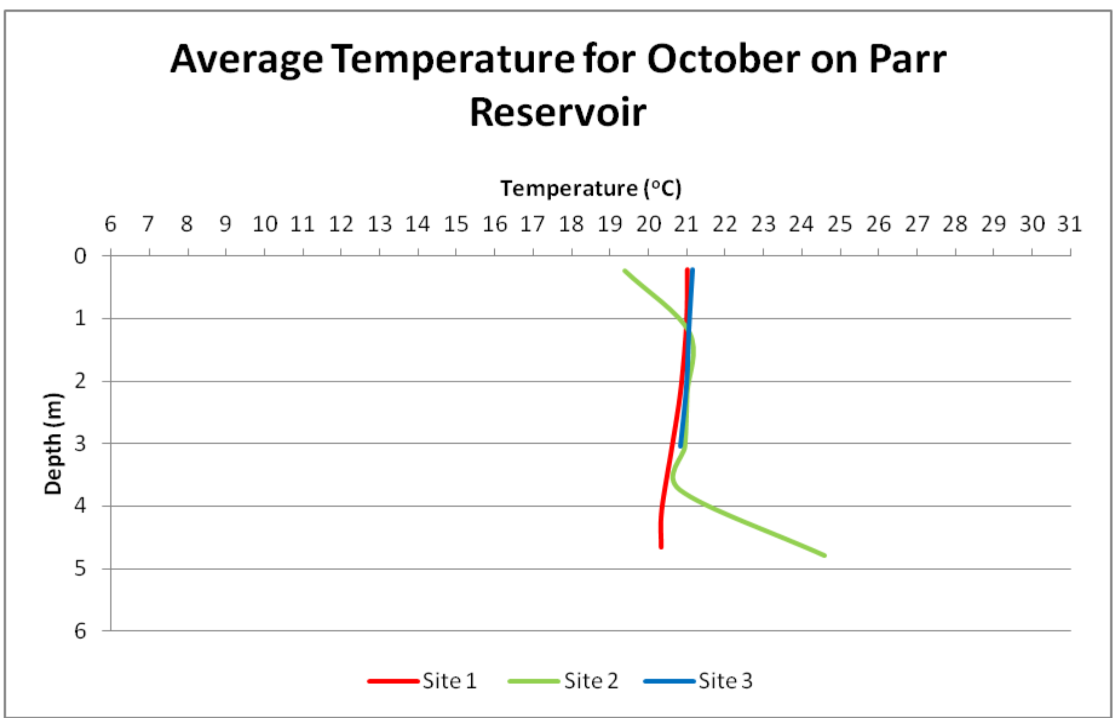


FIGURE 3-10 AVERAGE TEMPERATURE FOR OCTOBER ON PARR RESERVOIR

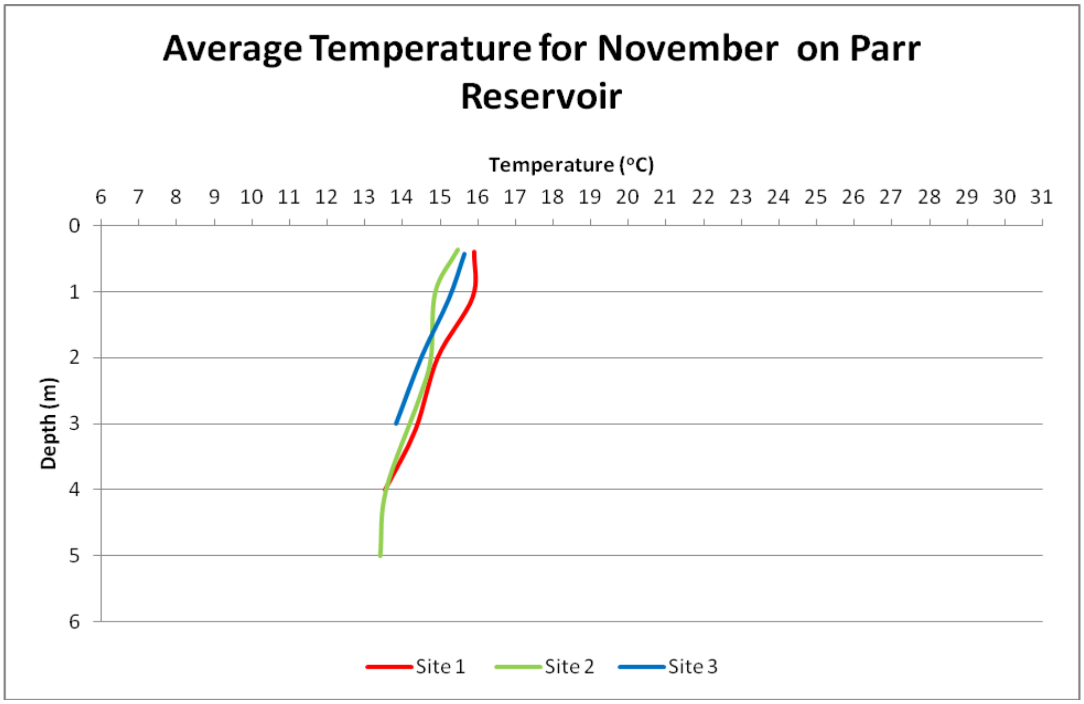


FIGURE 3-11 AVERAGE TEMPERATURE FOR NOVEMBER ON PARR RESERVOIR

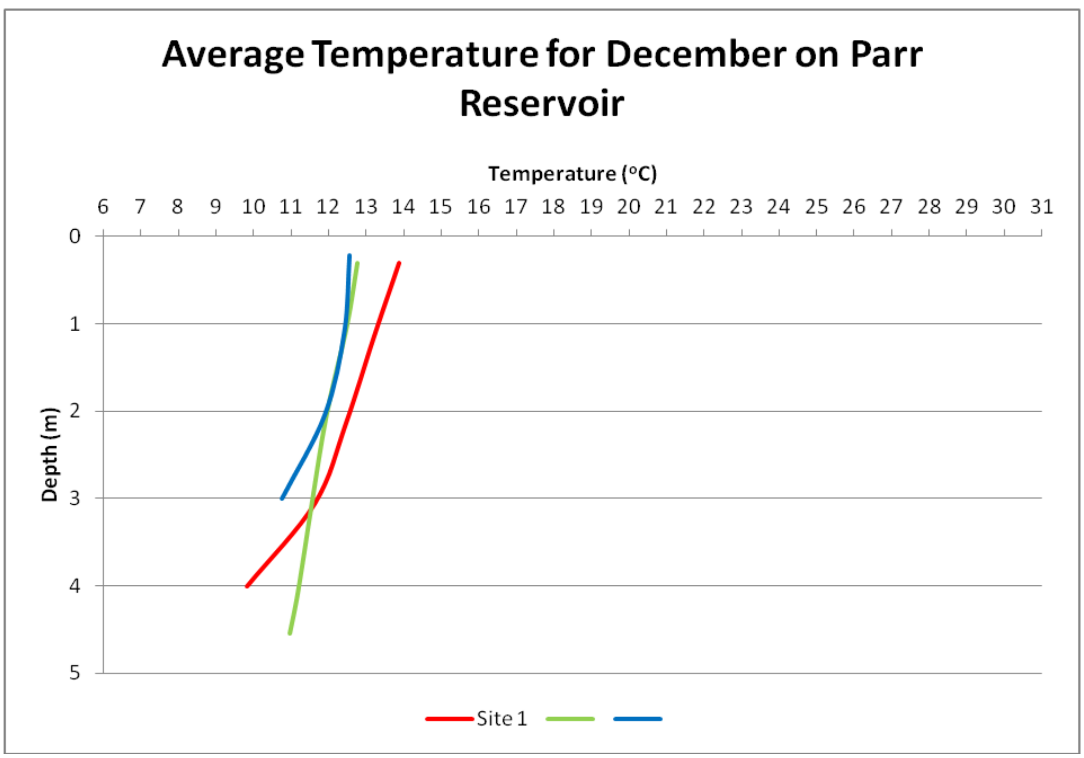


FIGURE 3-12 AVERAGE TEMPERATURE FOR DECEMBER ON PARR RESERVOIR

3.1.1.2 DISSOLVED OXYGEN

Dissolved oxygen values depicted in the graphs below are an average of monthly readings collected by SCE&G personnel, beginning in January of 2011 to December of 2013. Site 1 refers to the monitoring site located approximately 500 yards upstream of the proposed discharge site for the new nuclear units 2 and 3. Site 2 refers to the monitoring site located at the proposed discharge site for the new nuclear units 2 and 3. Site 3 is the monitoring site located approximately 300 yards downstream of the proposed discharge site.

General trends for the Parr Reservoir include a decrease in dissolved oxygen values during the summer months when water temperatures are higher. Dissolved oxygen values also decrease with an increased depth in the reservoir, where there is less possibility of oxygen to be dissolved in the water due to natural occurrences. Since 2011, dissolved oxygen in the Parr Reservoir has rarely dropped below 5.0 mg/L.

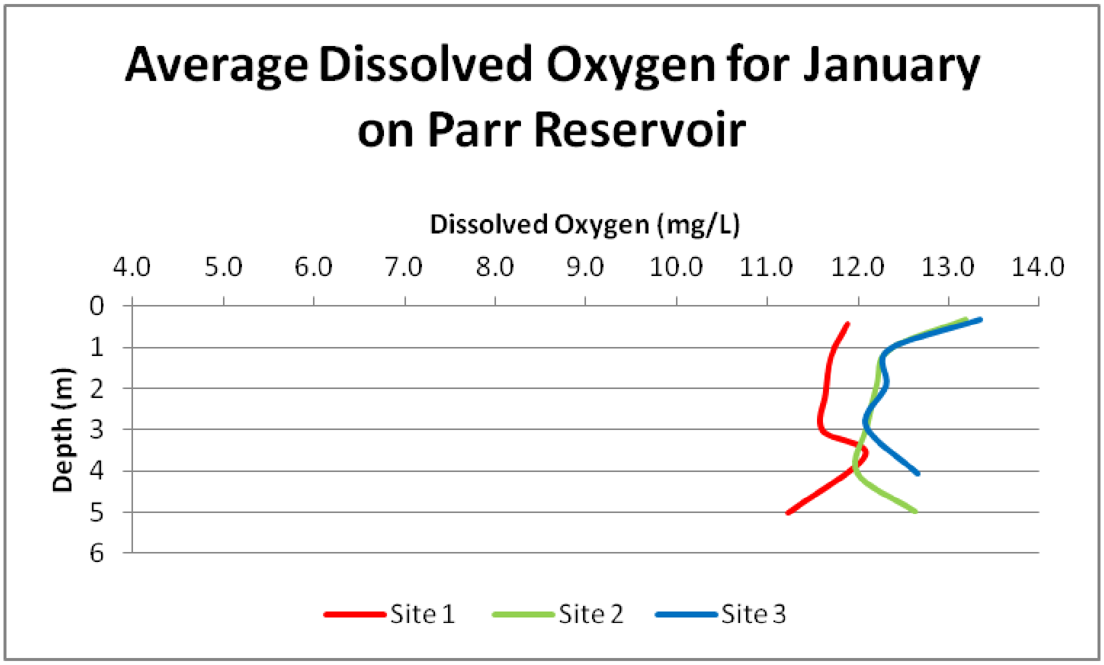


FIGURE 3-13 **AVERAGE DISSOLVED OXYGEN FOR JANUARY ON PARR RESERVOIR**

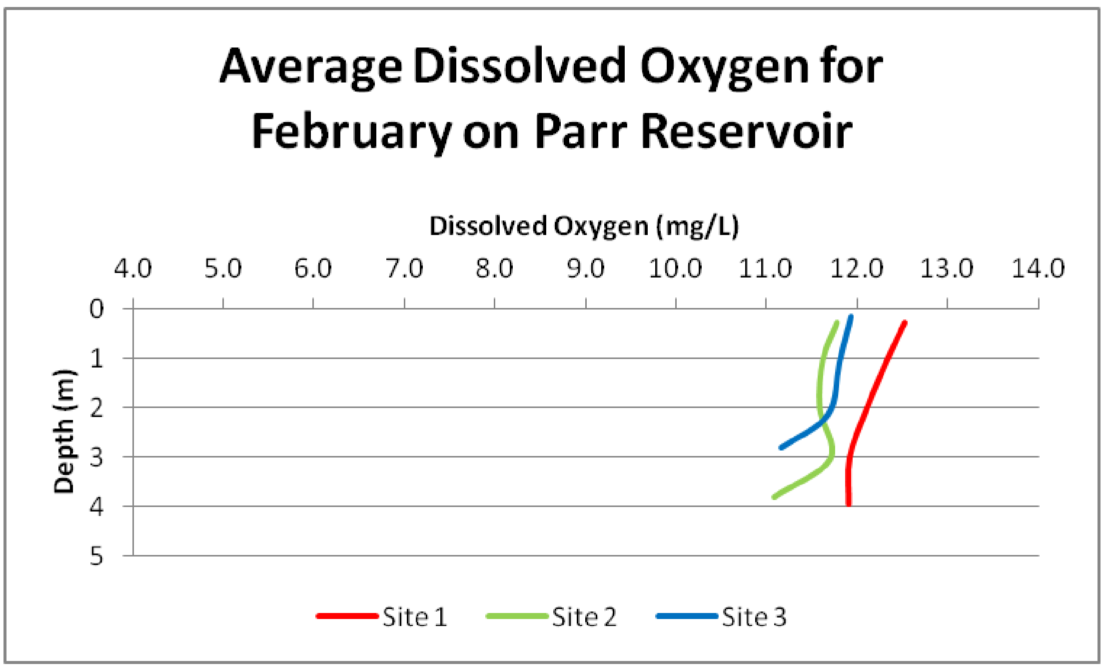


FIGURE 3-14 **AVERAGE DISSOLVED OXYGEN FOR FEBRUARY ON PARR RESERVOIR**

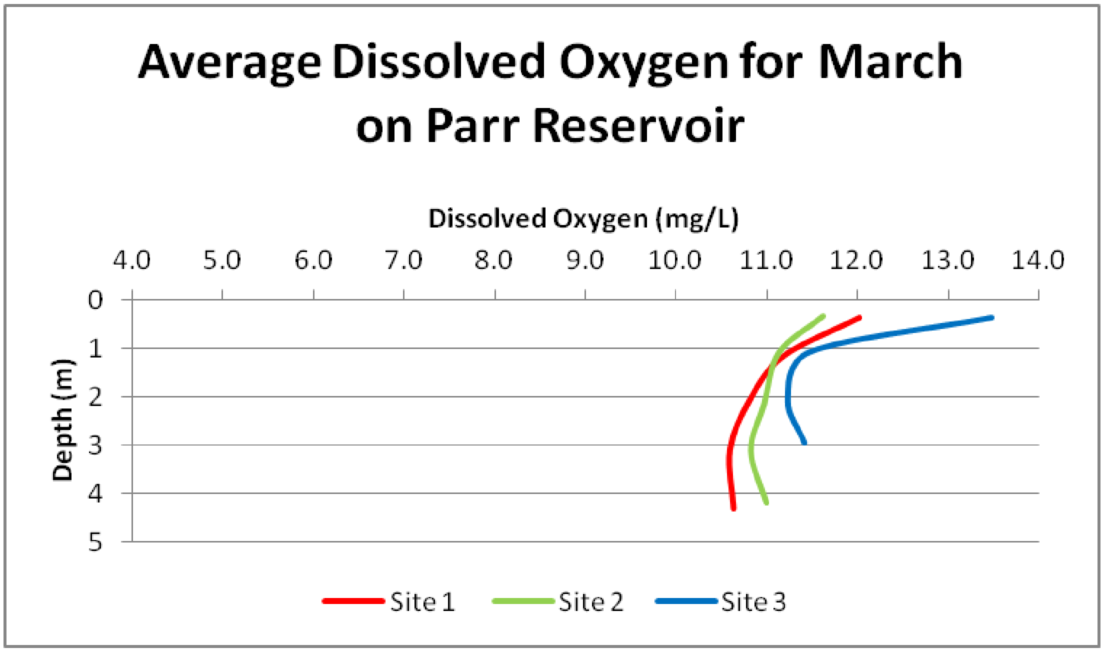


FIGURE 3-15 AVERAGE DISSOLVED OXYGEN FOR MARCH ON PARR RESERVOIR

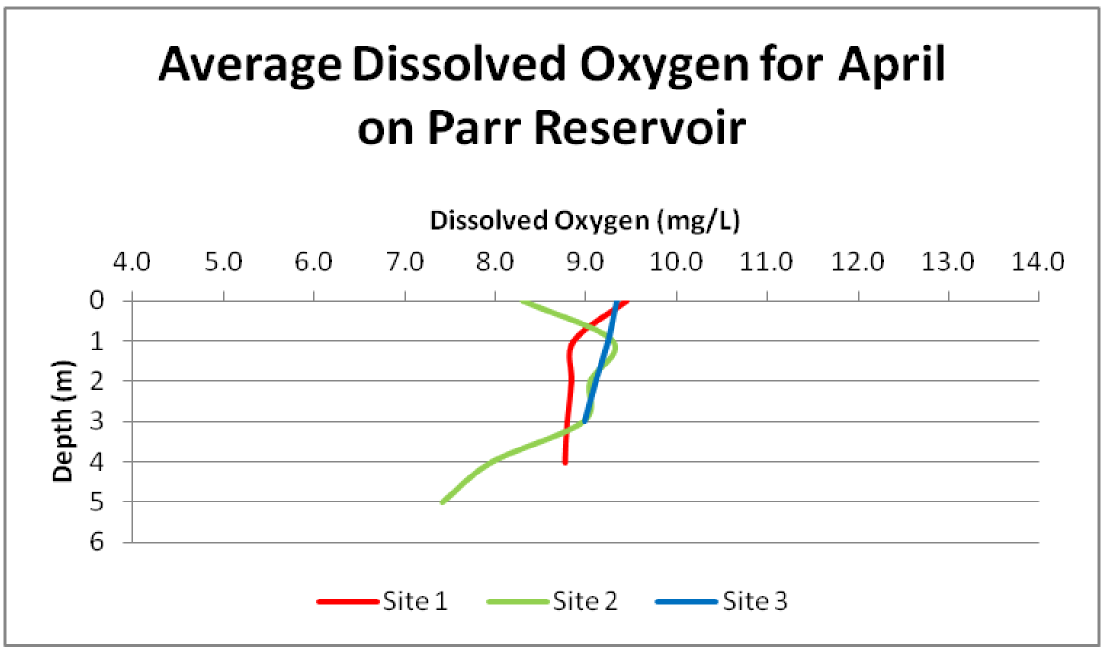


FIGURE 3-16 AVERAGE DISSOLVED OXYGEN FOR APRIL ON PARR RESERVOIR

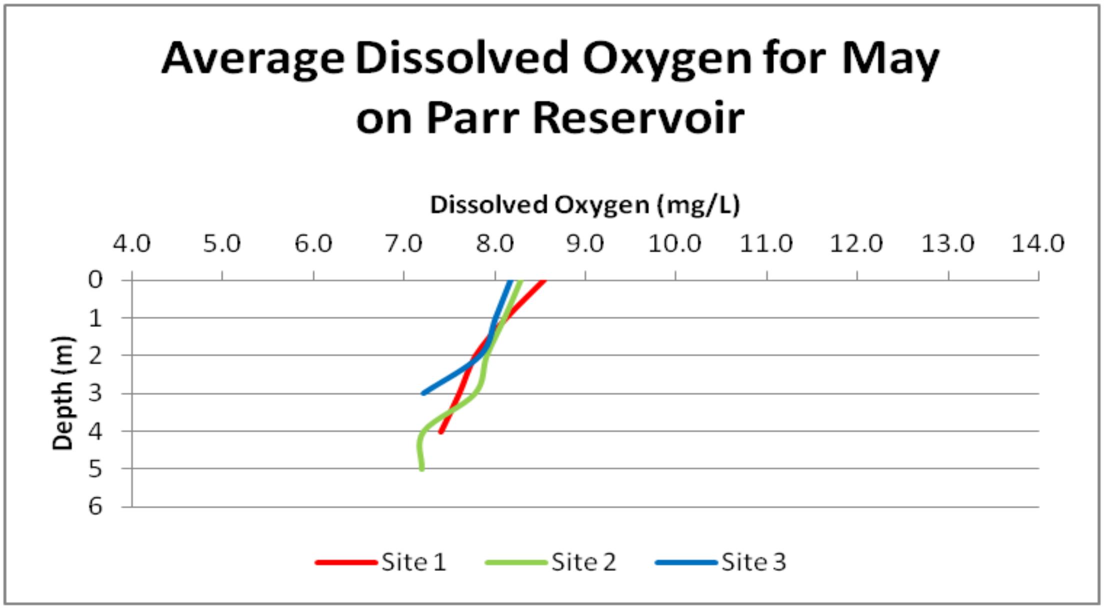


FIGURE 3-17 AVERAGE DISSOLVED OXYGEN FOR MAY ON PARR RESERVOIR

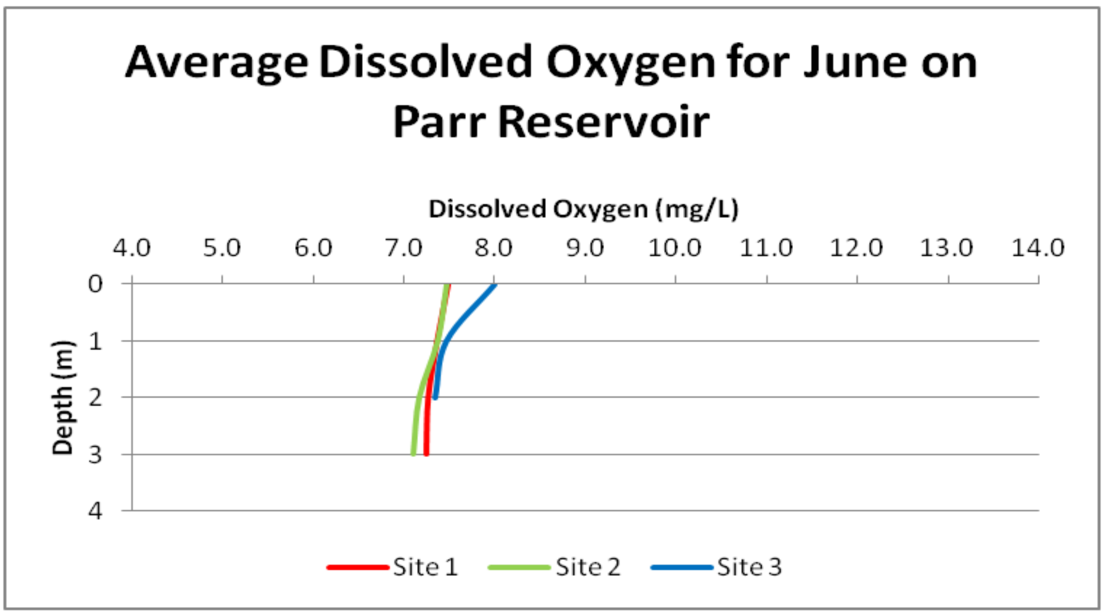


FIGURE 3-18 AVERAGE DISSOLVED OXYGEN FOR JUNE ON PARR RESERVOIR

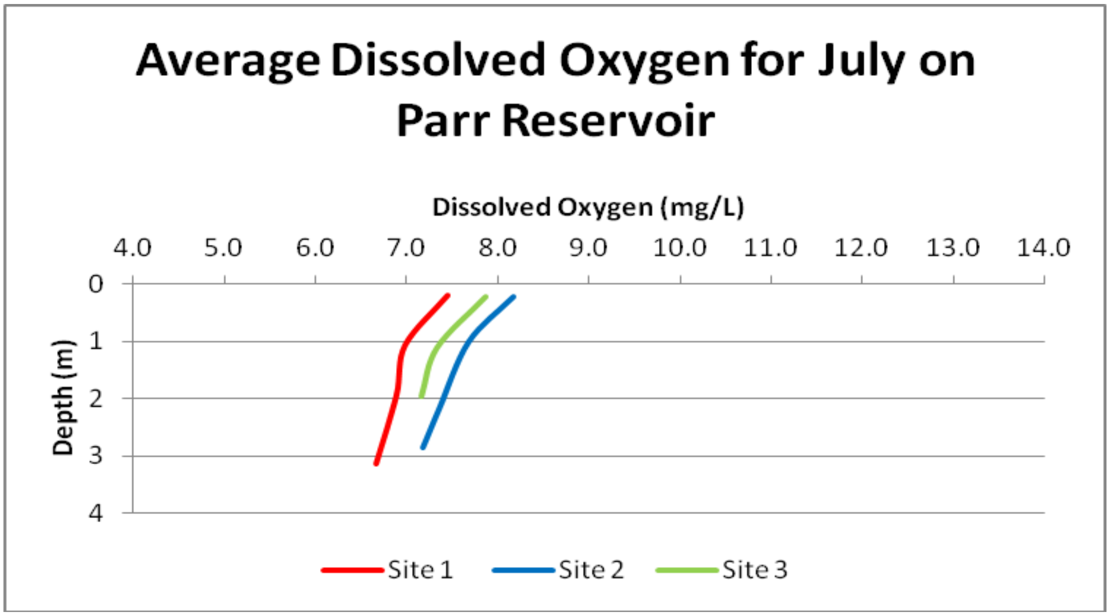


FIGURE 3-19 AVERAGE DISSOLVED OXYGEN FOR JULY ON PARR RESERVOIR

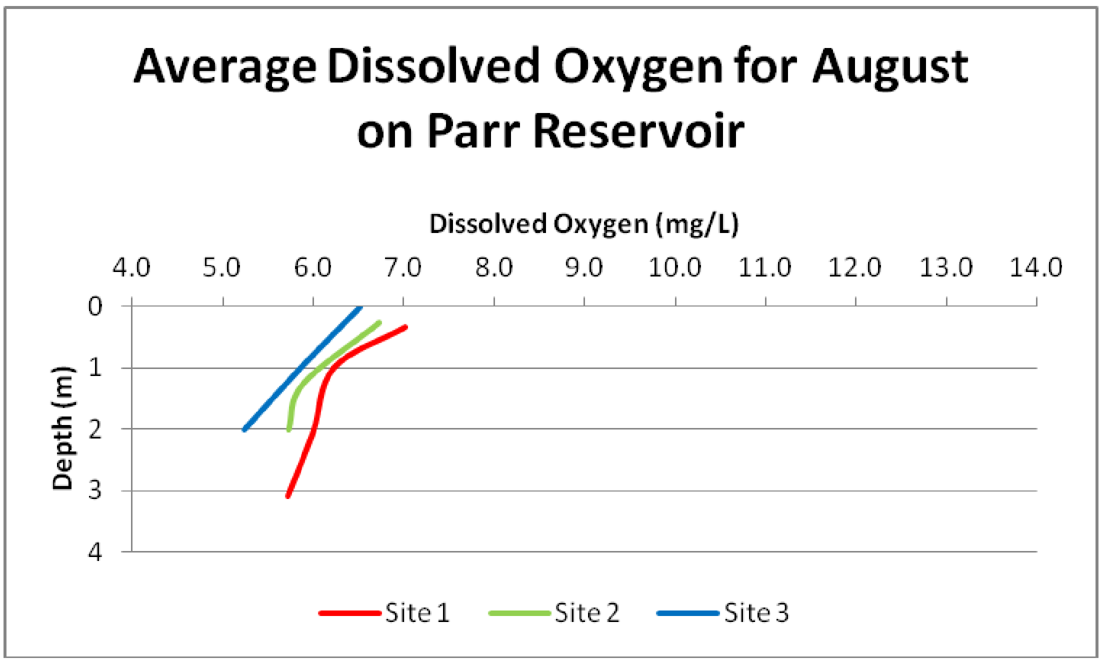


FIGURE 3-20 AVERAGE DISSOLVED OXYGEN FOR AUGUST ON PARR RESERVOIR

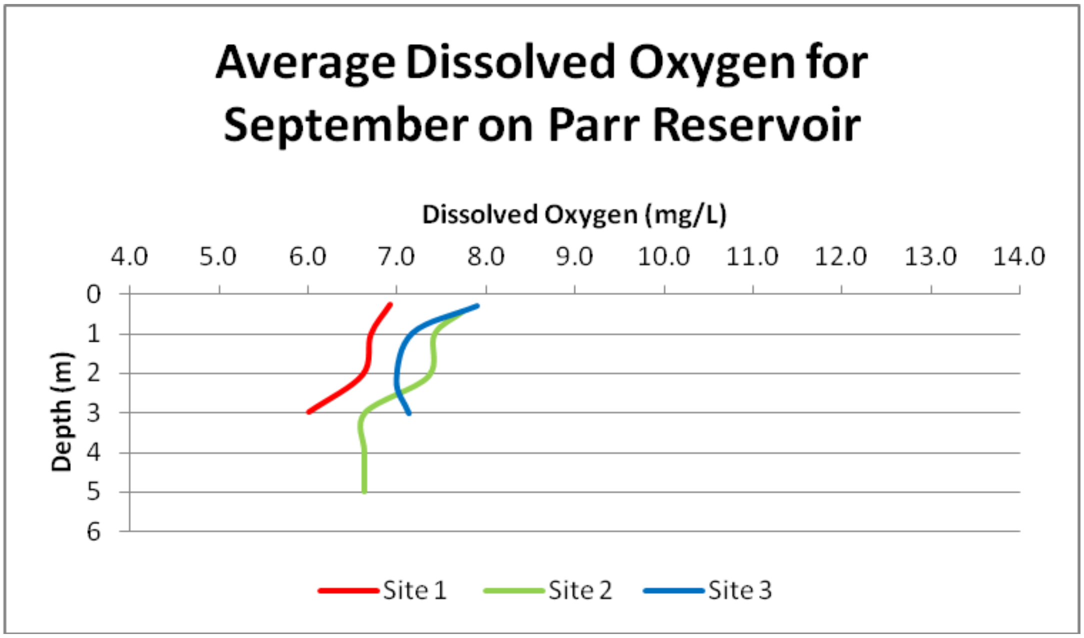


FIGURE 3-21 AVERAGE DISSOLVED OXYGEN FOR SEPTEMBER ON PARR RESERVOIR

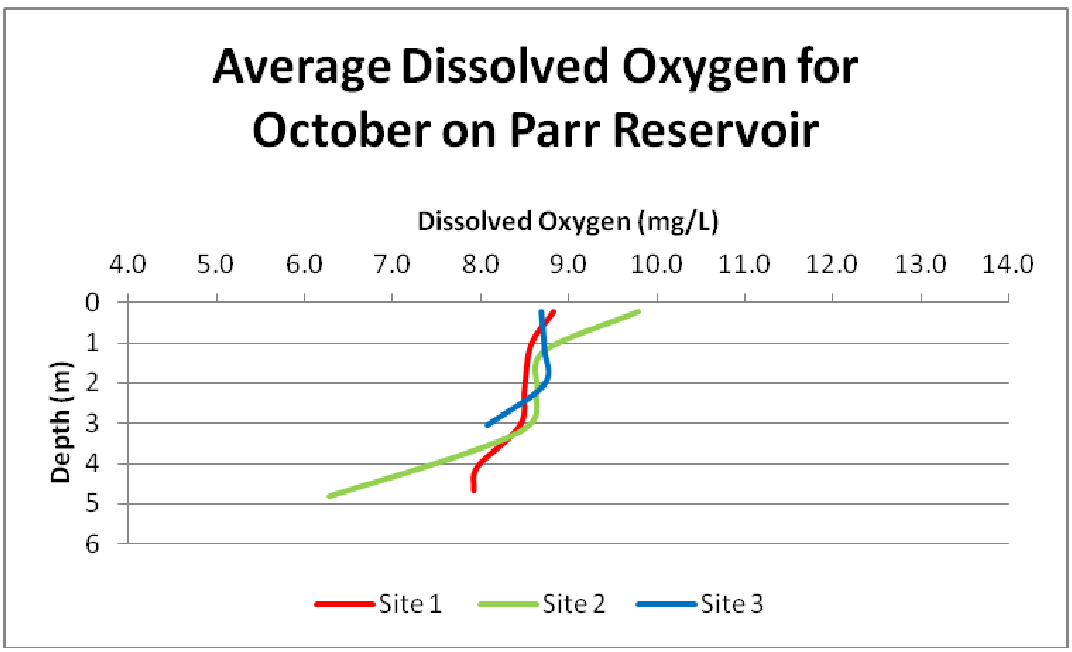


FIGURE 3-22 AVERAGE DISSOLVED OXYGEN FOR OCTOBER ON PARR RESERVOIR

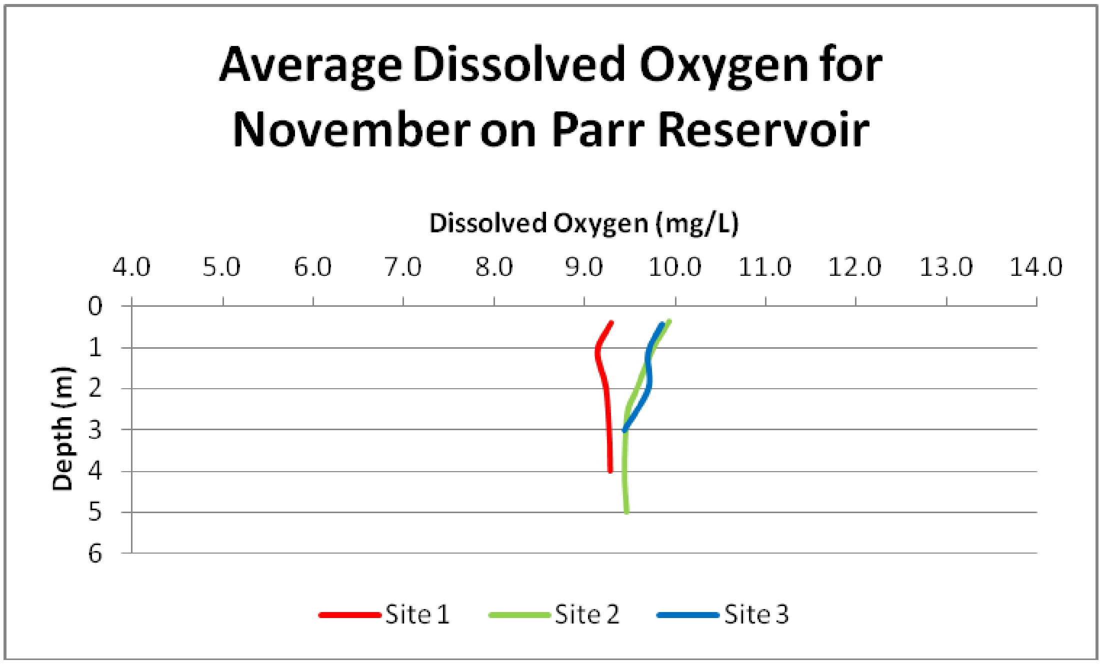


FIGURE 3-23 AVERAGE DISSOLVED OXYGEN FOR NOVEMBER ON PARR RESERVOIR

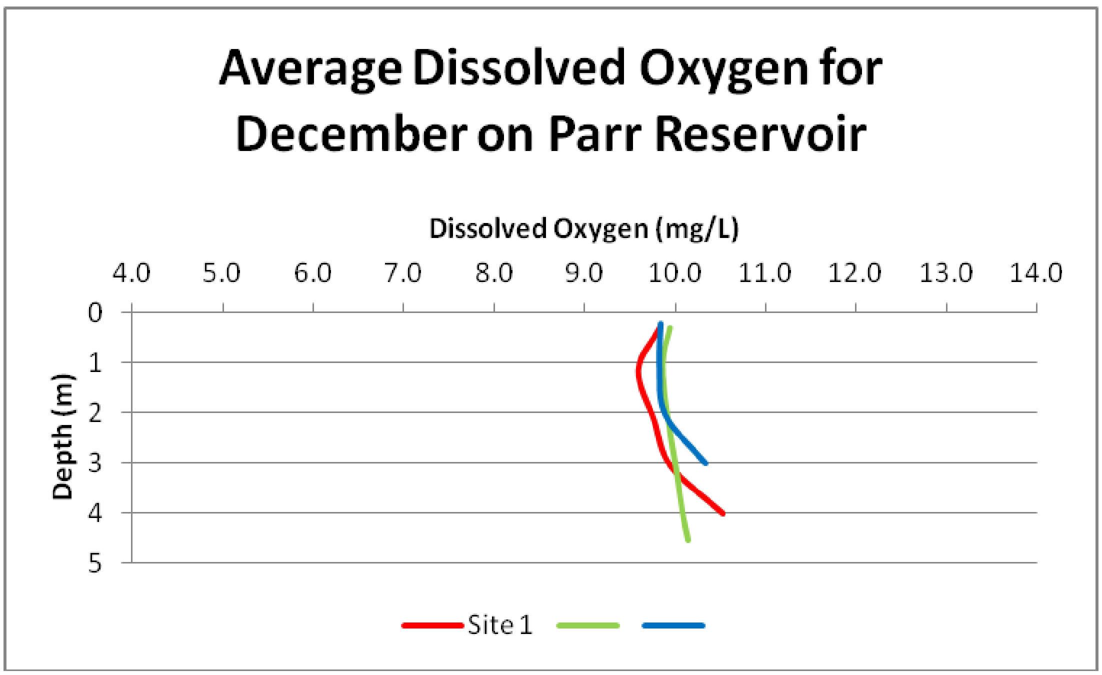


FIGURE 3-24 AVERAGE DISSOLVED OXYGEN FOR DECEMBER ON PARR RESERVOIR

3.1.1.3 SPECIFIC CONDUCTIVITY

Specific conductivity values depicted in the graphs below are an average of monthly readings collected by SCE&G personnel, beginning in January of 2011 to December of 2013. Site 1 refers to the monitoring site located approximately 500 yards upstream of the proposed discharge site for the new nuclear units 2 and 3. Site 2 refers to the monitoring site located at the proposed discharge site for the new nuclear units 2 and 3. Site 3 is the monitoring site located approximately 300 yards downstream of the proposed discharge site.

Conductivity readings for the three monitoring locations in the Parr Reservoir are fairly consistent throughout the year, staying mostly in the 80-90 µS/cm range, with the full range spanning from 65-122 µS/cm.

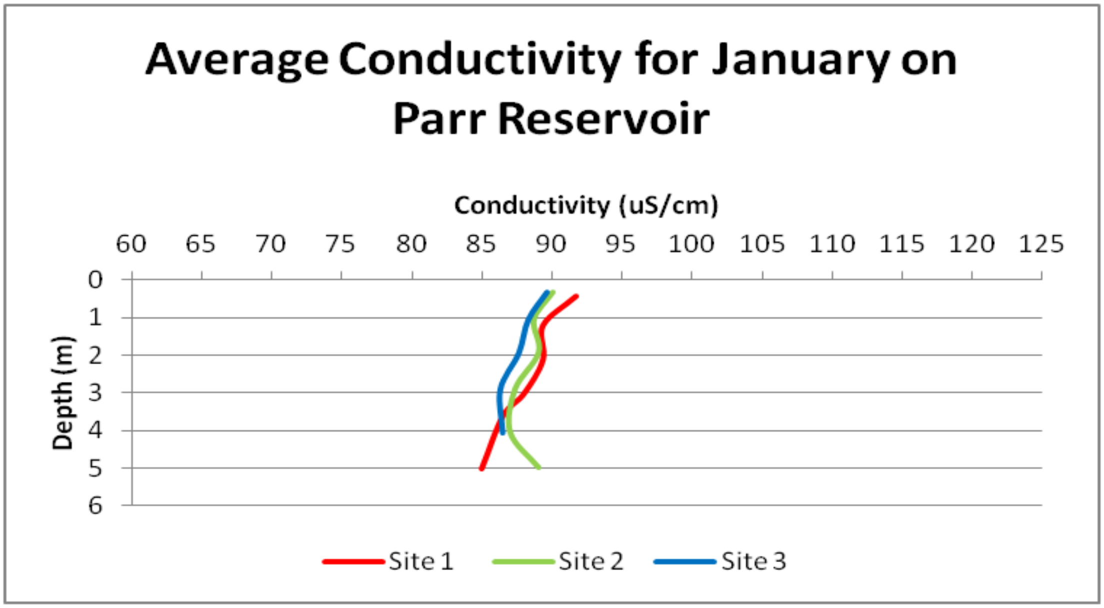


FIGURE 3-25 AVERAGE CONDUCTIVITY FOR JANUARY ON PARR RESERVOIR

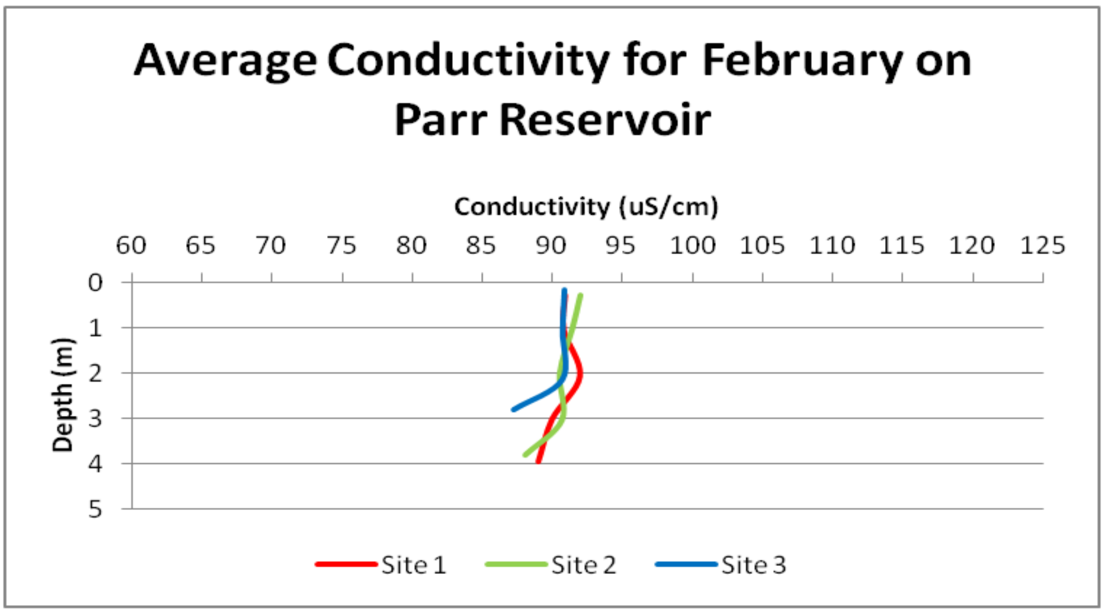


FIGURE 3-26 AVERAGE CONDUCTIVITY FOR FEBRUARY ON PARR RESERVOIR

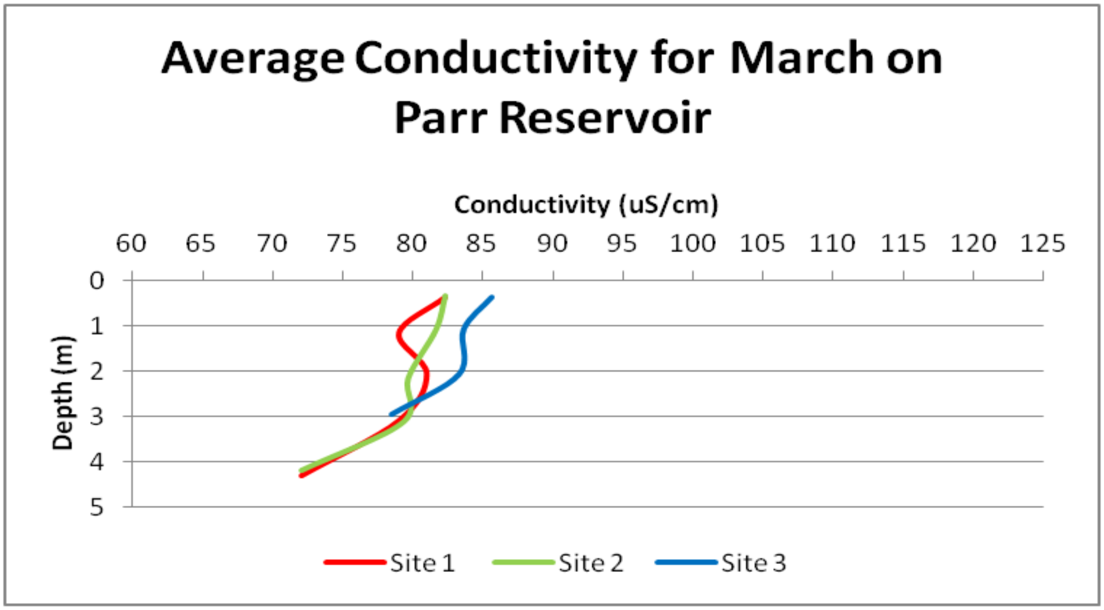


FIGURE 3-27 AVERAGE CONDUCTIVITY FOR MARCH ON PARR RESERVOIR

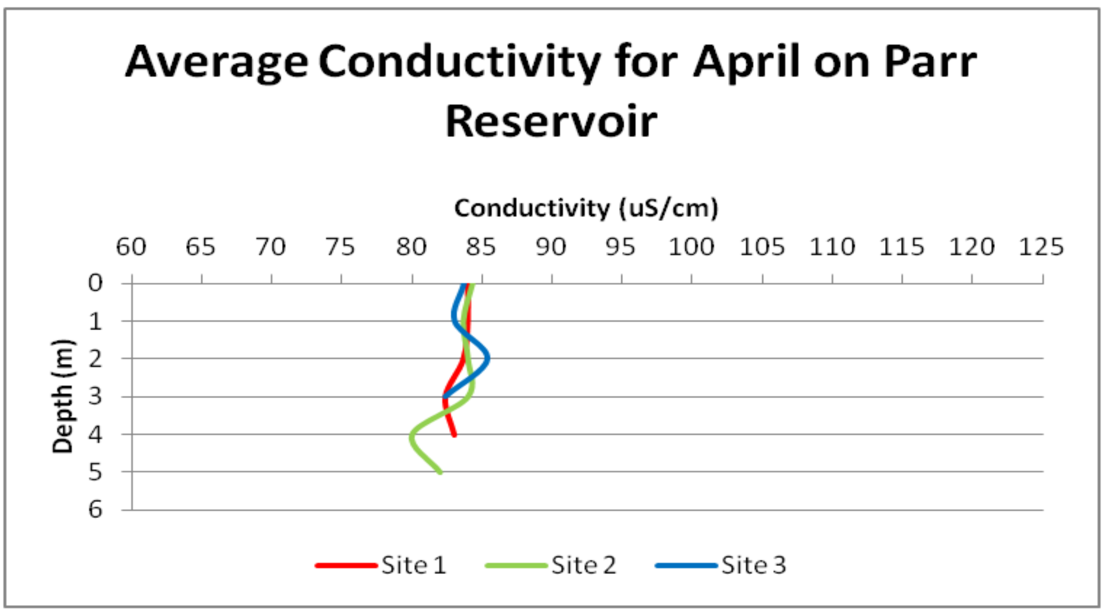


FIGURE 3-28 AVERAGE CONDUCTIVITY FOR APRIL ON PARR RESERVOIR

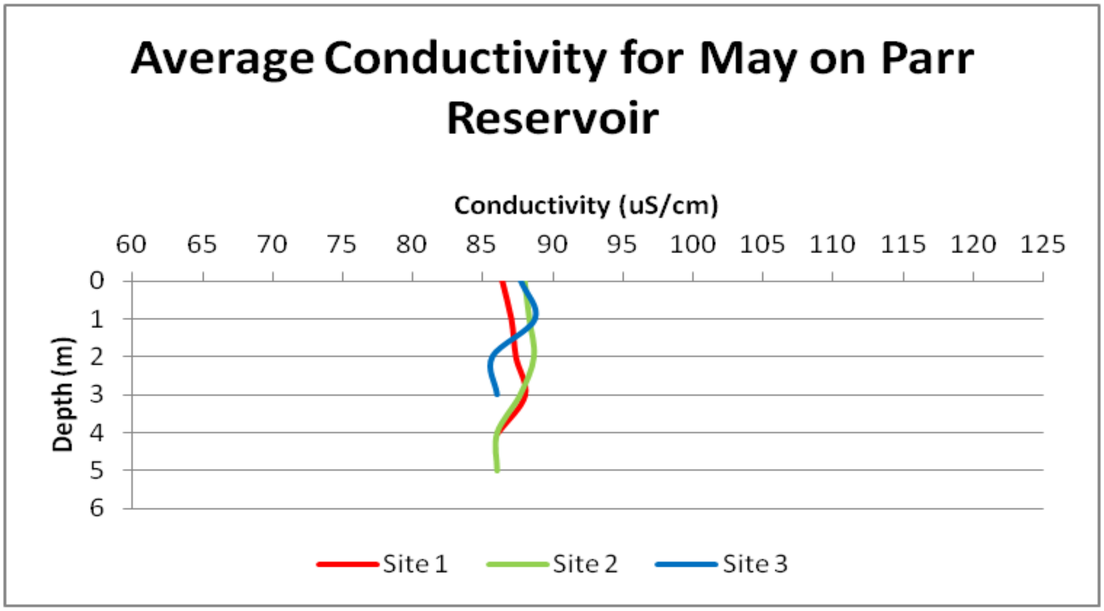


FIGURE 3-29 AVERAGE CONDUCTIVITY FOR MAY ON PARR RESERVOIR

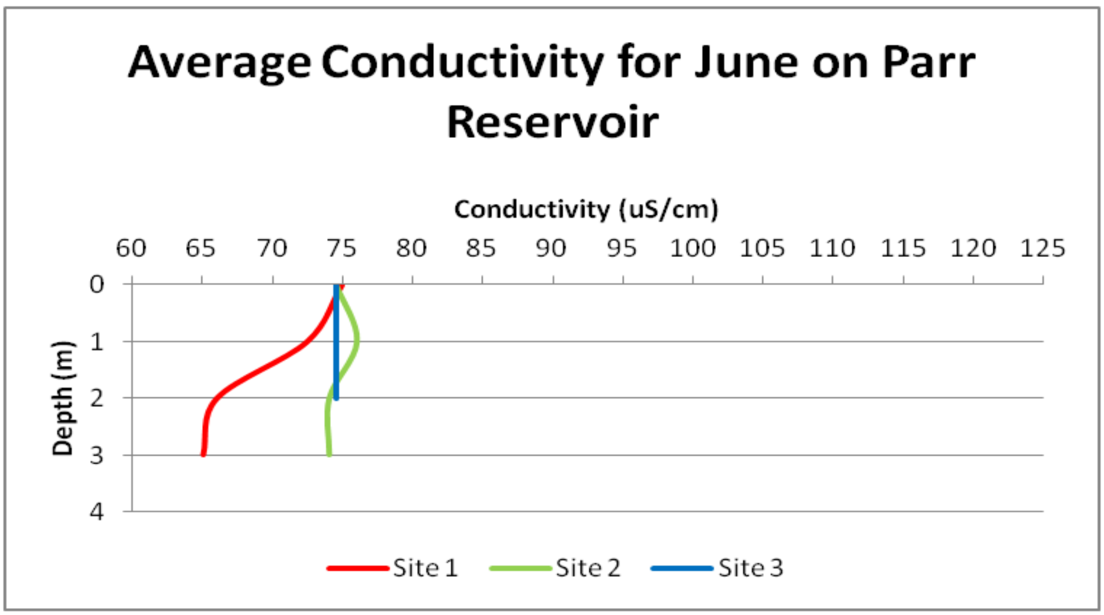


FIGURE 3-30 AVERAGE CONDUCTIVITY FOR JUNE ON PARR RESERVOIR

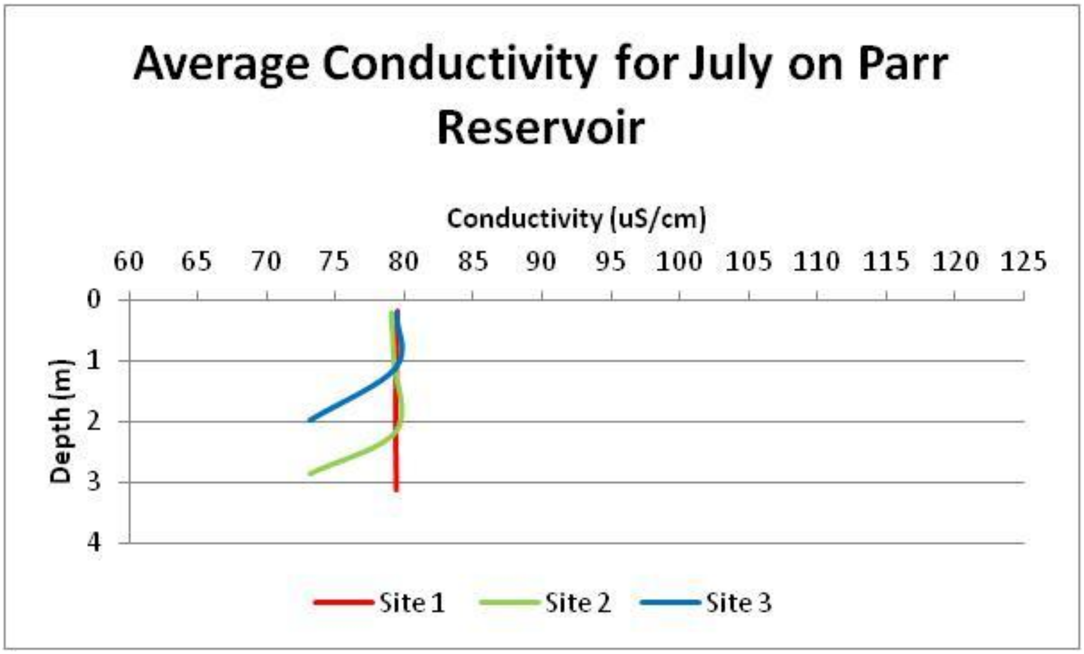


FIGURE 3-31 AVERAGE CONDUCTIVITY FOR JULY ON PARR RESERVOIR

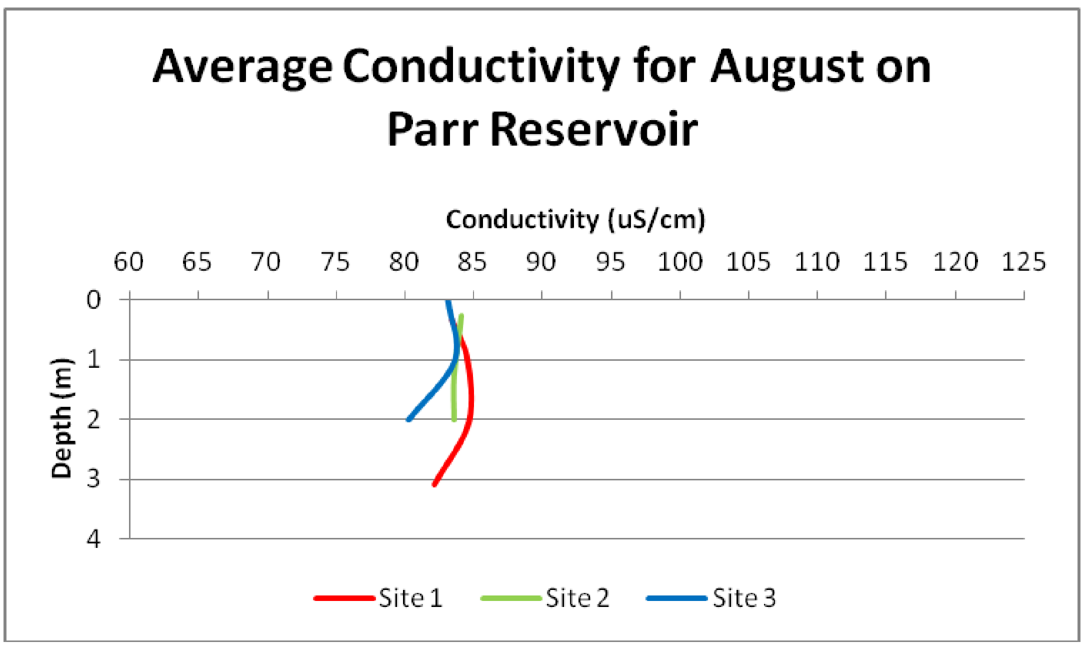


FIGURE 3-32 AVERAGE CONDUCTIVITY FOR AUGUST ON PARR RESERVOIR

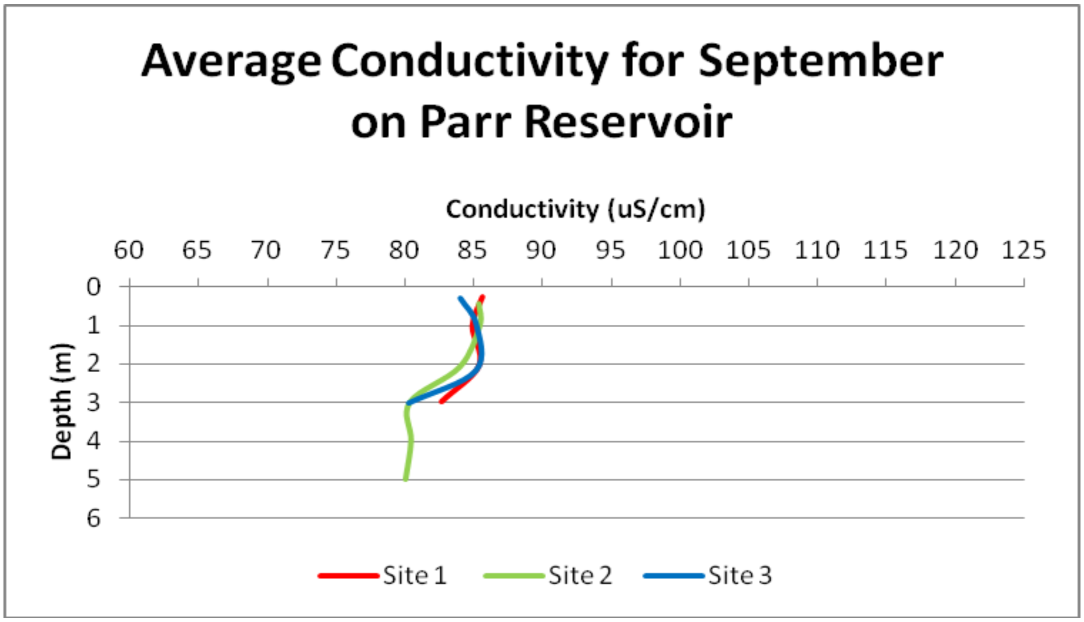


FIGURE 3-33 AVERAGE CONDUCTIVITY FOR SEPTEMBER ON PARR RESERVOIR

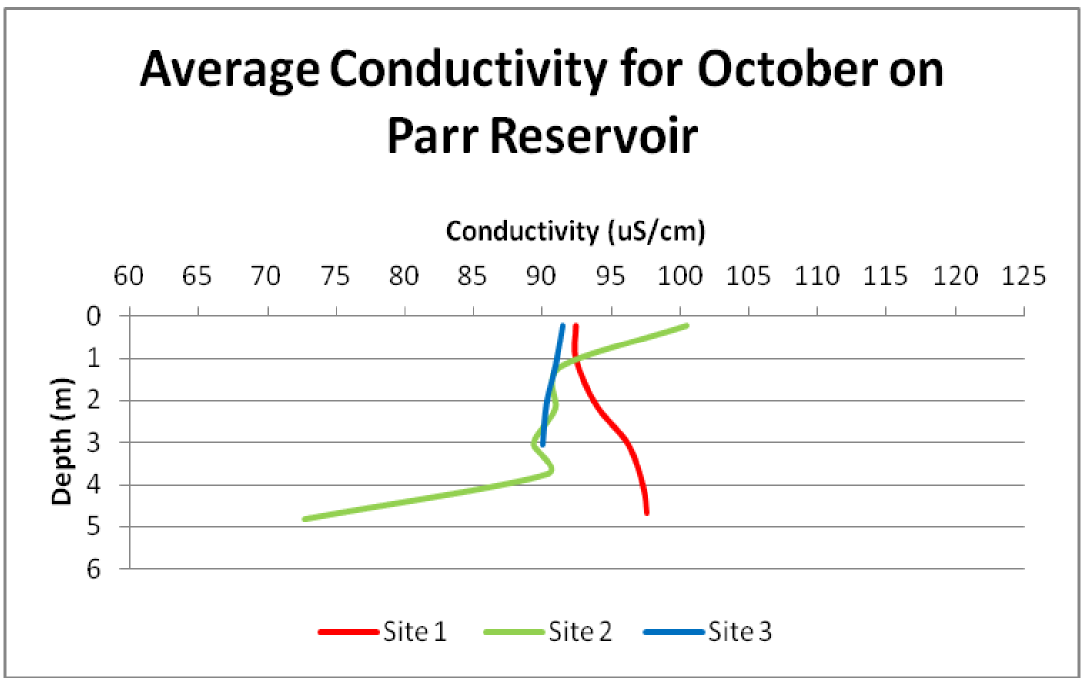


FIGURE 3-34 AVERAGE CONDUCTIVITY FOR OCTOBER ON PARR RESERVOIR

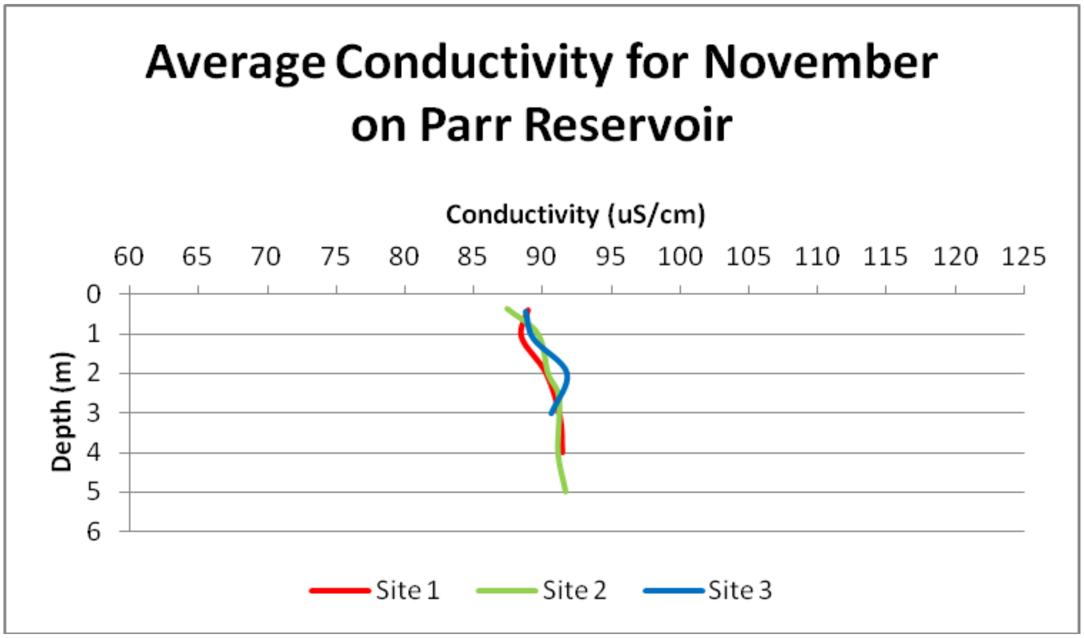


FIGURE 3-35 AVERAGE CONDUCTIVITY FOR NOVEMBER ON PARR RESERVOIR

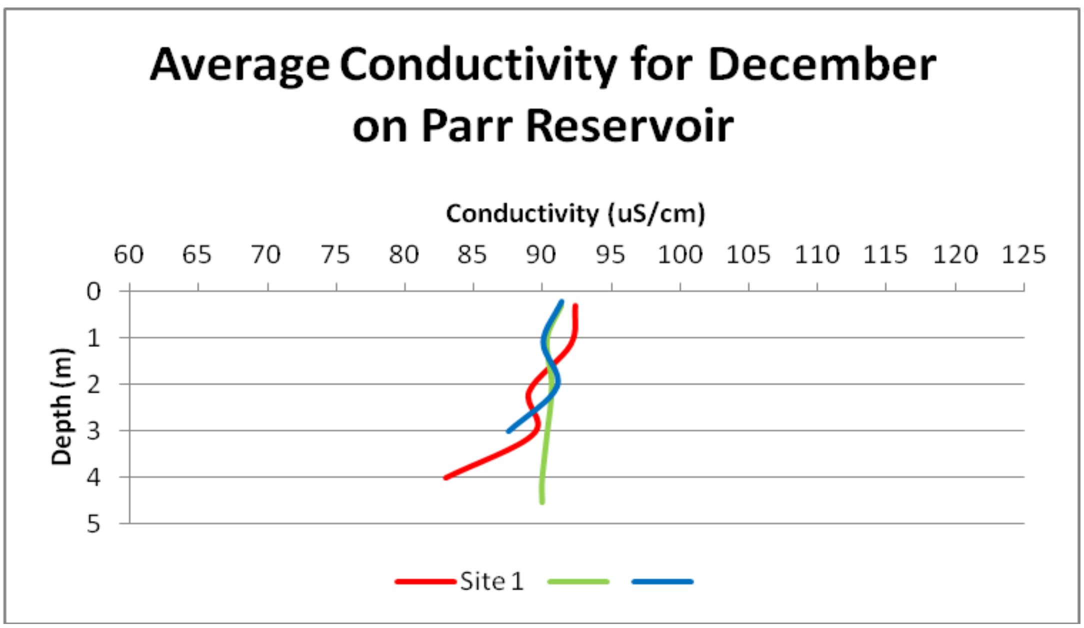


FIGURE 3-36 AVERAGE CONDUCTIVITY FOR DECEMBER ON PARR RESERVOIR

3.1.1.4 PH

pH values depicted in the graphs below are an average of monthly readings collected by SCE&G personnel, beginning in January of 2011 to December of 2013. Site 1 refers to the monitoring site located approximately 500 yards upstream of the proposed discharge site for the new nuclear units 2 and 3. Site 2 refers to the monitoring site located at the proposed discharge site for the new nuclear units 2 and 3. Site 3 is the monitoring site located approximately 300 yards downstream of the proposed discharge site.

Average pH values for the Parr Reservoir hover around 7.0, but range from 6.0 to 8.5 over the course of the year, and at various depths in the reservoir. Generally, pH decreases as the depth of the reservoir increases.

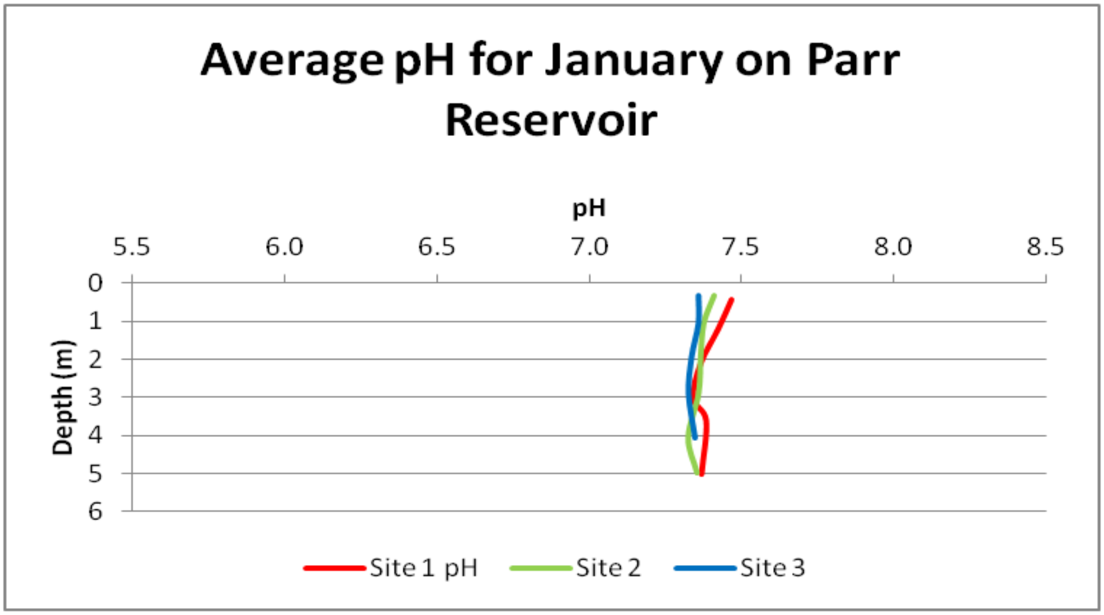


FIGURE 3-37 AVERAGE PH FOR JANUARY ON PARR RESERVOIR

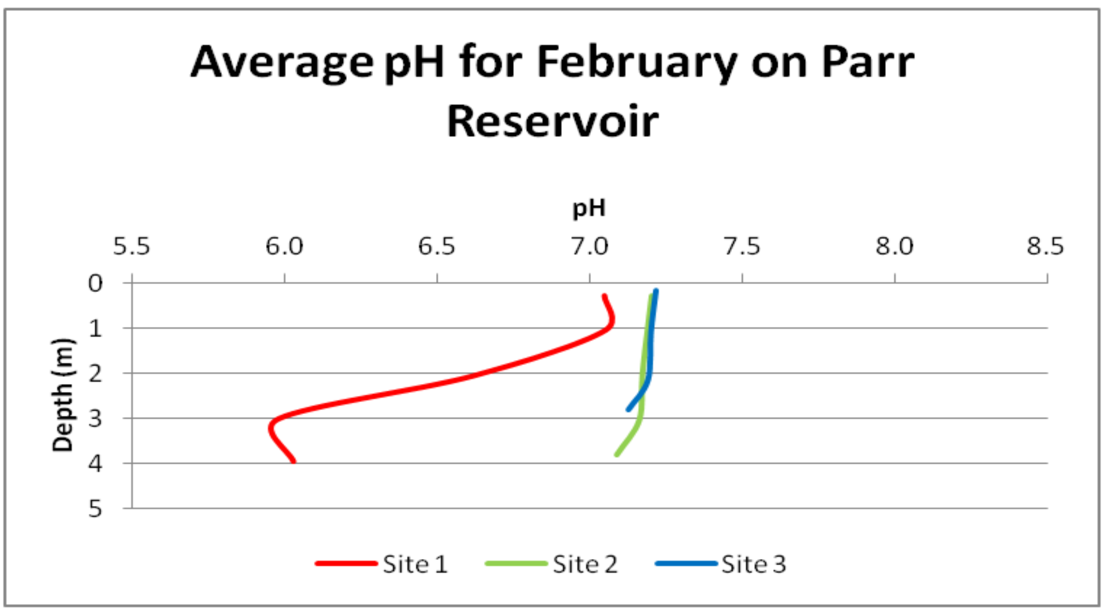


FIGURE 3-38 AVERAGE PH FOR FEBRUARY ON PARR RESERVOIR

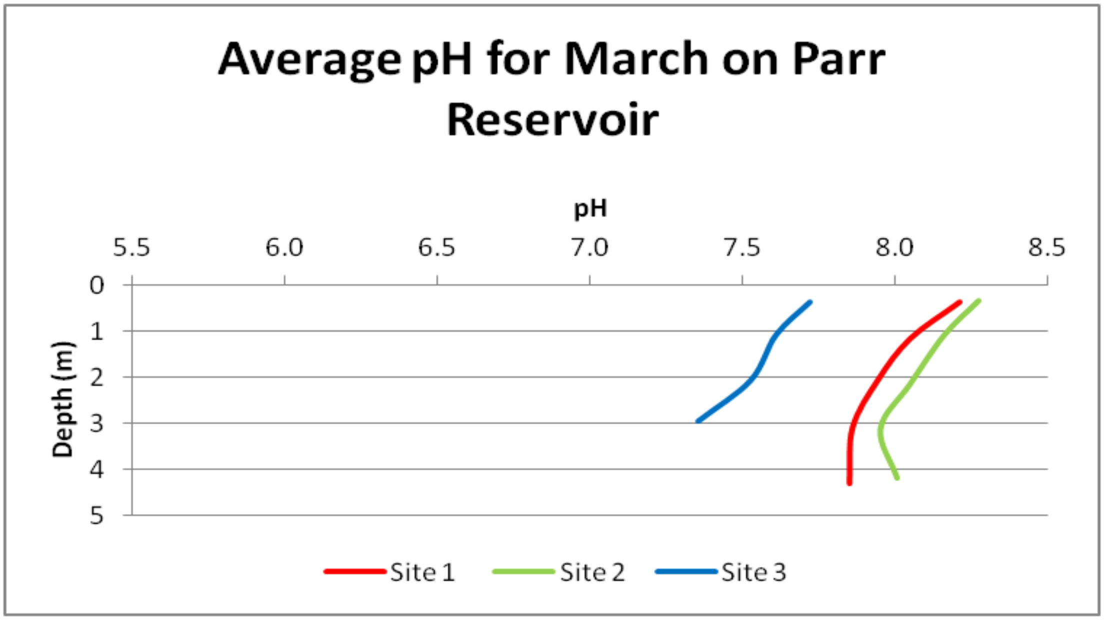


FIGURE 3-39 AVERAGE PH FOR MARCH ON PARR RESERVOIR

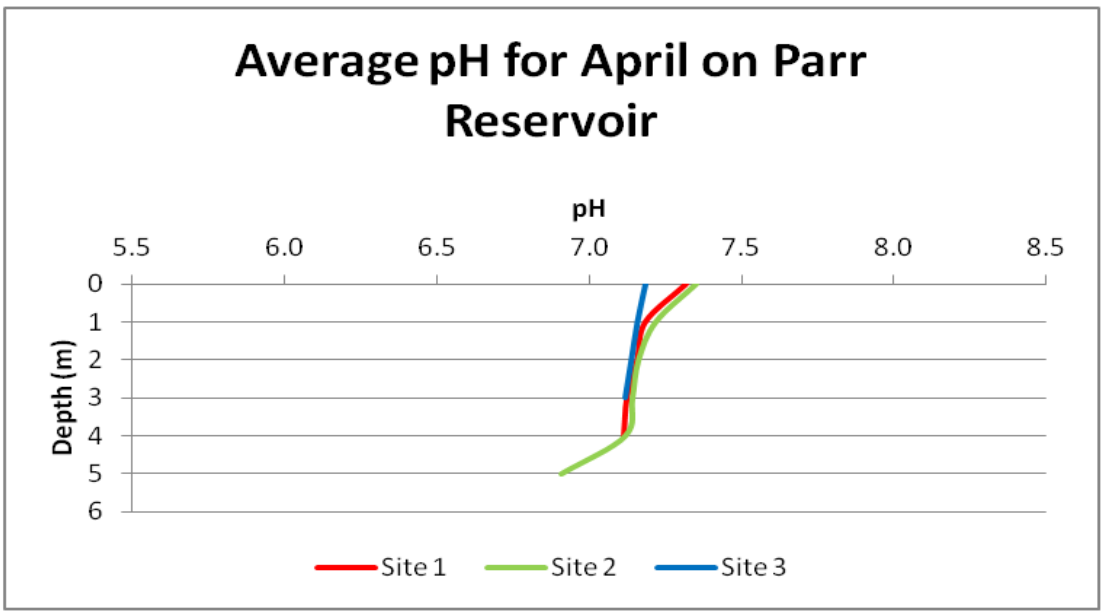


FIGURE 3-40 AVERAGE PH FOR APRIL ON PARR RESERVOIR

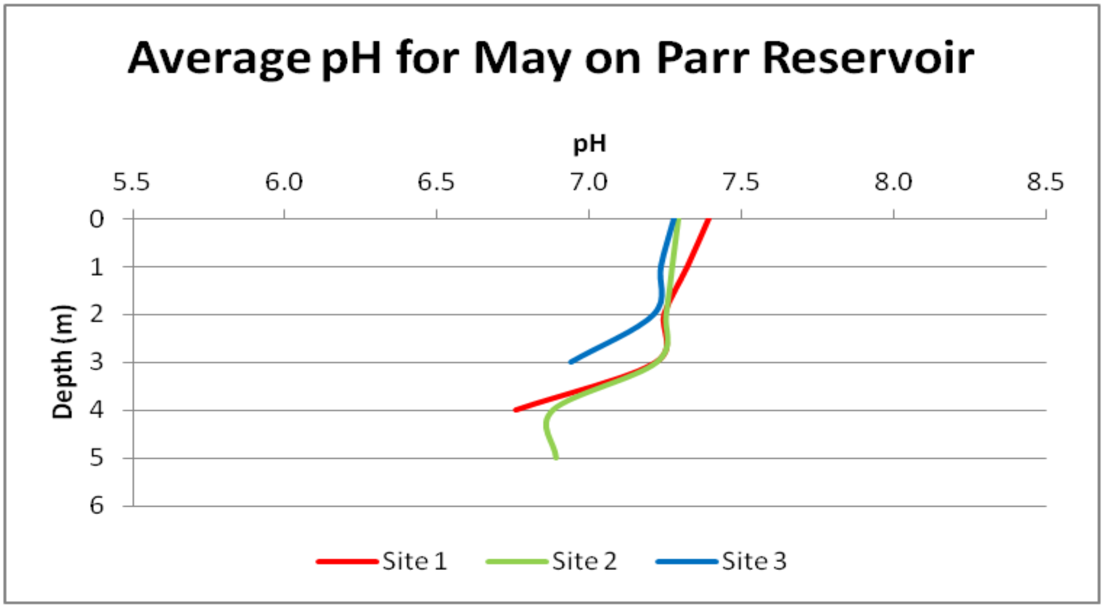


FIGURE 3-41 AVERAGE PH FOR MAY ON PARR RESERVOIR

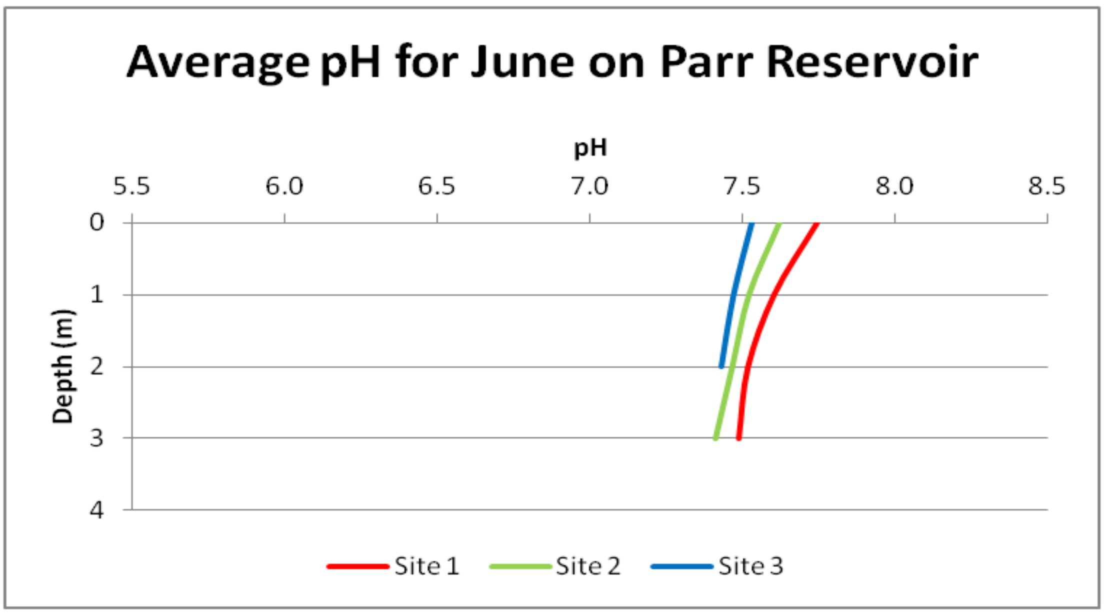


FIGURE 3-42 AVERAGE PH FOR JUNE ON PARR RESERVOIR

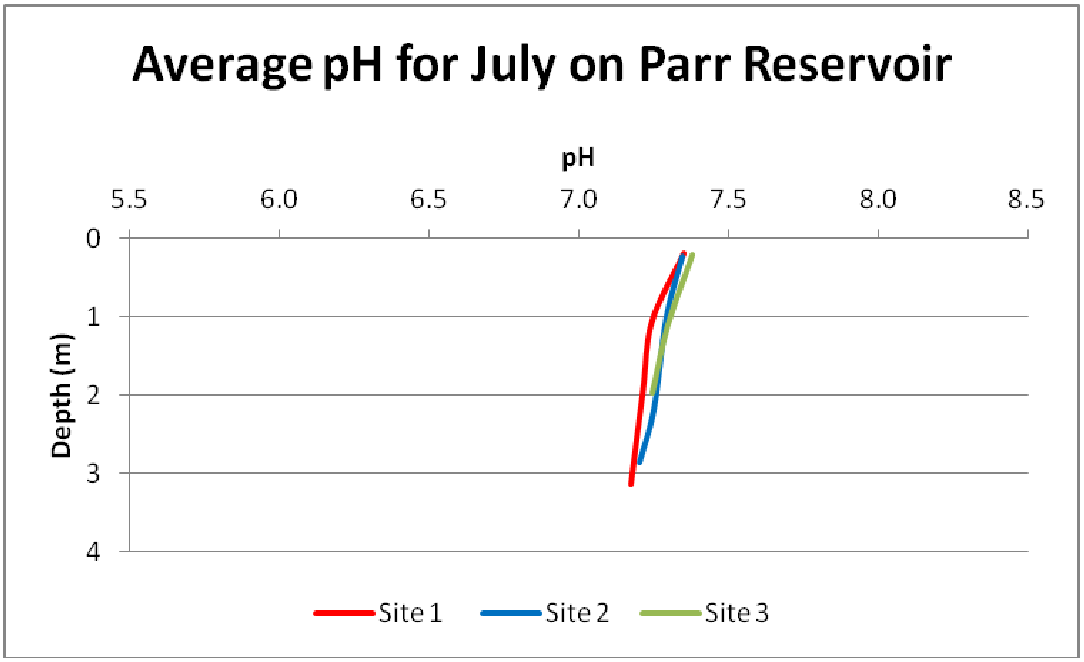


FIGURE 3-43 AVERAGE PH FOR JULY ON PARR RESERVOIR

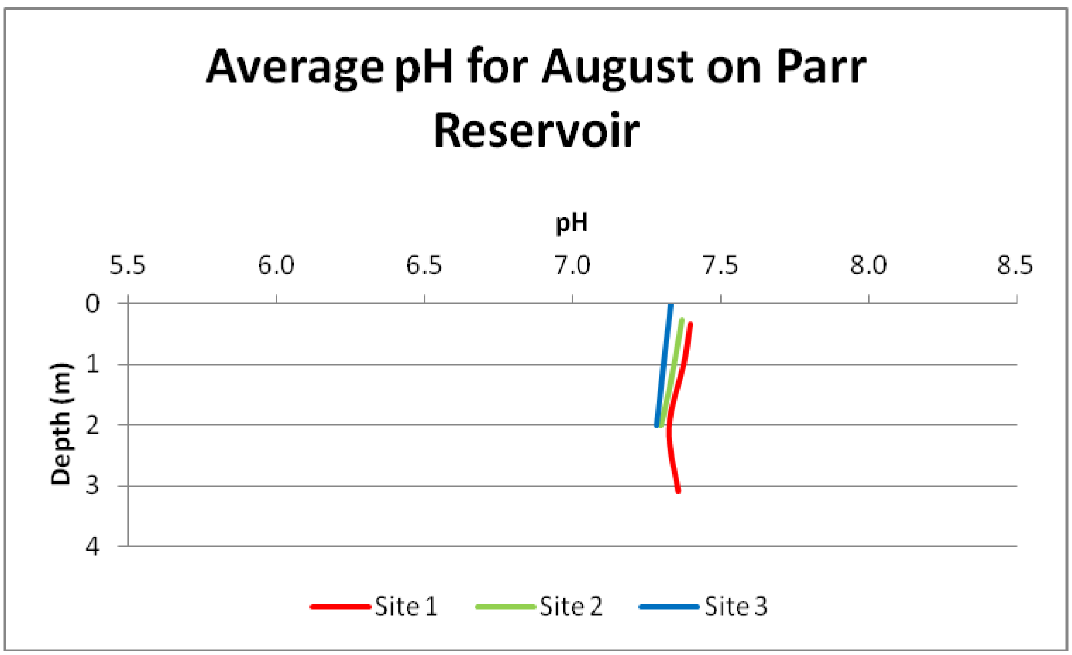


FIGURE 3-44 AVERAGE PH FOR AUGUST ON PARR RESERVOIR

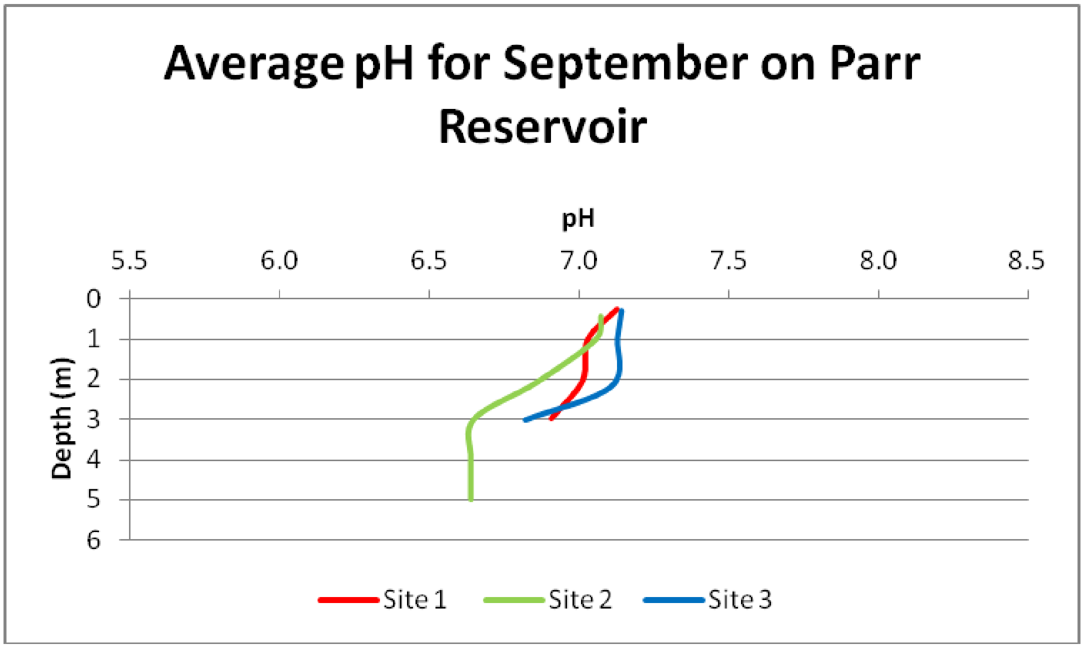


FIGURE 3-45 AVERAGE PH FOR SEPTEMBER ON PARR RESERVOIR

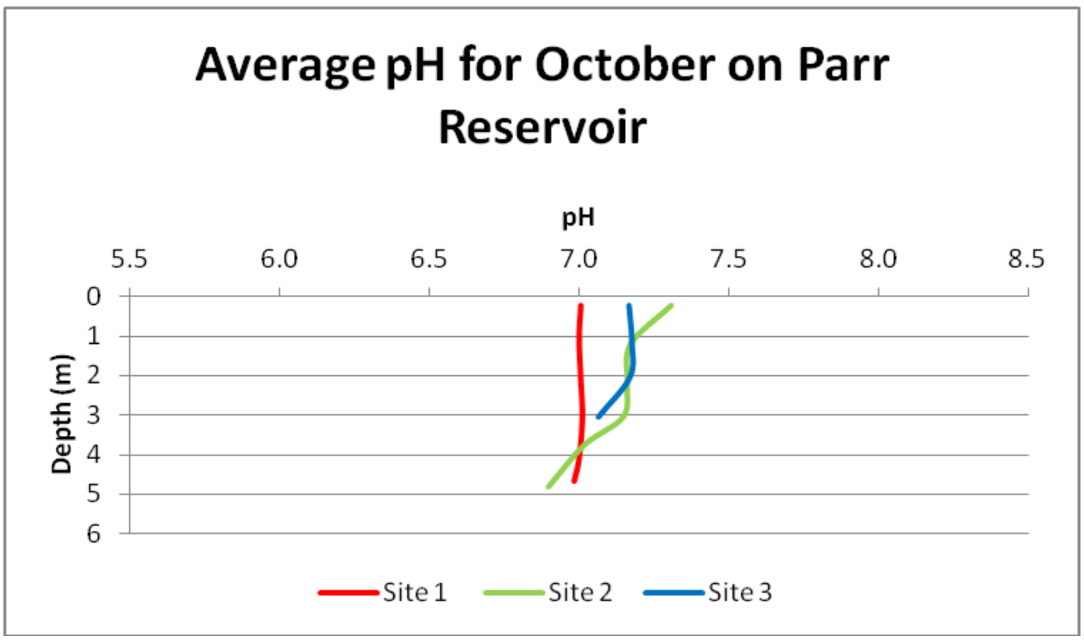


FIGURE 3-46 AVERAGE PH FOR OCTOBER ON PARR RESERVOIR

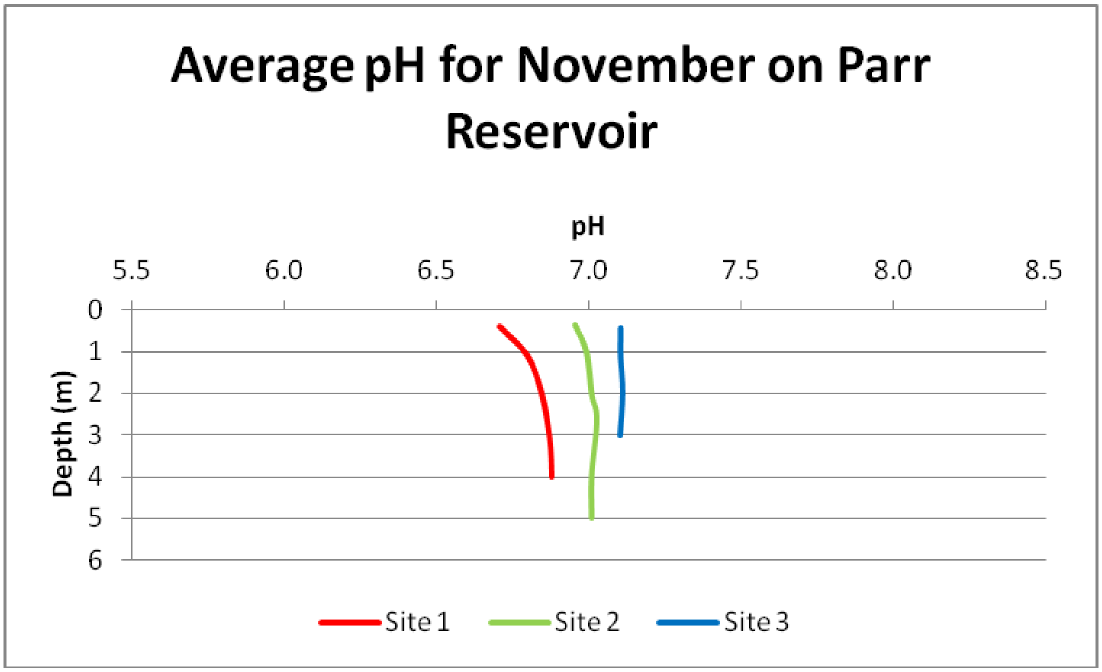


FIGURE 3-47 AVERAGE pH FOR NOVEMBER ON PARR RESERVOIR

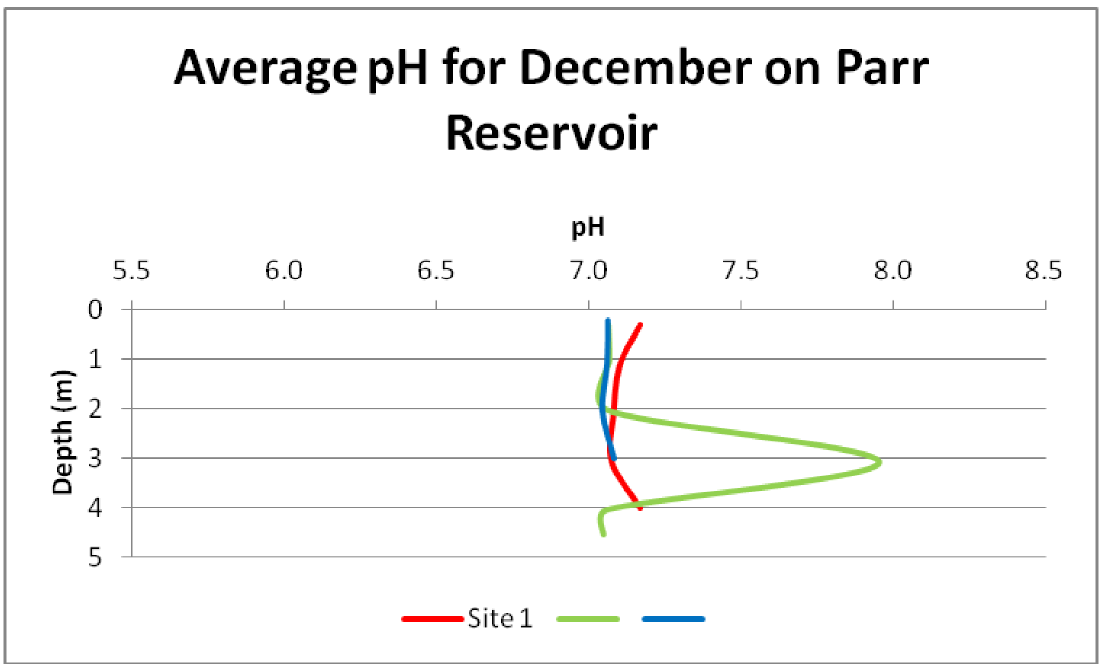


FIGURE 3-48 AVERAGE pH FOR DECEMBER ON PARR RESERVOIR

3.1.1.5 SUMMARY

Vertical profile data was collected on a monthly basis at three sites in Parr Reservoir, beginning in January 2011. Table 3-1 displays the maximum, minimum and mean temperature, DO, conductivity, and pH values on Parr Reservoir for each collection year at each collection location. The data summarized below were collected at a depth of 2 meters.

TABLE 3-1 SUMMARY TABLE FOR PARR RESERVOIR

Parr Reservoir		SITE 1				SITE 2				SITE 3			
		Temp	SpCond	DO Conc	pH	Temp	SpCond	DO Conc	pH	Temp	SpCond	DO Conc	pH
		C	uS/cm	mg/L		C	uS/cm	mg/L		C	uS/cm	mg/L	
2011	MAX	29.94	117	13.46	8.12	29.84	109	14.43	8.46	30.02	107	14.42	8.16
	MIN	8.56	74	5.11	6.85	8.76	73	5.46	7.08	8.58	72	5.30	7.15
	AVG	20.05	90	8.84	7.41	20.03	89	8.84	7.42	20.03	89	8.86	7.40
2012	MAX	28.82	96	12.24	7.75	28.56	97	12.32	7.71	28.66	98	12.63	7.70
	MIN	10.73	81	6.73	6.28	10.72	84	7.98	6.57	10.44	78	7.30	6.78
	AVG	18.38	91	9.30	7.23	18.43	91	9.69	7.23	18.34	90	9.70	7.24
2013	MAX	27.55	90	11.96	8.05	27.60	92	11.90	7.97	27.90	93	11.92	7.41
	MIN	9.62	56	6.23	5.85	8.62	57	5.02	6.59	8.32	57	5.18	6.72
	AVG	18.65	77	8.48	7.04	18.38	78	8.49	7.14	18.27	79	8.67	7.04

3.1.2 SCE&G METALS DATA

Parr Reservoir was analyzed for a variety of parameters, including metals, in 2007 and 2008 as part of the VCSNS expansion. Data were collected in the vicinity of the cooling tower blowdown discharge site on Parr Reservoir. The results of these analyses are shown below (Table 3-2).

TABLE 3-2 WATER QUALITY DATA AT NEW DISCHARGE SITE ON PARR RESERVOIR

		New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr	New Discharge Parr
Sample Date		6/26/2007	7/26/2007	8/28/2007	9/13/2007	10/31/2007	11/19/2007	12/11/2007	1/28/2008	2/21/2008	3/6/2008	4/24/2008
Analysis	**MDL /Units**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
Phosphorus	0.050 mg/l	0.106	0.059	0.062		0.081	0.081			0.07	0.06	0.09
Arsenic	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Barium	10.0 PPB	23	21	21	22	16	0	16.5	14	16	26	22
Cadmium	1.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Calcium	100.0 PPB	4798	4089	3286	3564	3728	5059	4503	4478	4557	5575	5621
Chromium	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Copper	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Iron	10.0 PPB	1017	568	485	669	203	485	357	341	329	2002	922
Lead	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Magnesium	100 .0 PPB	1998	2129	2092	2157	2230	466	2180	2139	2014	2138	2255
mercury (liquid)	0.4 PPB	0	0	0	0	0	0	0	0	0	0	0
Potassium	100.0 PPB	2171	2328	2500	2466	2337	2862	2520	2427	2133	2189	2109
Selenium	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Silver	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Sodium	1000.0 PPB	11780	12820	13600	16600	15620	21870	17090	14610	13170	9713	10900
Total Hardness (calc)	0.0 mg/l	20	19	17	18	19	15	20	20	20	23	23
Chlorides	0.5 mg/l	8.5	8.9	10.7	12.3	11.4	17.2	11.7	10.9	10.4	7.4	8.2
Conductivity	0.05 umhos	100.7	106.6	105.9	116.5	101.3	144.2	135.8	126.2	112.6	126.7	93.1
Nitrate-N	0.11 mg/l as N	0.4	0.24	0.14	0.21	0.28	0.4	0.36	0.43	0.45	0.36	0.32
Othrophosphate	0.010 mg/l	0.69	0.023	0.023	0.038	0.03	0.097	0.027	0.05	0.05	0.098	0.04
pH	0.0 S.U.	6.49		7.23	7.15							
Sulfates	0.5 mg/l	3.69	4.6	7.9	5.9	3.9	8.2	6.1	9	8.9	8.4	6.8
Total Alkalinity	1.0 mg/l	31.5	28.9	36.4	28.33	23.58	41.3	38.03	45.6	31.2	40.1	27.3
Total Dissolved Solid	2.0 mg/l	77	84	70	76	67	99	82	66	79	89	66
Total Suspended Solid	1.0 mg/l	9	8	8	10	3	4	2.5	0	3	12	11
Turbidity	0.05 NTU	22.2	10.5	8.88	13.1	4.02	7.62	5.32	4.02	4.89	35.1	11.7
Fecal Coliform	1.0 #/100ml	37	37	3	16	9	0			2	623	0
Total Coliform	Present/Absent	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present

0 -Represents in results column shows that values are less than the MDL for that particular parameter.

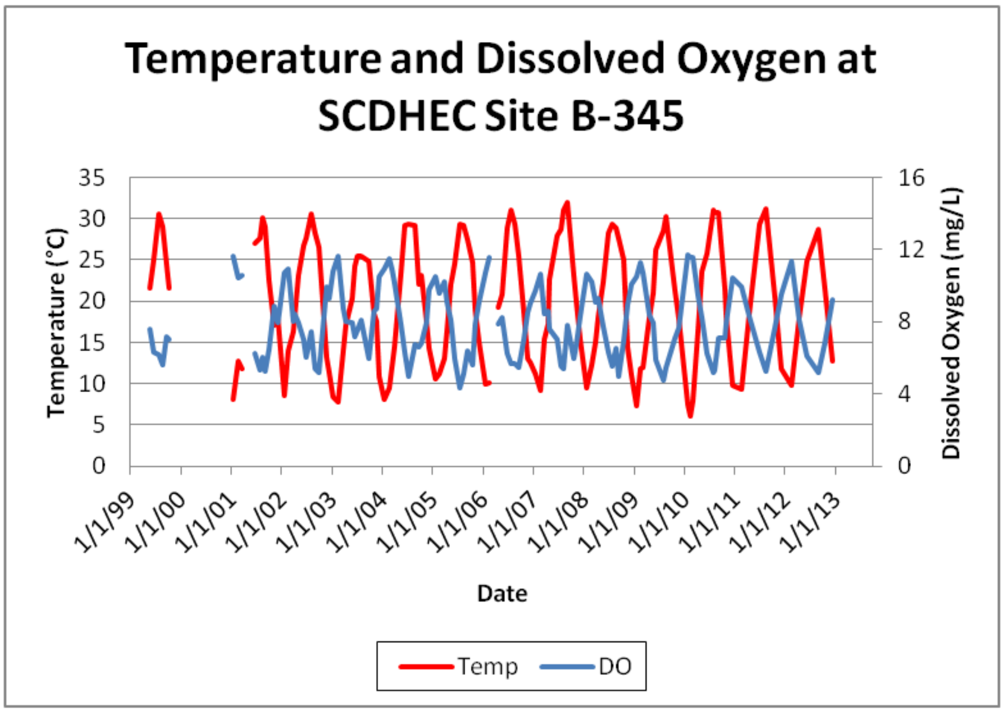
3.1.3 SCDHEC DATA

3.1.3.1 MONITORING STATION B-345

While samples collected from SCDHEC monitoring station B-345, in the forebay behind the dam, have been outside the allowed limits for the parameters discussed below in the past, this site is currently without impairment and is not listed on the South Carolina 303(d) List of Impaired Waters (303(d) list).

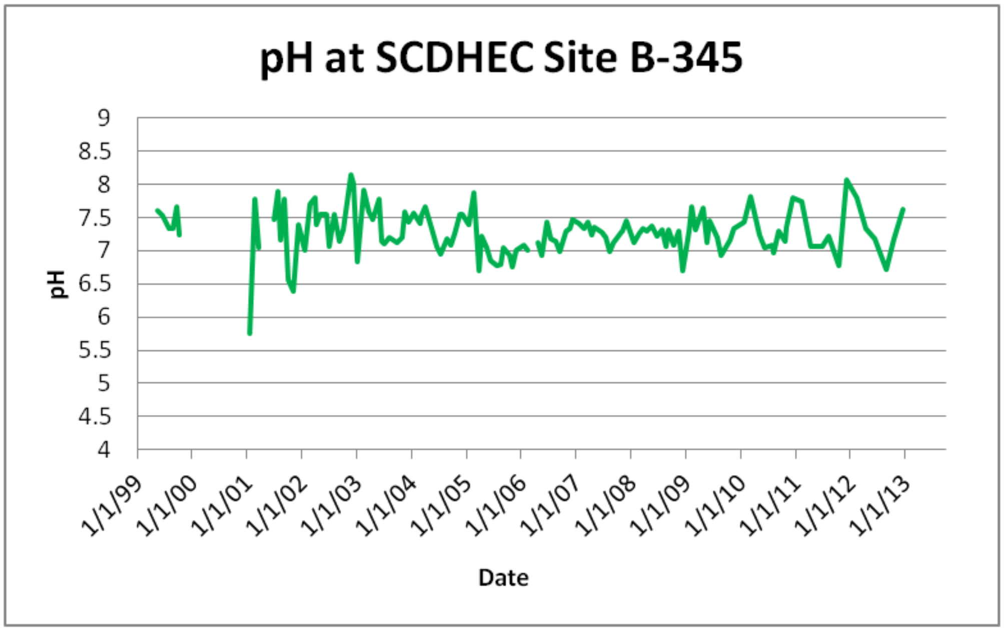
Temperature, DO, pH, and Turbidity

The following data were collected from 1999 through 2013 at the SCDHEC monitoring station B-345, located in the Parr Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



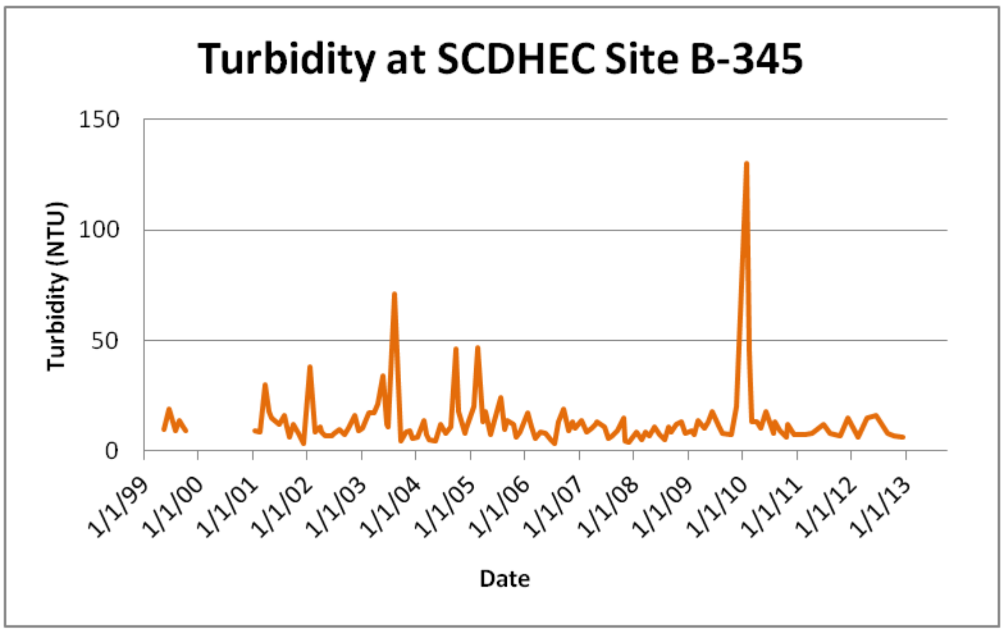
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-49 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION B-345[a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-50 pH AT SCDHEC MONITORING STATION B-345[a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-51 TURBIDITY AT SCDHEC MONITORING STATION B-345[a]

Metals

Water samples from monitoring station B-345 were collected on a quarterly basis from 1999 until 2013 and analyzed for metals (Table 3-3). As shown in Table 3-3, the SCDHEC core indicator metals (Table 2-3) have been consistently measured as Present Below Quantification Limit (PBQL) at site B-345, indicating the reservoir supports aquatic life use.

TABLE 3-3 METALS PRESENT AT SCDHEC MONITORING STATION B-345[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
8/26/99	PBQL	PBQL	PBQL	0.92	PBQL	-	0.05	PBQL	PBQL	PBQL
2/21/01	PBQL	PBQL	PBQL	0.56	PBQL	-	0.02	PBQL	PBQL	PBQL
5/7/01	PBQL	PBQL	PBQL	0.61	PBQL	-	0.06	PBQL	PBQL	PBQL
8/16/01	PBQL	PBQL	PBQL	0.044	PBQL	-	0.07	PBQL	PBQL	PBQL
11/6/01	PBQL	PBQL	PBQL	0.45	PBQL	-	0.037	PBQL	PBQL	0.041
2/21/02	PBQL	PBQL	0.015	0.4	PBQL	1.9	0.03	PBQL	PBQL	0.048
5/6/02	PBQL	PBQL	PBQL	0.74	PBQL	-	0.053	PBQL	PBQL	PBQL
8/8/02	PBQL	PBQL	PBQL	0.58	PBQL	-	0.07	PBQL	PBQL	0.082
11/21/02	PBQL	PBQL	PBQL	1	PBQL	-	0.034	PBQL	PBQL	0.026
2/19/03	PBQL	PBQL	PBQL	1.4	PBQL	1.8	0.041	PBQL	PBQL	PBQL
5/28/03	PBQL	PBQL	PBQL	2.1	PBQL	-	0.058	PBQL	PBQL	PBQL
8/7/03	PBQL	PBQL	PBQL	2.8	PBQL	-	0.055	PBQL	PBQL	PBQL
11/20/03	PBQL	PBQL	0.035	0.25	PBQL	-	0.018	PBQL	PBQL	0.017
2/25/04	PBQL	PBQL	PBQL	0.88	PBQL	1.6	0.032	PBQL	PBQL	0.048
5/13/04	PBQL	PBQL	PBQL	0.22	PBQL	-	0.027	PBQL	PBQL	0.011
8/26/04	PBQL	PBQL	PBQL	0.4	PBQL	-	0.04	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	PBQL	0.47	PBQL	-	0.02	PBQL	PBQL	PBQL
2/23/05	PBQL	PBQL	PBQL	1.8	PBQL	1.5	0.051	PBQL	PBQL	PBQL
5/18/05	PBQL	0.025	PBQL	0.55	PBQL	-	0.046	PBQL	PBQL	PBQL
8/18/05	PBQL	PBQL	PBQL	0.45	PBQL	-	0.046	PBQL	PBQL	PBQL
11/2/05	PBQL	PBQL	PBQL	0.33	PBQL	-	0.026	PBQL	PBQL	PBQL
2/16/06	PBQL	PBQL	PBQL	0.56	PBQL	1.6	0.024	PBQL	PBQL	PBQL
5/18/06	PBQL	PBQL	PBQL	0.44	PBQL	-	0.039	PBQL	PBQL	0.013
8/17/06	PBQL	PBQL	PBQL	0.57	PBQL	-	0.043	PBQL	PBQL	0.016
11/20/06	PBQL	PBQL	PBQL	1	PBQL	-	0.038	PBQL	PBQL	PBQL
2/20/07	PBQL	PBQL	PBQL	0.54	PBQL	1.6	0.019	PBQL	PBQL	0.018
5/2/07	PBQL	PBQL	PBQL	0.3	PBQL	1.6	0.053	PBQL	PBQL	0.031
8/13/07	PBQL	PBQL	PBQL	0.28	PBQL	1.6	0.062	PBQL	PBQL	0.036
11/8/07	PBQL	PBQL	PBQL	0.12	PBQL	1.3	0.02	PBQL	PBQL	PBQL
2/28/08	PBQL	PBQL	PBQL	0.37	PBQL	1.7	0.014	PBQL	PBQL	PBQL
5/22/08	PBQL	PBQL	PBQL	0.66	PBQL	-	0.049	PBQL	PBQL	PBQL
8/19/08	PBQL	PBQL	PBQL	0.4	PBQL	1.8	0.055	PBQL	PBQL	0.017
11/18/08	PBQL	PBQL	PBQL	0.65	PBQL	1.7	0.042	PBQL	PBQL	PBQL
2/12/09	PBQL	PBQL	PBQL	0.46	-	1.8	0.032	PBQL	PBQL	0.018
5/20/09	PBQL	PBQL	PBQL	0.47	-	1.9	0.056	PBQL	PBQL	PBQL
8/20/09	PBQL	PBQL	PBQL	0.27	-	1.9	0.071	PBQL	PBQL	PBQL
11/19/09	0.0002	PBQL	PBQL	0.99	-	1.5	0.033	PBQL	PBQL	PBQL
1/28/10	0.00027	0.0052	PBQL	3.8	-	-	0.12	PBQL	PBQL	PBQL
5/6/10	PBQL	PBQL	PBQL	0.41	-	-	0.055	PBQL	PBQL	PBQL
7/29/10	PBQL	PBQL	PBQL	0.32	-	-	0.043	PBQL	PBQL	PBQL
11/4/10	0.00058	PBQL	PBQL	0.55	-	1.5	0.02	PBQL	PBQL	PBQL
2/16/11	PBQL	PBQL	PBQL	0.31	-	-	0.015	PBQL	PBQL	PBQL
6/29/11	PBQL	PBQL	PBQL	0.32	-	-	0.058	PBQL	PBQL	PBQL
8/11/11	PBQL	PBQL	PBQL	0.27	-	-	0.052	PBQL	PBQL	PBQL
12/5/11	PBQL	PBQL	PBQL	0.73	-	1.5	0.021	PBQL	PBQL	PBQL
2/16/12	PBQL	PBQL	PBQL	0.33	-	-	0.019	PBQL	PBQL	PBQL
6/11/12	PBQL	PBQL	PBQL	0.31	-	-	0.059	PBQL	PBQL	0.01
8/30/12	PBQL	PBQL	PBQL	0.24	-	-	0.048	PBQL	PBQL	PBQL
12/13/12	PBQL	PBQL	PBQL	0.2	-	-	0.022	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

The nutrients data collected at SCDHEC monitoring station B-345 are presented in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-4 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION B-345[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)	Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
5/20/99	0.78	0.062	-	1/17/07	0.58	PBQL	-
6/17/99	0.53	0.058	-	2/20/07	0.56	PBQL	-
7/29/99	0.7	0.043	-	5/2/07	-	-	1.42
8/26/99	0.58	0.031	-	6/21/07	0.52	0.045	3.9
9/23/99	0.74	0.039	-	7/19/07	0.65	0.039	3.33
10/5/99	PBQL	0.039	-	8/13/07	PBQL	0.057	4.24
2/21/01	1.15	0.038	-	9/10/07	-	-	4.95
4/17/01	0.66	0.063	-	10/25/07	-	-	2.24
5/7/01	-	-	3.66	11/8/07	0.48	0.049	-
6/26/01	0.41	0.031	-	1/24/08	0.66	0.031	-
7/30/01	-	-	3.05	1/24/08	0.66	0.024	-
8/16/01	0.63	0.046	3.82	2/28/08	0.52	0.039	-
10/4/01	0.42	0.053	1.99	2/28/08	0.52	0.03	-
12/6/01	0.45	0.032	-	3/25/08	0.73	0.028	-
1/24/02	PBQL	0.026	-	3/25/08	0.73	0.028	-
2/21/02	0.45	0.029	-	4/17/08	0.62	PBQL	-
3/27/02	0.51	0.027	-	4/17/08	0.62	0.02	-
5/6/02	0.49	0.031	2.06	5/22/08	PBQL	0.035	-
6/13/02	0.4	0.039	-	5/22/08	PBQL	0.089	-
7/1/02	0.41	0.039	4.45	6/26/08	0.34	0.028	4.72
8/8/02	-	-	8.42	6/26/08	0.34	PBQL	-
9/5/02	0.38	0.036	7.26	7/29/08	0.25	0.06	-
10/2/02	-	-	4.19	7/29/08	0.25	0.046	6.28
11/21/02	0.68	0.032	-	8/19/08	0.202	0.048	6.18
12/12/02	0.64	0.036	-	9/11/08	0.26	0.057	6.5
1/6/03	0.64	0.039	-	9/11/08	0.26	0.032	-
3/27/03	0.54	0.037	-	10/14/08	0.46	0.029	2.51
5/28/03	0.88	0.027	-	10/14/08	0.46	0.04	-
7/2/03	0.49	PBQL	-	11/18/08	PBQL	0.025	-
9/25/03	0.73	0.022	1.74	11/18/08	PBQL	0.047	-
10/30/03	-	-	0.76	12/9/08	1.26	0.071	-
11/20/03	0.98	0.031	-	12/9/08	1.26	0.058	-
1/15/04	0.81	PBQL	-	1/22/09	0.49	0.046	-
3/11/04	0.76	0.031	-	2/12/09	0.55	0.047	-
4/1/04	0.73	PBQL	-	3/5/09	0.69	0.023	-
5/13/04	-	-	2.81	4/23/09	PBQL	PBQL	-
6/17/04	0.82	0.028	2.29	5/20/09	0.86	0.032	2.5
7/15/04	0.62	0.042	2.18	6/11/09	0.44	0.026	1.89
8/26/04	0.49	0.024	4.54	7/30/09	0.3	0.039	5.16
9/22/04	0.6	PBQL	-	8/20/09	0.41	0.041	8.88
10/14/04	0.58	0.023	4.75	10/22/09	0.43	0.037	2.27
11/22/04	0.71	0.022	-	11/19/09	0.48	0.047	-
12/7/04	0.57	0.048	-	1/28/10	0.74	0.12	-
1/20/05	0.98	0.038	-	2/11/10	0.66	0.058	-
2/23/05	0.88	0.03	-	3/4/10	0.61	0.045	-
3/24/05	0.9	0.052	-	4/8/10	PBQL	0.029	-
4/14/05	0.7	0.045	-	5/6/10	0.45	0.051	3.28
5/18/05	0.7	0.031	1.87	6/10/10	2.06	0.042	6.04
6/9/05	0.86	0.046	1.07	7/29/10	0.31	0.038	7.5
7/21/05	0.85	0.047	2.26	8/5/10	0.45	0.055	7.99
8/18/05	0.51	0.083	2.54	9/9/10	0.31	0.036	3.23
9/8/05	0.53	0.047	1.94	10/21/10	0.41	0.03	-
10/20/05	0.69	0.044	-	11/4/10	0.88	0.045	-
11/2/05	0.64	0.033	-	12/14/10	0.82	0.043	-
12/1/05	0.72	0.056	-	2/16/11	0.55	0.052	-
1/17/06	0.73	0.05	-	4/14/11	-	0.054	-
2/16/06	0.77	0.035	-	6/29/11	0.26	0.061	-
3/16/06	0.91	0.043	-	8/11/11	0.29	0.043	15.57
4/20/06	1.04	0.033	-	10/20/11	0.52	0.046	-
5/18/06	PBQL	0.027	2.06	12/5/11	0.69	0.074	-
6/22/06	0.57	0.03	2.5	2/16/12	0.96	0.057	-
7/20/06	0.58	0.037	3.63	4/12/12	0.99	0.083	-
8/17/06	0.95	0.024	3.96	6/11/12	0.48	0.035	5.2
9/14/06	0.53	0.035	3.01	8/30/12	0.55	0.027	8.59
10/26/06	0.56	0.024	1.1	10/17/12	0.63	0.041	3.67
11/20/06	0.54	0.03	-	12/13/12	0.99	0.068	-
12/7/06	0.55	PBQL	-	4/11/13	1.18	0.034	-

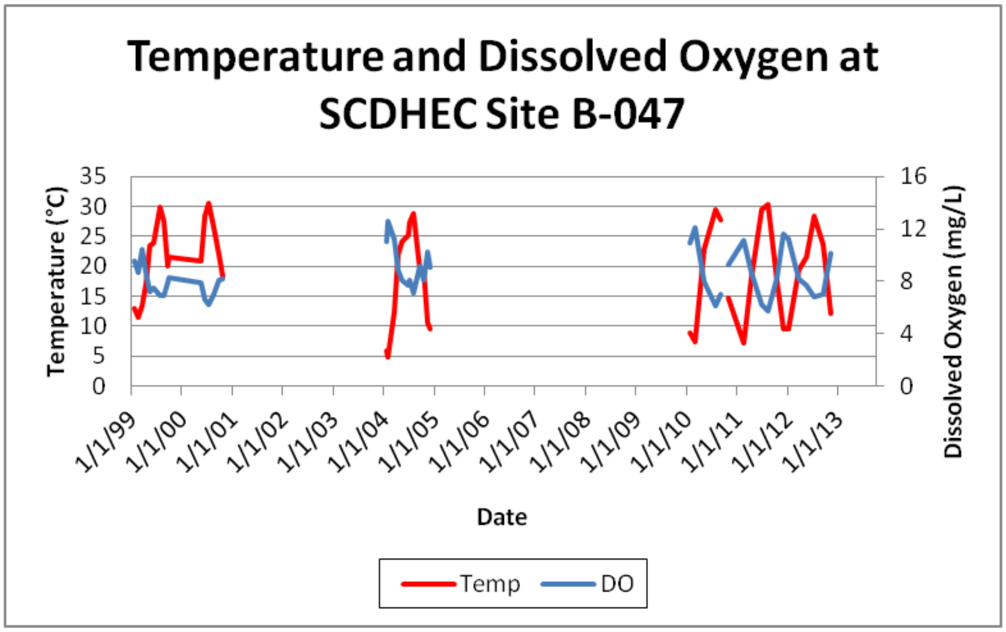
[A] PBQL is Present Below Quantification Limit.

3.1.3.2 Monitoring Station B-047

Historically, samples collected from SCDHEC monitoring station B-047, Broad River at SC 34, have been outside the allowed limits for some of the parameters discussed below, however this site is currently without impairment and is not listed on the 303(d) list.

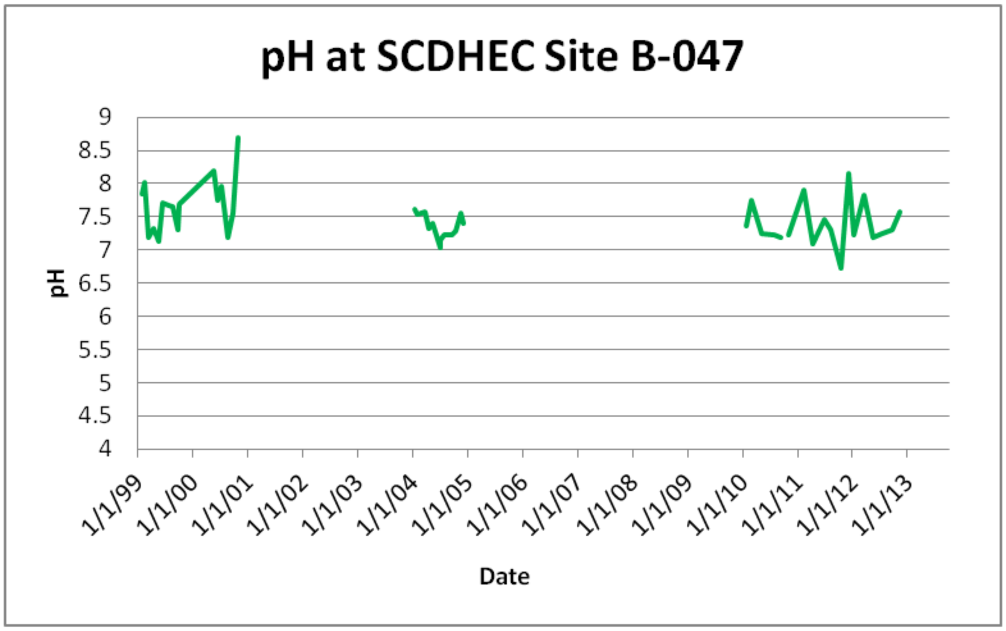
Temperature, DO, pH, and Turbidity

The following data were collected during the years 1999-2000, 2004 and 2010-2012 at the SCDHEC monitoring station B-047, located in the Parr Reservoir. The data collected for temperature, DO, pH, and turbidity reflect expected values, inside normal ranges. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



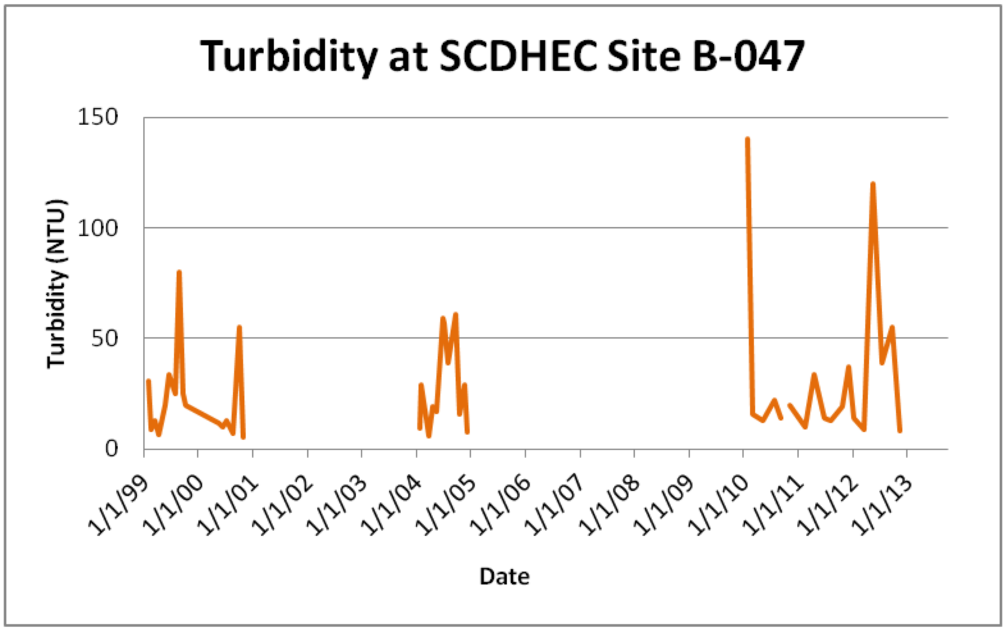
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

Figure 3-52 Water Temperature and Dissolved Oxygen at SCDHEC Monitoring Station B-047 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-53 pH AT SCDHEC MONITORING STATION B-047 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-54 TURBIDITY AT SCDHEC MONITORING STATION B-047[A]

Metals

Metals data collected by SCDHEC was available on STORET for monitoring station B-047 only for the years 2004, 2010, 2011, and 2012 (Table 3-5). During these years, water samples were tested on a quarterly basis for the presence of metals. In 2012, iron, magnesium, and manganese were all present at various times and levels. However, the aquatic life use core indicator metals (see Table 2-3) are consistently found to be PBQL.

TABLE 3-5 METALS PRESENT AT SCDHEC MONITORING STATION B-047[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/5/04	PBQL	PBQL	PBQL	1.1	PBQL	1.6	0.041	PBQL	PBQL	PBQL
5/11/04	PBQL	0.01	0.012	1.2	PBQL	-	0.092	PBQL	PBQL	0.025
8/2/04	PBQL	PBQL	PBQL	1.4	PBQL	-	0.042	PBQL	PBQL	PBQL
11/16/04	PBQL	PBQL	PBQL	1.5	PBQL	-	0.03	PBQL	PBQL	PBQL
1/28/10	0.00026	PBQL	PBQL	2.3	-	-	0.089	PBQL	PBQL	0.013
5/6/10	PBQL	PBQL	PBQL	0.5	-	-	0.042	PBQL	PBQL	PBQL
7/29/10	PBQL	PBQL	PBQL	1	-	-	0.065	PBQL	PBQL	PBQL
11/4/10	PBQL	PBQL	PBQL	1.1	-	1.4	0.057	PBQL	PBQL	PBQL
2/16/11	PBQL	PBQL	PBQL	0.53	-		0.029	PBQL	PBQL	PBQL
6/29/11	PBQL	PBQL	PBQL	0.53	-		0.06	PBQL	PBQL	PBQL
8/11/11	PBQL	PBQL	PBQL	0.57	-		0.077	PBQL	PBQL	PBQL
12/5/11	PBQL	PBQL	PBQL	1.2	-	1.5	0.054	PBQL	PBQL	PBQL
1/12/12	PBQL	PBQL	PBQL	0.66	-		0.034	PBQL	PBQL	PBQL
5/15/12	PBQL	PBQL	PBQL	4.4	-		0.34	PBQL	PBQL	PBQL
7/17/12	PBQL	PBQL	PBQL	0.96	-		0.13	PBQL	PBQL	PBQL
11/8/12	PBQL	PBQL	PBQL	0.32	-	1.8	0.027	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station B-047 during 2004, 2010, 2011, and 2012 and is included in the table below. Site B-047 is considered by SCDHEC to be located in the Broad River; the nutrient and chlorophyll-a standards only apply to reservoirs and therefore do not apply to this site. There are no nutrient and chlorophyll-a standards established for rivers.

TABLE 3-6 NUTRIENTS AT SCDHEC MONITORING STATION B-047

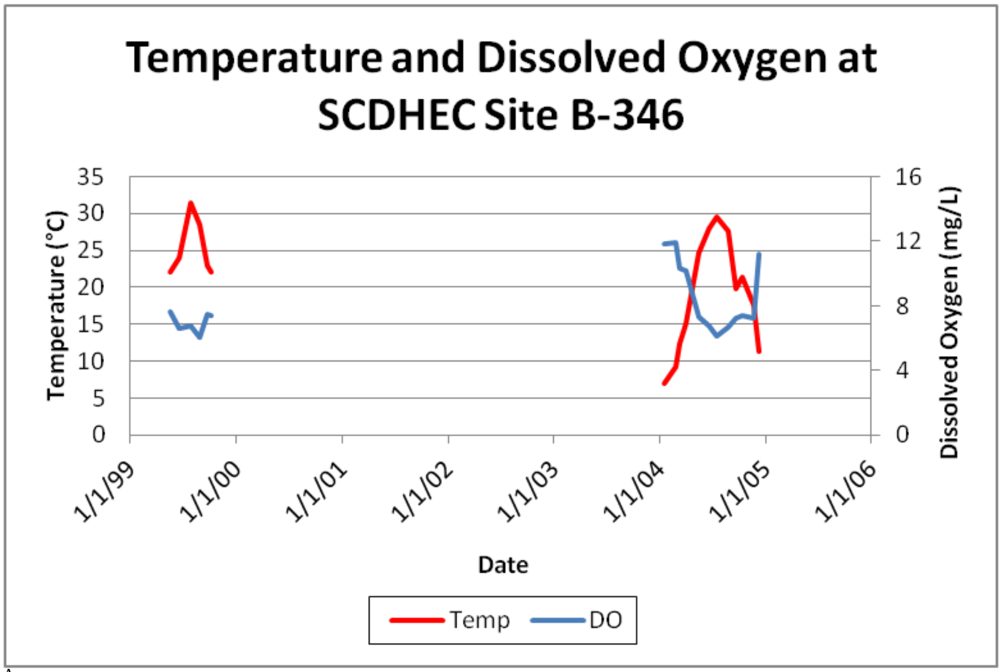
Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
1/20/04	-	0.074
2/5/04	0.94	0.052
3/23/04	-	0.047
4/20/04	0.88	0.12
5/11/04	0.78	0.13
6/30/04	0.94	0.11
7/7/04	0.67	0.11
8/2/04	0.86	0.088
9/21/04	0.45	0.057
10/14/04	0.63	0.055
11/16/04	0.66	0.042
12/6/04	0.7	0.13
1/28/10	0.39	0.046
3/4/10	0.51	0.054
5/6/10	0.57	0.13
7/29/10	0.99	0.15
9/9/10	0.87	0.085
11/4/10	0.69	0.092
2/16/11	0.54	0.076
6/29/11	0.6	0.15
8/11/11	0.69	0.15
10/20/11	1.15	0.11
12/5/11	0.84	0.11
1/12/12	0.7	0.13
3/19/12	0.67	0.088
5/15/12	0.53	0.22
7/17/12	0.65	0.12
9/20/12	0.67	0.17
11/8/12	0.94	0.23

3.1.3.3 MONITORING STATION B-346

The SCDHEC monitoring station B-346, Parr Reservoir approximately 3 miles upstream of the dam, is an inactive site where SCDHEC no longer collects water quality data. Currently, this site is listed on the 303(d) list for total phosphorus. See the nutrients section below for more details on the total phosphorus levels at this site.

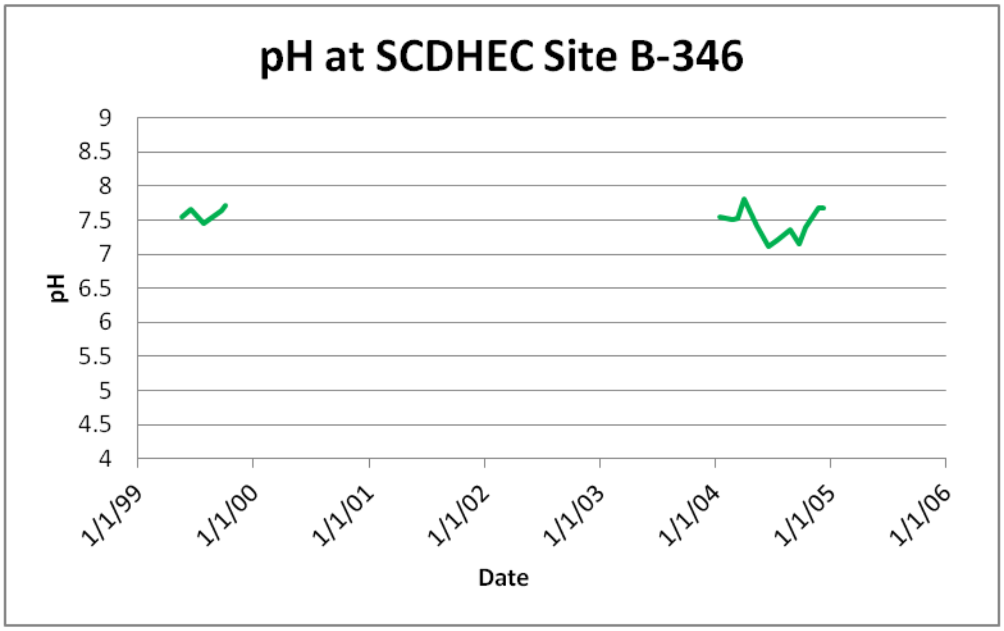
Temperature, DO, pH, and Turbidity

The following data was collected during the years 1999 and 2004 at the SCDHEC monitoring station B-346 located in the Parr Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



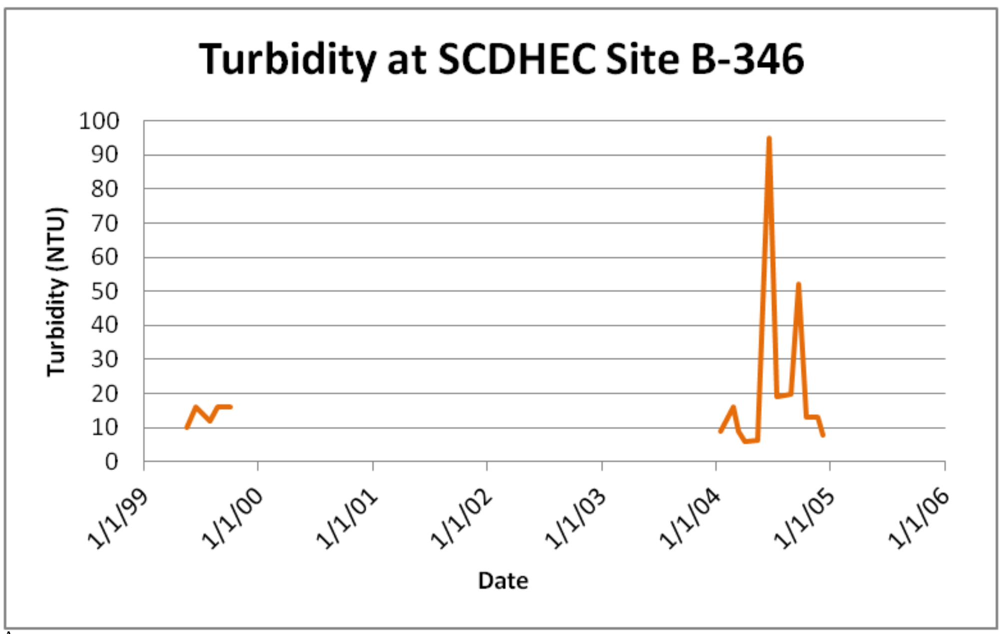
[A] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-55 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION B-346[A]



[A] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-56 PH AT SCDHEC MONITORING STATION B-346[A]



[A] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-57 TURBIDITY AT SCDHEC MONITORING STATION B-346[A]

Metals

Metals data collected by SCDHEC was available on STORET for monitoring station B-346 only for the year 1999 and 2004. The SCDHEC core indicator metals (Table 2-3) were consistently measured as Present Below Quantification Limit (PBQL) at site B-346, indicating the reservoir supports aquatic life use.

TABLE 3-7 METALS AT SCDHEC MONITORING STATION B-346[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
8/26/99	PBQL	PBQL	PBQL	0.84	PBQL	-	0.04	PBQL	PBQL	0.02
2/25/04	PBQL	PBQL	PBQL	1	PBQL	1.7	0.05	PBQL	PBQL	PBQL
5/13/04	PBQL	PBQL	PBQL	0.45	PBQL	-	0.033	PBQL	PBQL	PBQL
8/26/04	PBQL	PBQL	PBQL	1.1	PBQL	-	0.034	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	PBQL	0.73	PBQL	-	0.038	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station B-346 during 1999 and 2004 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients. This site is currently listed on the 2012 303(d) list for total phosphorus. However, it should be noted that total phosphorus has not been analyzed at this site since 2004.

TABLE 3-8 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION B-346[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
5/20/99	0.73	-	-
6/17/99	0.7	-	-
7/29/99	1.75	-	-
8/26/99	PBQL	-	-
9/23/99	0.8	-	-
10/5/99	0.74	-	-
1/15/04	0.76	0.051	-
2/25/04	-	0.047	-
3/11/04	0.75	0.036	-
4/1/04	0.54	0.03	-
5/13/04	0.74	0.056	1.47
6/17/04	1.02	0.13	1.54
7/15/04	0.93	0.079	1.41
8/26/04	0.77	0.098	1.24
9/22/04	0.61	0.075	1.01
10/14/04	0.61	0.051	1.29
11/22/04	0.67	0.038	-
12/7/04	0.59	0.037	-

[A] PBQL is Present Below Quantification Limit.

3.1.3.4 MONITORING STATION RL-12049

SCDHEC monitoring station RL-12049, Parr Reservoir approximately 1 mile southeast of the mouth of Hellers Creek, is a randomly selected site that was monitored on a monthly basis during 2012. Data collected at this site is summarized below. These data have not yet been evaluated for potential §303(d) listing.

Temperature, DO, pH, and Turbidity

The following data was collected during 2012 at the SCDHEC monitoring station RL-12049 located in the Parr Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.

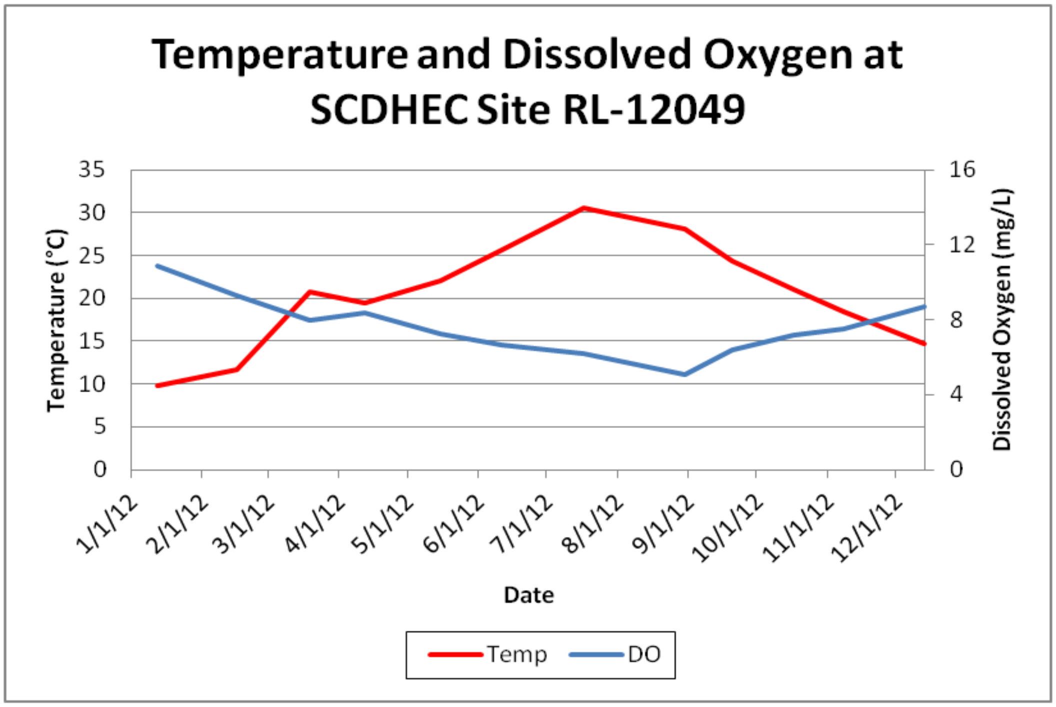
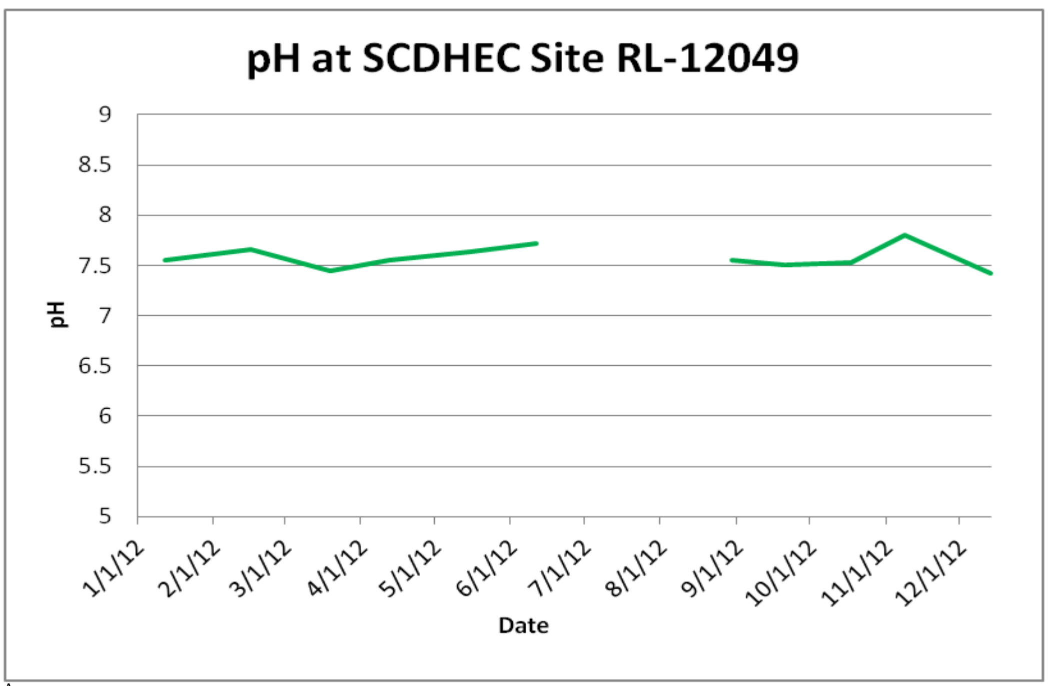


FIGURE 3-58 TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION RL-12049



[A] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-59 PH AT SCDHEC MONITORING STATION RL-12049[A]

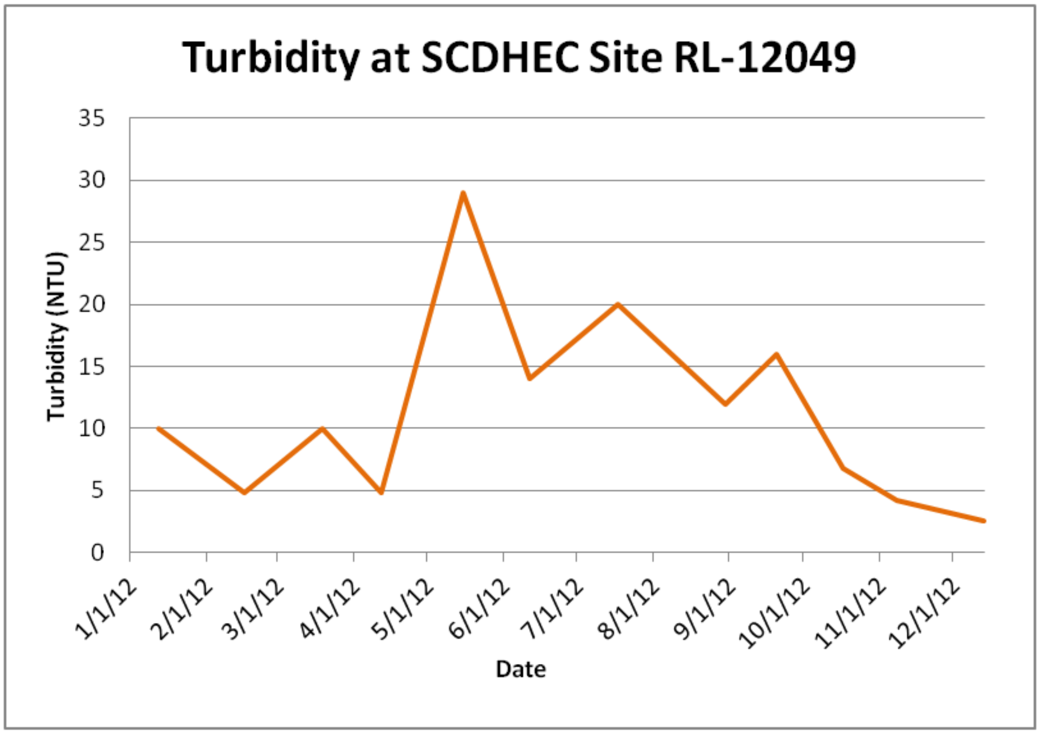


FIGURE 3-60 TURBIDITY AT SCDHEC MONITORING STATION RL-12049

Metals

The metals data collected in 2012 at SCDHEC monitoring site RL-12049 is presented in the table below. The SCDHEC core indicator metals (Table 2-3) were consistently measured as Present Below Quantification Limit (PBQL) at site RL-12049, indicating the reservoir supports aquatic life use.

TABLE 3-9 METALS AT SCDHEC MONITORING STATION RL-12049[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
1/12/12	PBQL	PBQL	PBQL	0.69	-	-	0.026	PBQL	PBQL	PBQL
5/15/12	PBQL	PBQL	PBQL	1.8	-	-	0.095	PBQL	PBQL	PBQL
7/17/12	PBQL	PBQL	PBQL	0.48	-	-	0.05	PBQL	PBQL	PBQL
11/8/12	PBQL	PBQL	PBQL	0.089	-	1.6	0.045	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Water samples were collected at SCDHEC monitoring site RL-12049 and analyzed for nitrogen, phosphorus and chlorophyll-a. The results of these analyses are included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-10 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION RL-12049[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/12/12	PBQL	0.1	-
2/16/12	0.76	0.038	-
3/19/12	0.87	0.089	-
4/12/12	0.85	0.036	-
5/15/12	0.62	0.12	1.23
6/11/12	0.7	0.078	4.36
7/17/12	0.72	0.1	-
8/30/12	0.61	0.062	3.55
9/20/12	0.76	0.092	1.62
10/17/12	0.52	0.05	-
11/8/12	0.45	0.032	-
12/13/12	0.86	0.04	-

[A] PBQL is Present Below Quantification Limit.

3.1.4 PARR RESERVOIR SEDIMENT INVESTIGATION 2012

The data collected in 2012 will be used to form a baseline for determining what impact, if any the discharge from the operation of the V.C. Summer Nuclear Station Units 2 and 3 will have on various constituents of the sediment in the vicinity of the discharge. Data will continue to be collected at the two transect sites through the construction and operation of these nuclear units.

3.1.4.1 SEDIMENT INVESTIGATION RESULTS

Four metals, including antimony, arsenic, lead and nickel, were measured at <10 mg/kg. Antimony (1.7 mg/kg) and arsenic (3.8 mg/kg) were detected at Transect 2 compared to non-detect at Transect 1. Lead and nickel concentrations at Transect 2 ranged from 6.0 times to 6.6 times higher than Transect 1. Reference Figure 2-4

Copper, chromium, zinc and barium results at Transect 2 range in values from 15 mg/kg to 97 mg/kg. In comparison Transect 1 values ranged from 2.1 mg/kg to 24 mg/kg. Copper concentrations at Transect 2 (15 mg/kg) were measured 7 times higher than Transect 1 (2.1 mg/kg) results.

The results at Transect 2 for manganese and calcium ranged between 580 mg/kg to 790 mg/kg. Calcium was measured at 790 mg/kg at Transect 2 compared to non-detect at Transect 1 for this sampling event. Manganese concentrations at Transect 2 (580 mg/kg) were two times higher than those at Transect 1 (290 mg/kg).

Potassium, magnesium, aluminum and iron results ranged from 1,600 mg/kg to 21,000 mg/kg at Transect 2, compared to a range of 500 mg/kg to 5,500 mg/kg at Transect 1. Aluminum concentrations at Transects 2 were 6.5 times higher than those at Transect 1. Potassium, magnesium, and iron concentrations at Transect 2 ranged from 3.2 times to 3.8 times higher than Transect 1.

The phosphorus results were higher at Transect 2 with a value of 350 mg/kg compared to a value of 150 mg/kg at Transect 1.

For the complete 2012 Parr Sediment Investigation Report, please see Appendix A.

3.2 Monticello Reservoir

3.2.1 SCE&G Vertical Profile Data

3.2.1.1 Temperature

Water temperatures depicted in the graphs below are an average of ten years of monthly readings collected from Monticello Reservoir by SCANA personnel, beginning in January of 2003 to December 2012. The data corresponding to the "intake" refers to that collected at the monitoring site located in the channel near the circulating water intake for the VCSNS. The data corresponding to the "discharge" refers to that collected at the monitoring site located just outside the northern end of the circulating water discharge canal for VCSNS. The data corresponding to the "uplake" refers to that collected at the monitoring site located near the northern end of the reservoir.

Water temperatures in Monticello Reservoir at the monitoring site near the intake of the VCSNS and the monitoring site located at the north end of the reservoir follow a general trend of increasing during the summer months and decreasing with depth of the reservoir. Temperatures at these two locations range from around 9^{o}C during winter months up to 30^{o}C during the summer months. Water temperatures near the discharge area of the VCSNS have a slightly different trend, with surface temperatures being consistently around five to seven degrees warmer than the other two monitoring locations. However, as the depth increases, these temperatures quickly drop back to what is normal for the lake, according to monitoring at the intake and uplake monitoring locations. Please see Appendix B for the Thermal Mixing Zone Evaluation and NPDES permit issued to the VCSNS regarding this water quality trend.

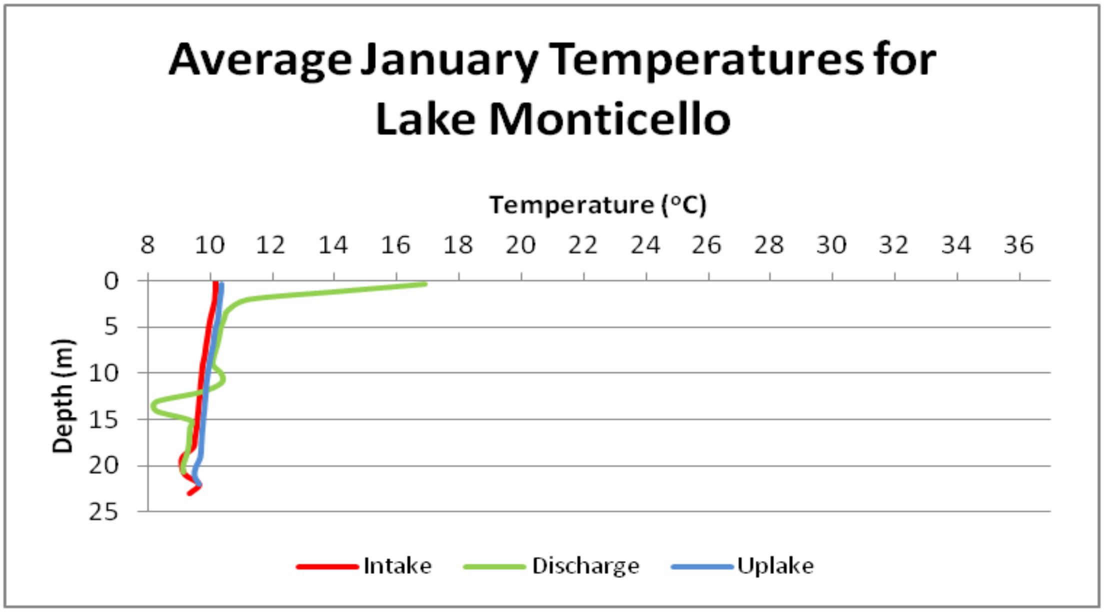


FIGURE 3-61 AVERAGE TEMPERATURE FOR JANUARY ON MONTICELLO RESERVOIR

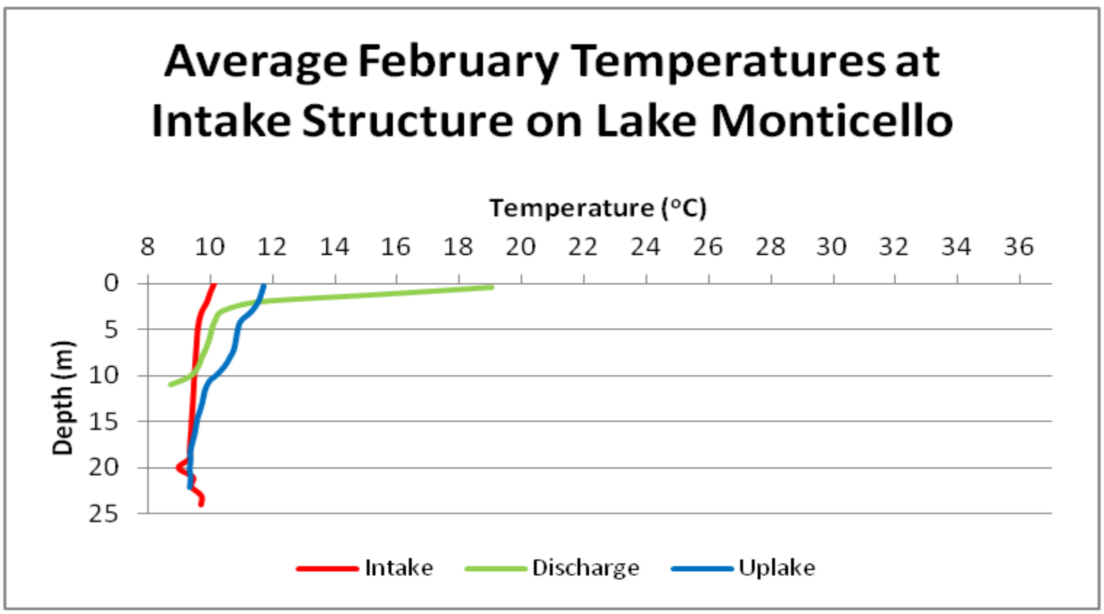


FIGURE 3-62 AVERAGE TEMPERATURE FOR FEBRUARY ON MONTICELLO RESERVOIR

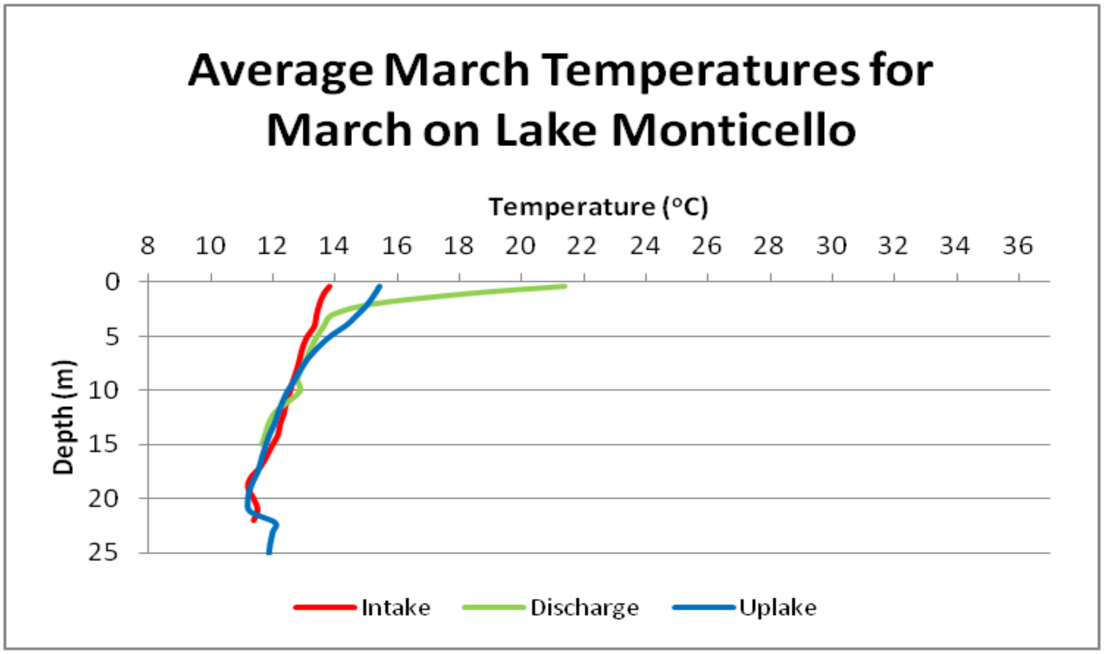


FIGURE 3-63 AVERAGE TEMPERATURE FOR MARCH ON MONTICELLO RESERVOIR

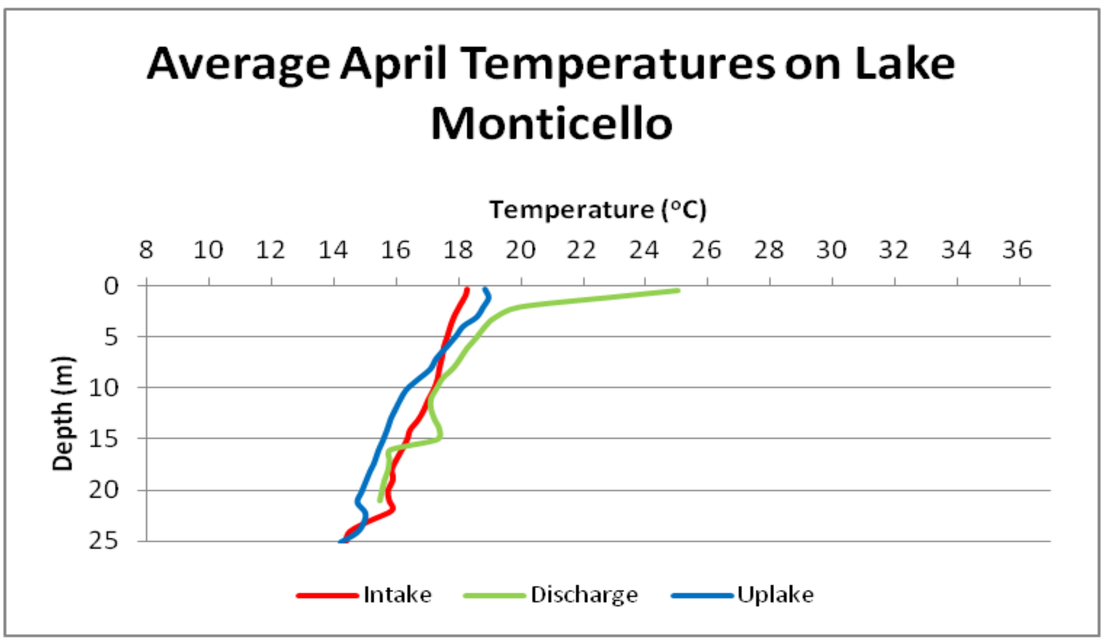


FIGURE 3-64 AVERAGE TEMPERATURE FOR APRIL ON MONTICELLO RESERVOIR

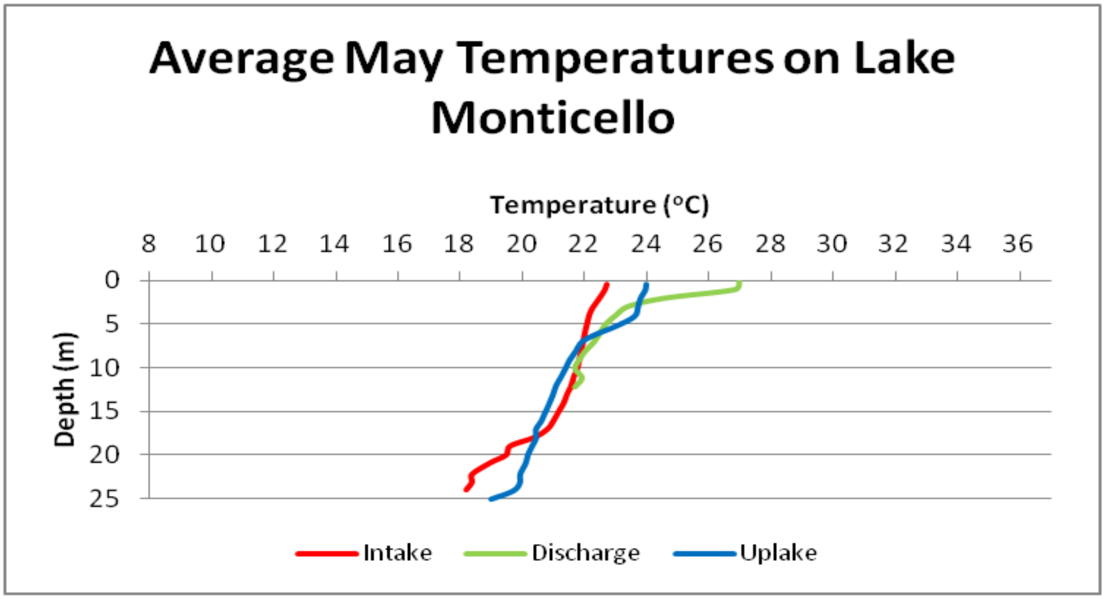


FIGURE 3-65 AVERAGE TEMPERATURE FOR MAY ON MONTICELLO RESERVOIR

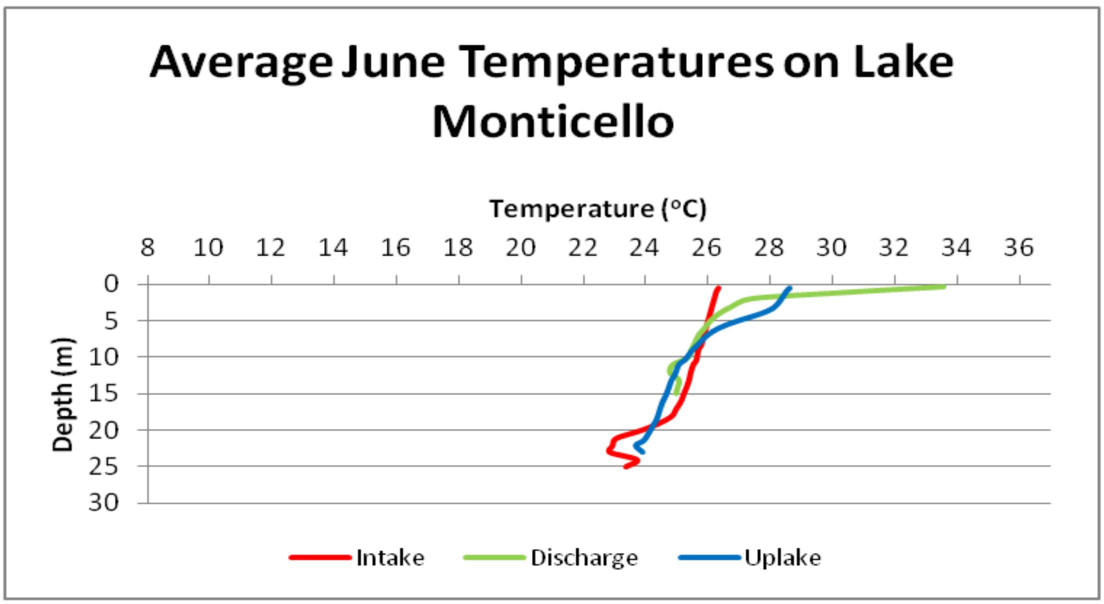


FIGURE 3-66 AVERAGE TEMPERATURE FOR JUNE ON MONTICELLO RESERVOIR

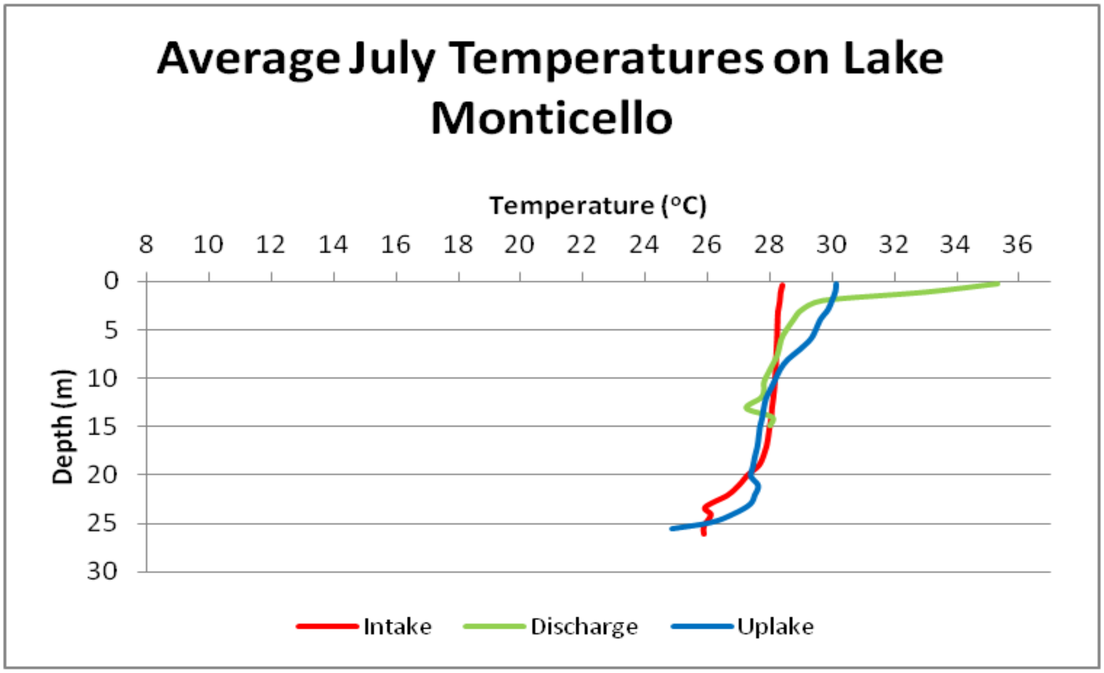


FIGURE 3-67 AVERAGE TEMPERATURE FOR JULY ON MONTICELLO RESERVOIR

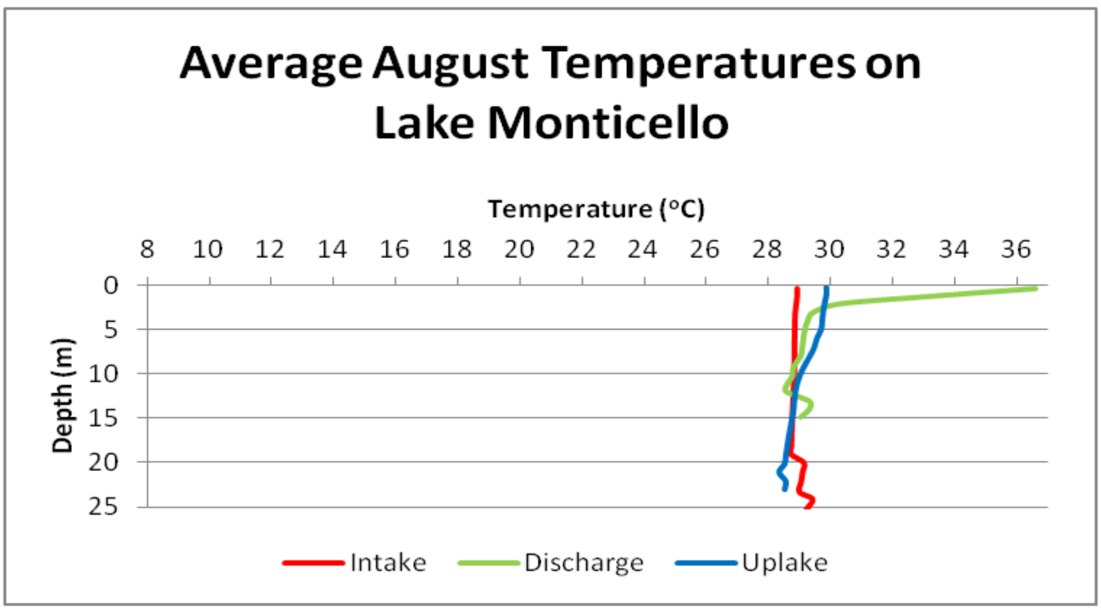


FIGURE 3-68 AVERAGE TEMPERATURE FOR AUGUST ON MONTICELLO RESERVOIR

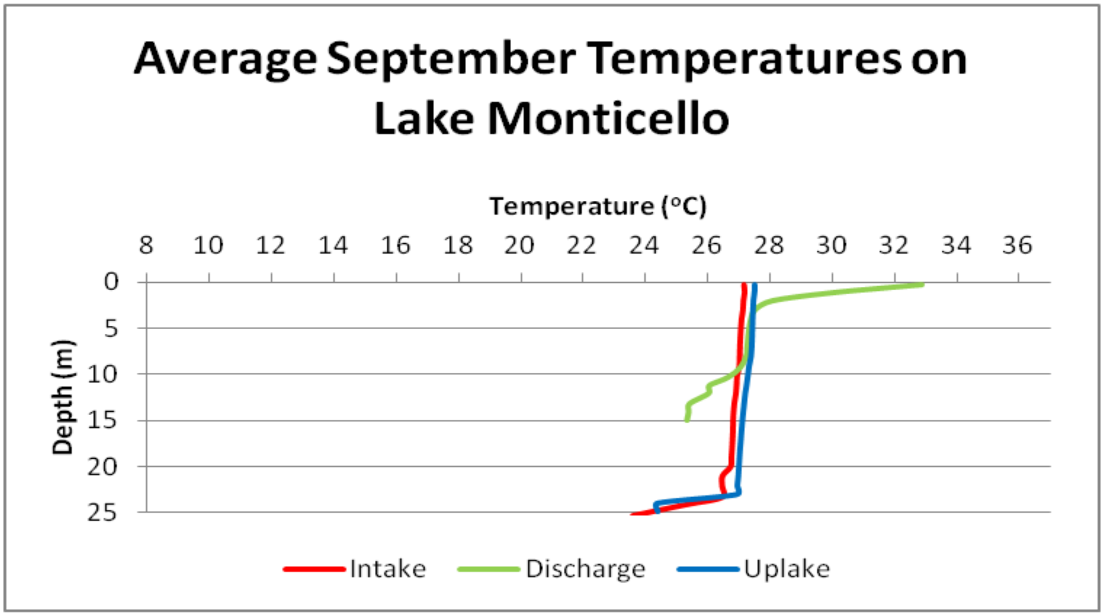


FIGURE 3-69 AVERAGE TEMPERATURE FOR SEPTEMBER ON MONTICELLO RESERVOIR

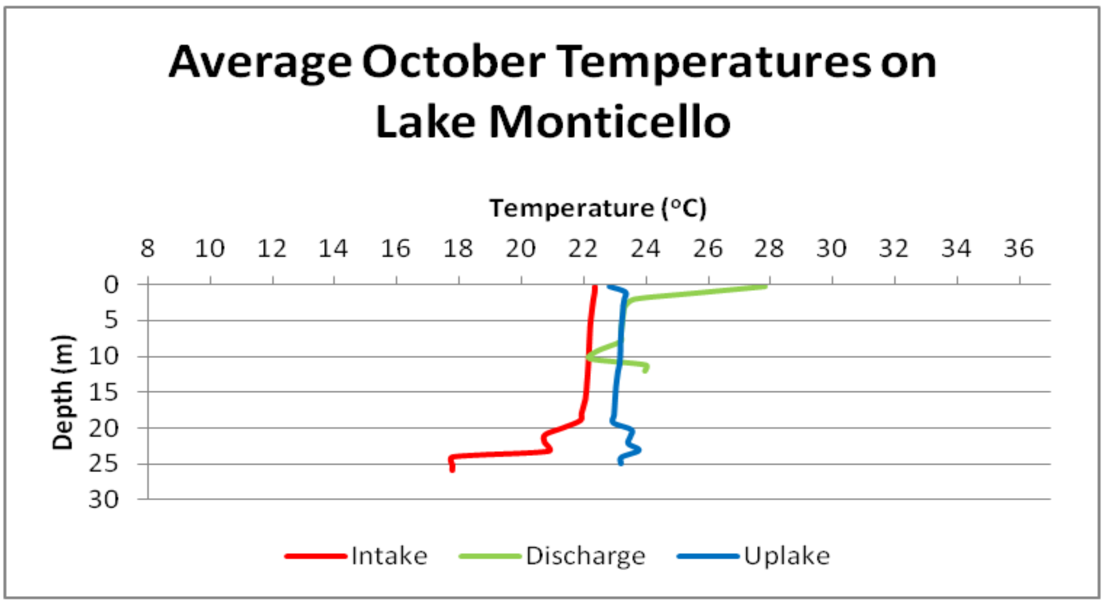


FIGURE 3-70 AVERAGE TEMPERATURE FOR OCTOBER ON MONTICELLO RESERVOIR

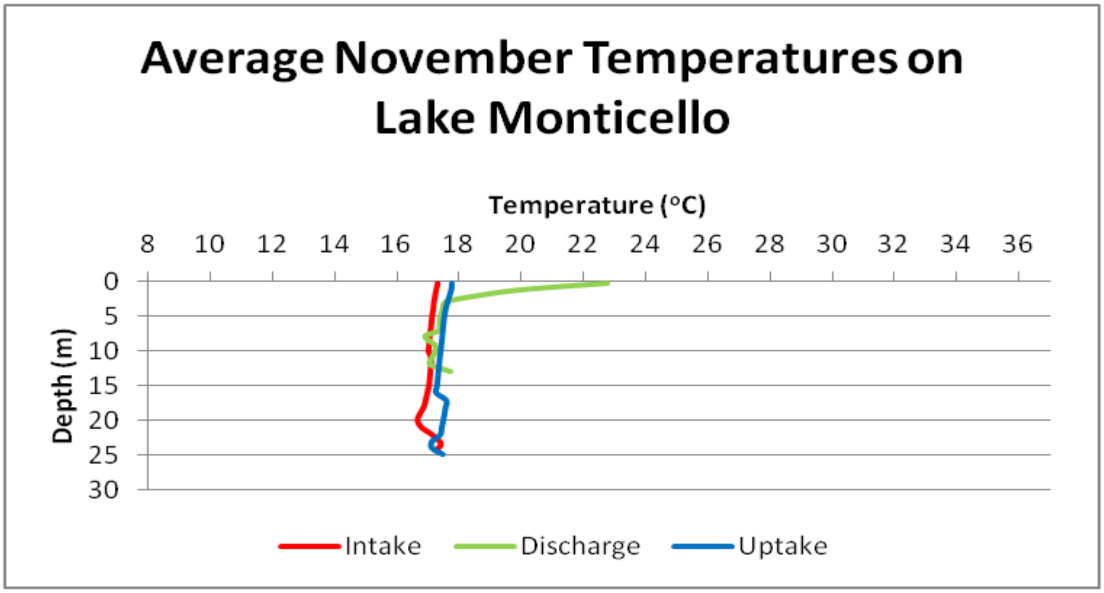


FIGURE 3-71 AVERAGE TEMPERATURE FOR NOVEMBER ON MONTICELLO RESERVOIR

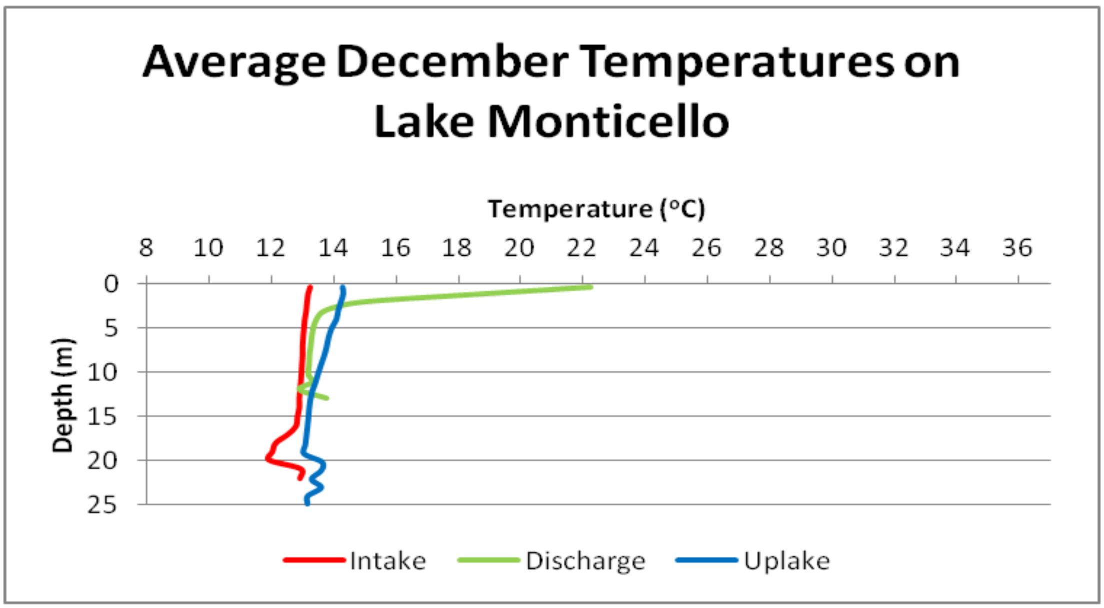


FIGURE 3-72 AVERAGE TEMPERATURE FOR DECEMBER ON MONTICELLO RESERVOIR

3.2.1.2 DISSOLVED OXYGEN

Dissolved oxygen values depicted in the graphs below are an average of ten years of monthly readings collected by SCANA personnel, beginning in January of 2003 to December 2012. The data corresponding to the “intake” refers to that collected at the monitoring site located in the channel near the circulating water intake for the VCSNS. The data corresponding to the “discharge” refers to that collected at the monitoring site located just outside the northern end of the circulating water discharge canal for VCSNS. The data corresponding to the “uplake” refers to that collected at the monitoring site located near the northern end of the reservoir.

The dissolved oxygen values at Monticello Reservoir typically range from 5 mg/L to 8 mg/L in the summer months up to 13 mg/L to 15 mg/L in the winter months, which is to be expected with the fluctuations in water temperatures. Dissolved oxygen levels at the uplake site have dropped to below 5 mg/L at the deepest depths of the reservoir, on several occasions during the summer months. These low DO values can be attributed to the depth of the reservoir, along with the fact that this particular area of the reservoir is far away from any turbulence in the water due to the intake and discharge activities of the VCSNS.

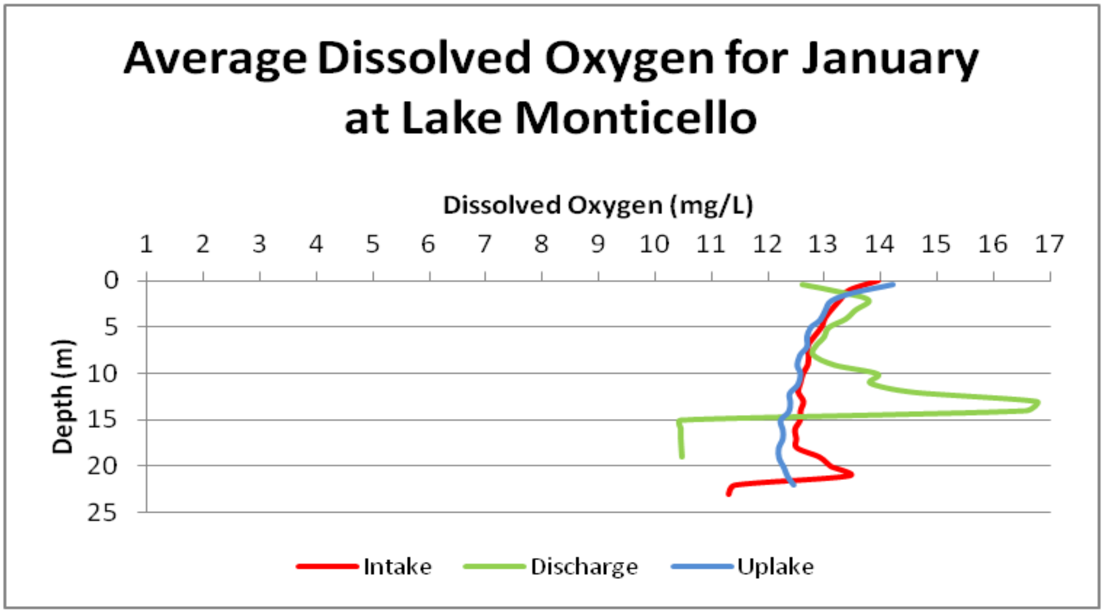


FIGURE 3-73 AVERAGE DISSOLVED OXYGEN FOR JANUARY ON MONTICELLO RESERVOIR

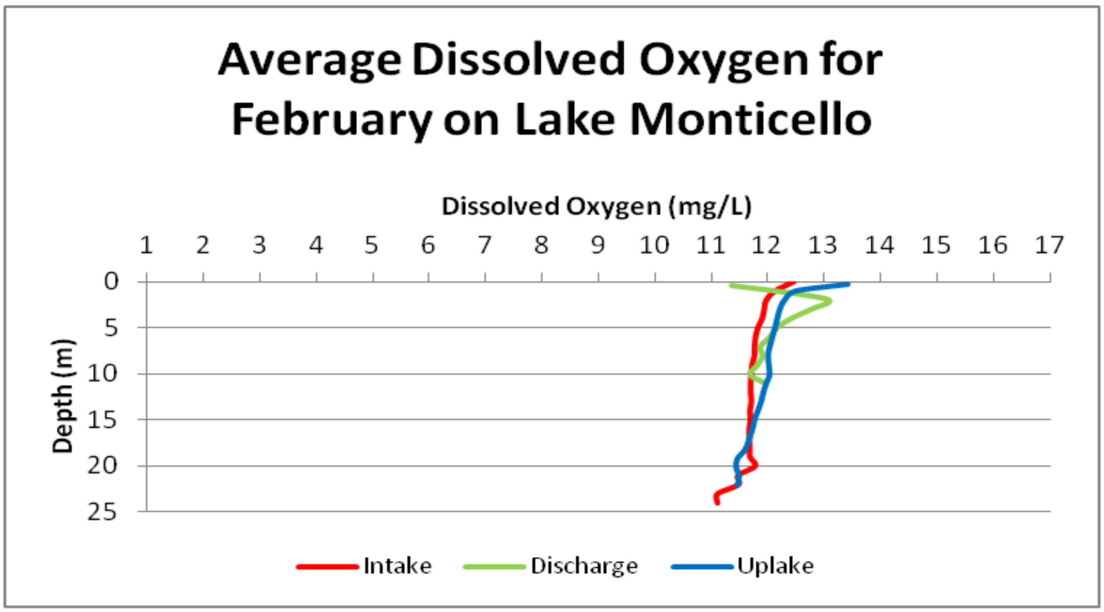


FIGURE 3-74 AVERAGE DISSOLVED OXYGEN FOR FEBRUARY ON MONTICELLO RESERVOIR

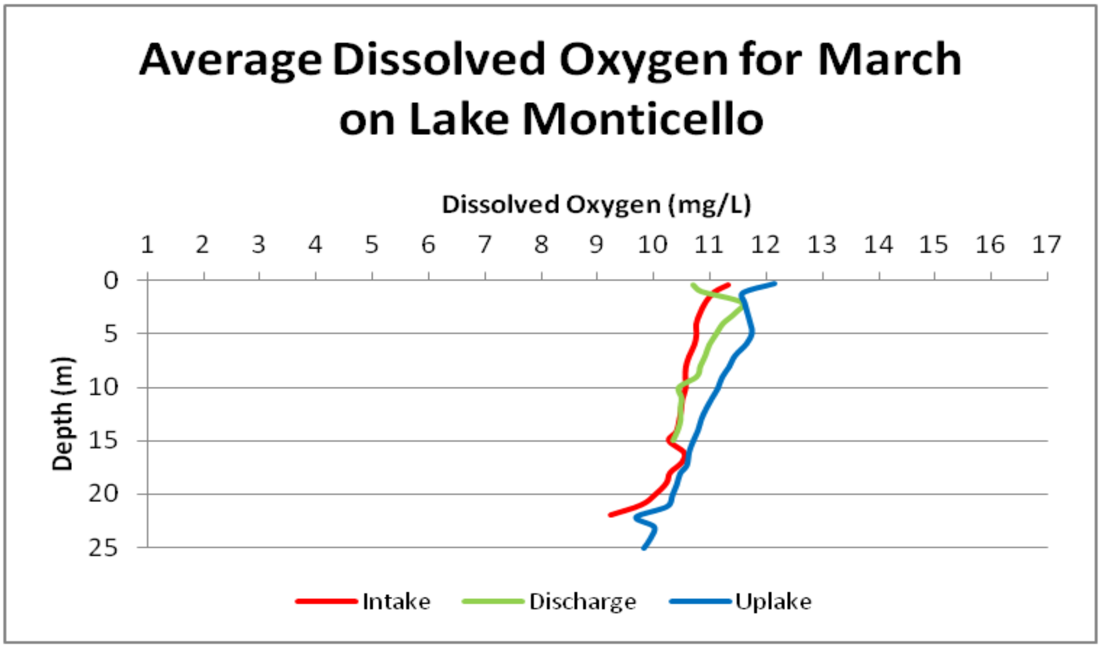


FIGURE 3-75 AVERAGE DISSOLVED OXYGEN FOR MARCH ON MONTICELLO RESERVOIR

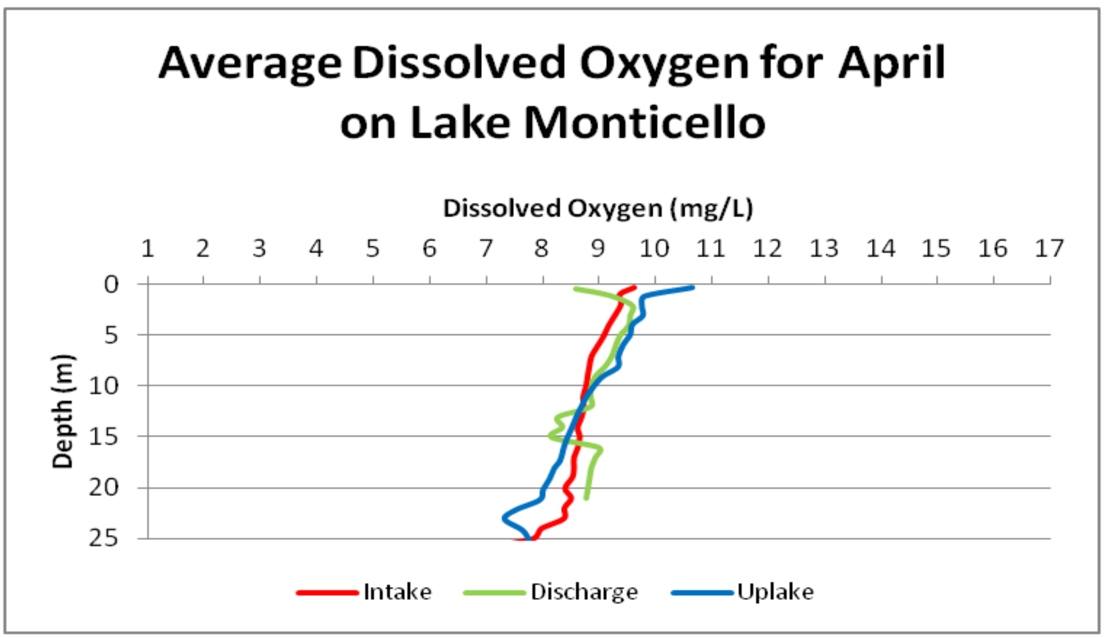


FIGURE 3-76 AVERAGE DISSOLVED OXYGEN FOR APRIL ON MONTICELLO RESERVOIR

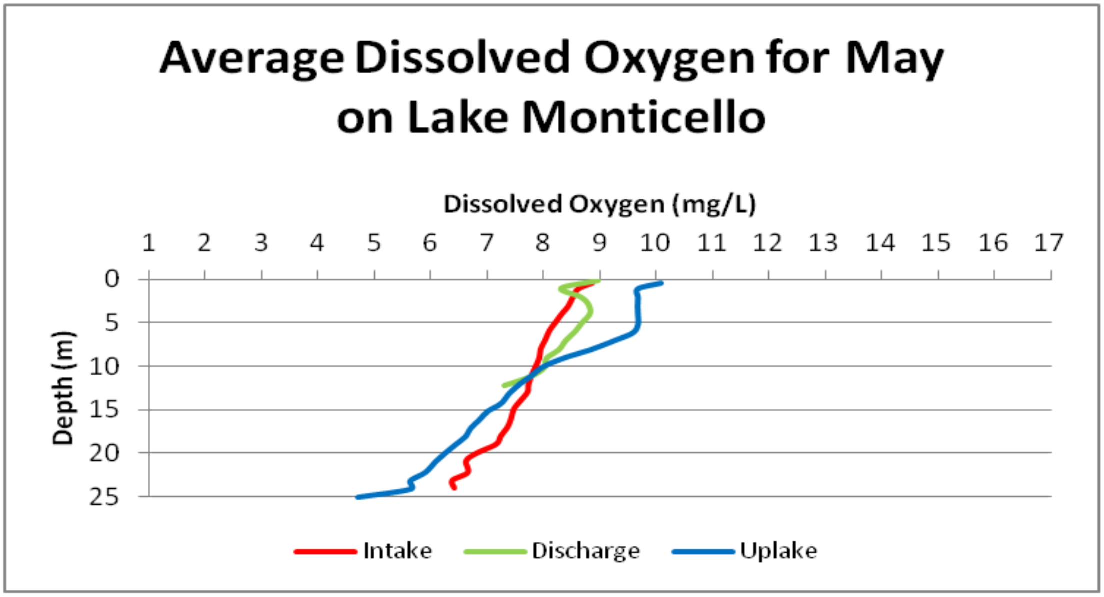


FIGURE 3-77 AVERAGE DISSOLVED OXYGEN FOR MAY ON MONTICELLO RESERVOIR

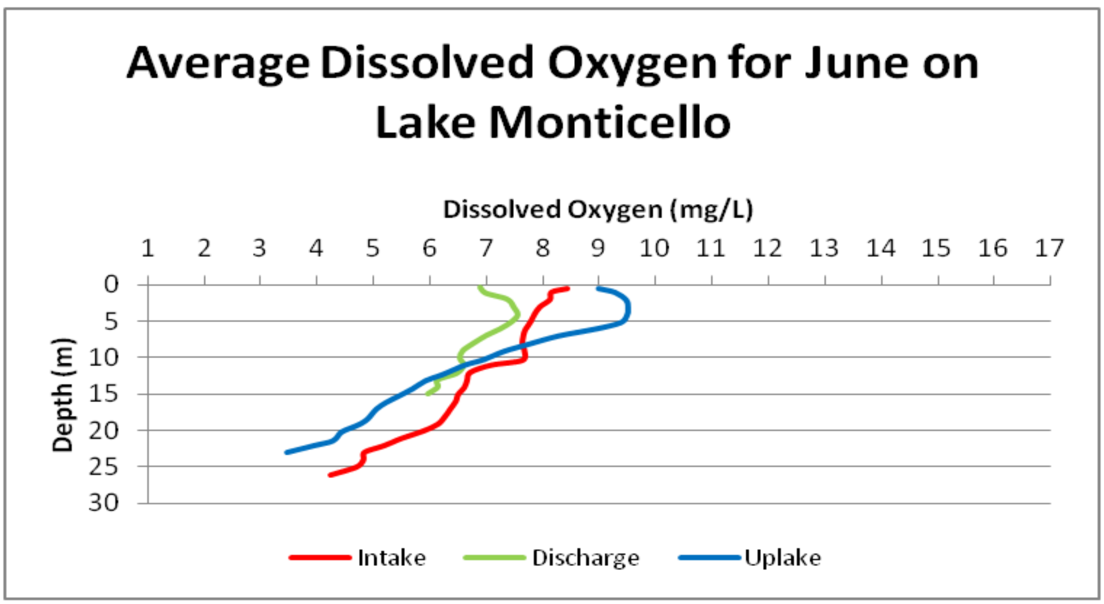


FIGURE 3-78 AVERAGE DISSOLVED OXYGEN FOR JUNE ON MONTICELLO RESERVOIR

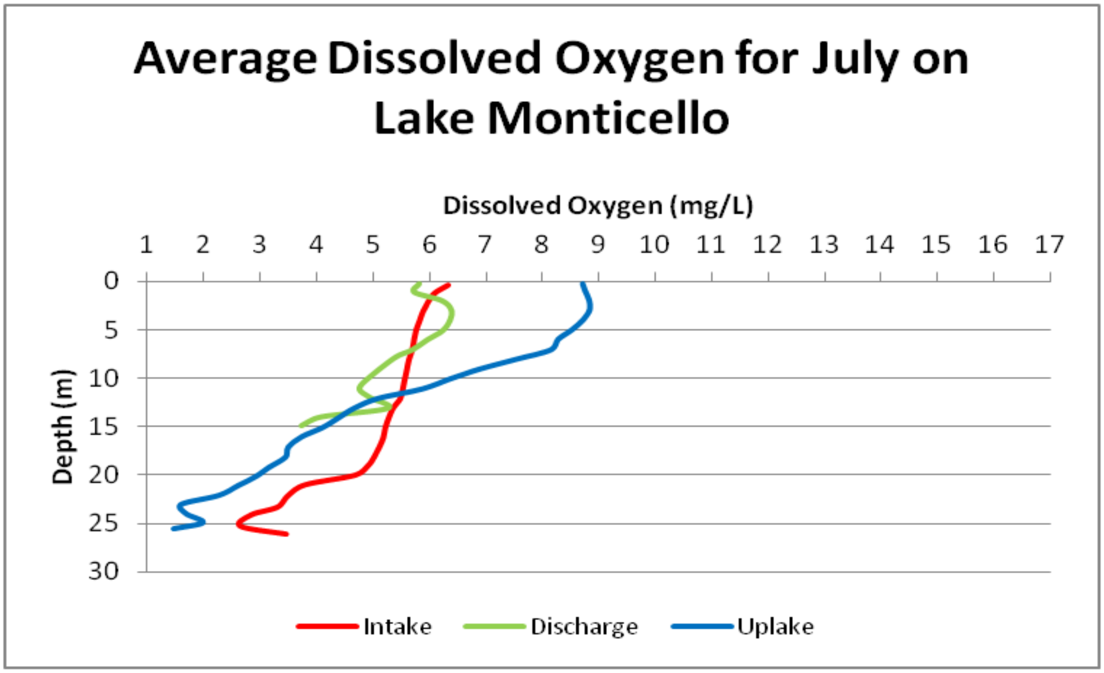


FIGURE 3-79 AVERAGE DISSOLVED OXYGEN FOR JULY ON MONTICELLO RESERVOIR

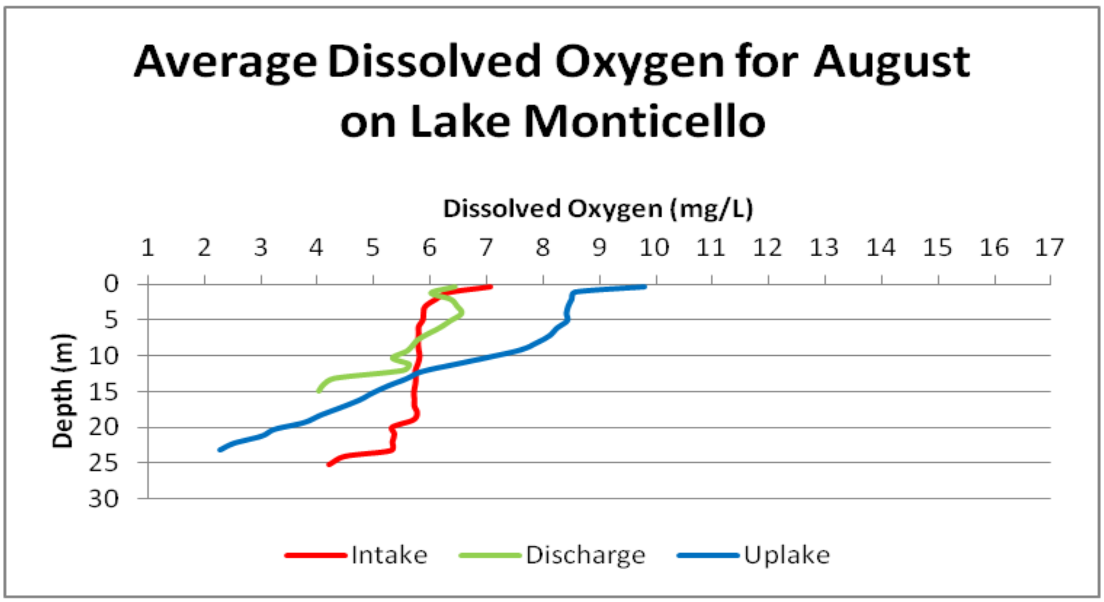


FIGURE 3-80 AVERAGE DISSOLVED OXYGEN FOR AUGUST ON MONTICELLO RESERVOIR

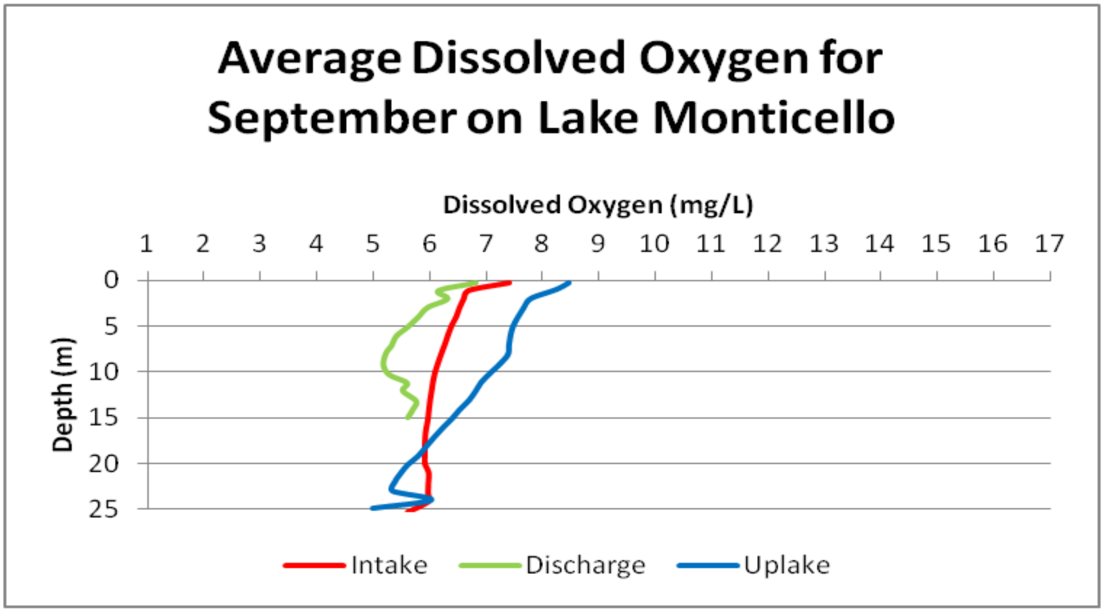


FIGURE 3-81 AVERAGE DISSOLVED OXYGEN FOR SEPTEMBER ON MONTICELLO RESERVOIR

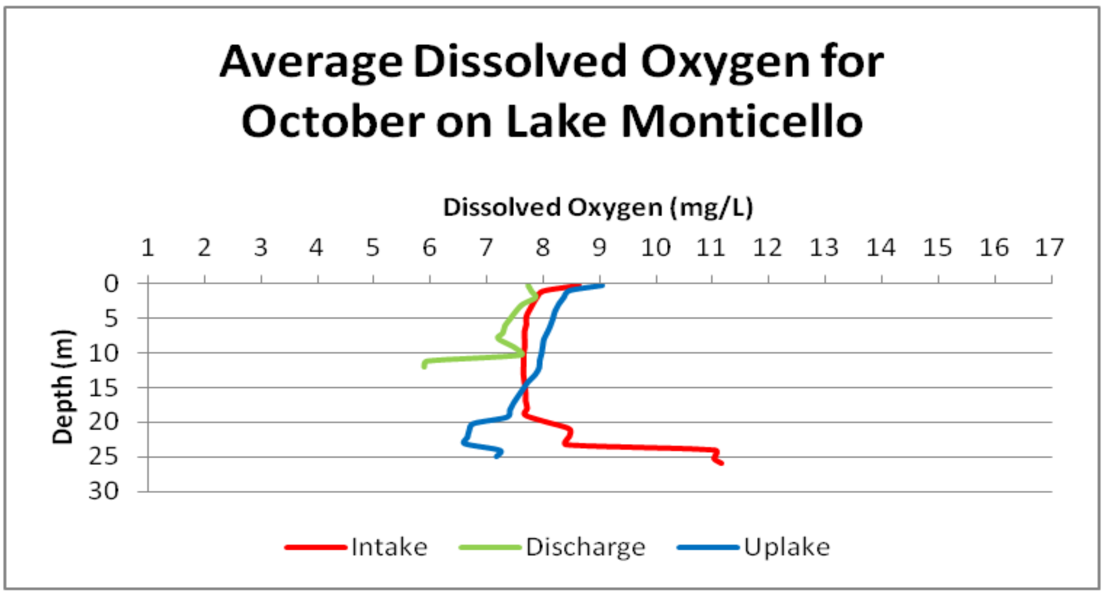


FIGURE 3-82 AVERAGE DISSOLVED OXYGEN FOR OCTOBER ON MONTICELLO RESERVOIR

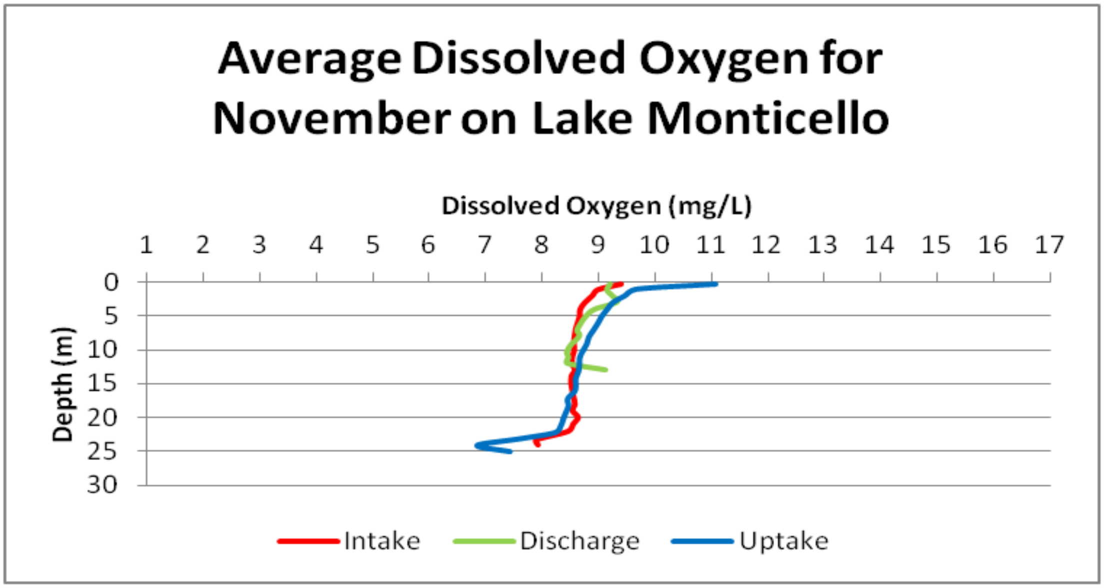


FIGURE 3-83 **AVERAGE DISSOLVED OXYGEN FOR NOVEMBER ON MONTICELLO RESERVOIR**

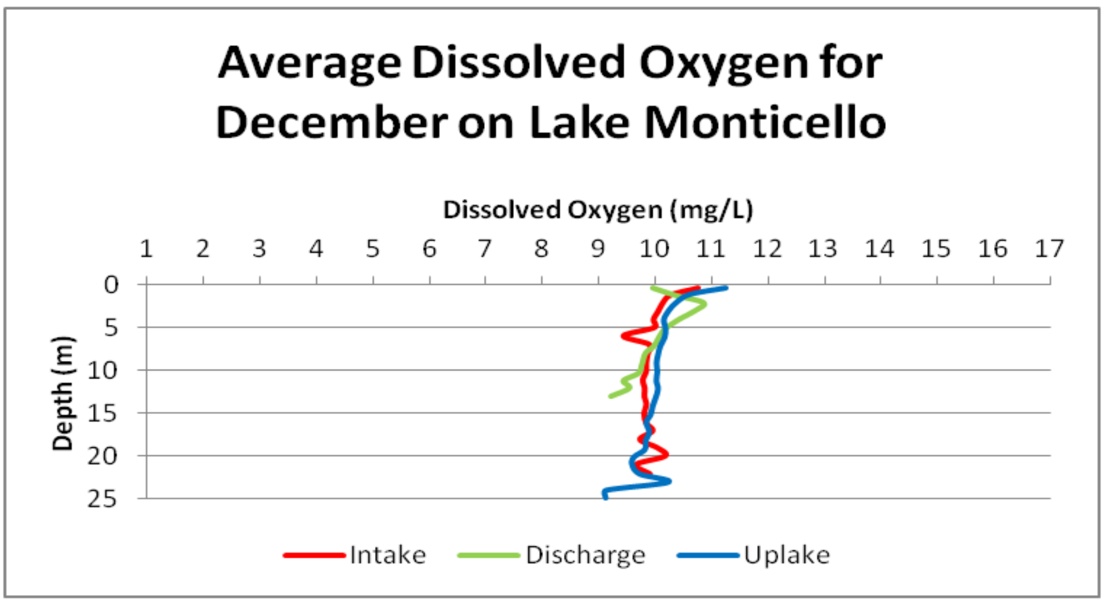


FIGURE 3-84 **AVERAGE DISSOLVED OXYGEN FOR DECEMBER ON MONTICELLO RESERVOIR**

3.2.1.3 SPECIFIC CONDUCTIVITY

Specific conductivity values depicted in the graphs below are an average of ten years of monthly readings collected by SCANA personnel, beginning in January of 2003 to December 2012. The data corresponding to the "intake" refers to that collected at the monitoring site located in the channel near the circulating water intake for the VCSNS. The data corresponding to the "discharge" refers to that collected at the monitoring site located just outside the northern end of the circulating water discharge canal for VCSNS. The data corresponding to the "uplake" refers to that collected at the monitoring site located near the northern end of the reservoir.

Specific conductivity of Monticello Reservoir typically ranges from 80.0 to 120.0 µS/cm at all monitoring sites, at all depths of the reservoir.

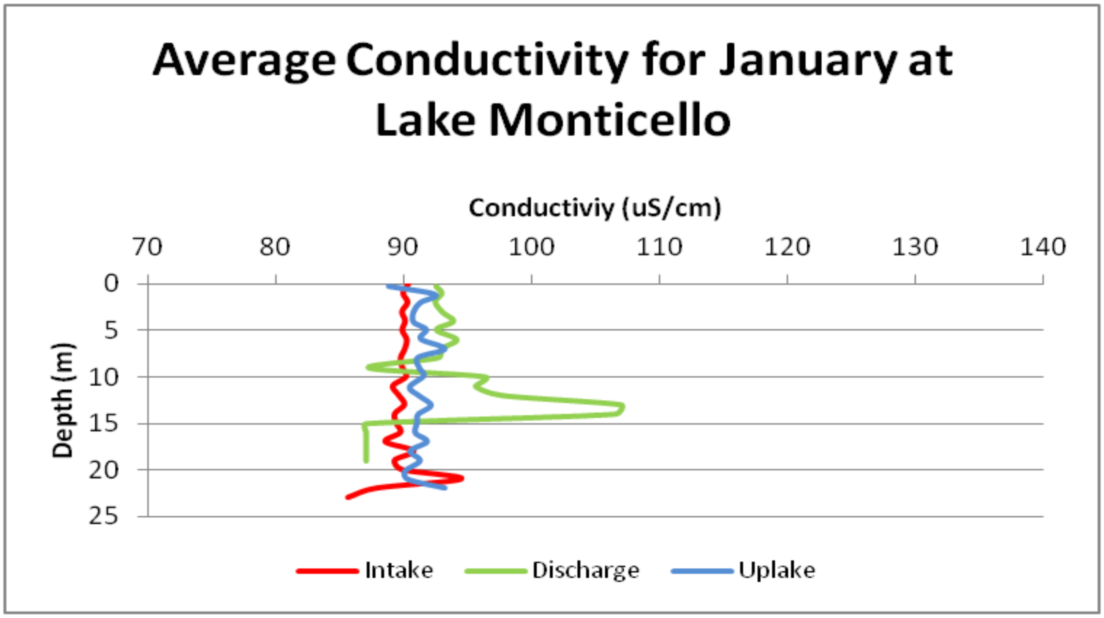


FIGURE 3-85 AVERAGE CONDUCTIVITY FOR JANUARY ON MONTICELLO RESERVOIR

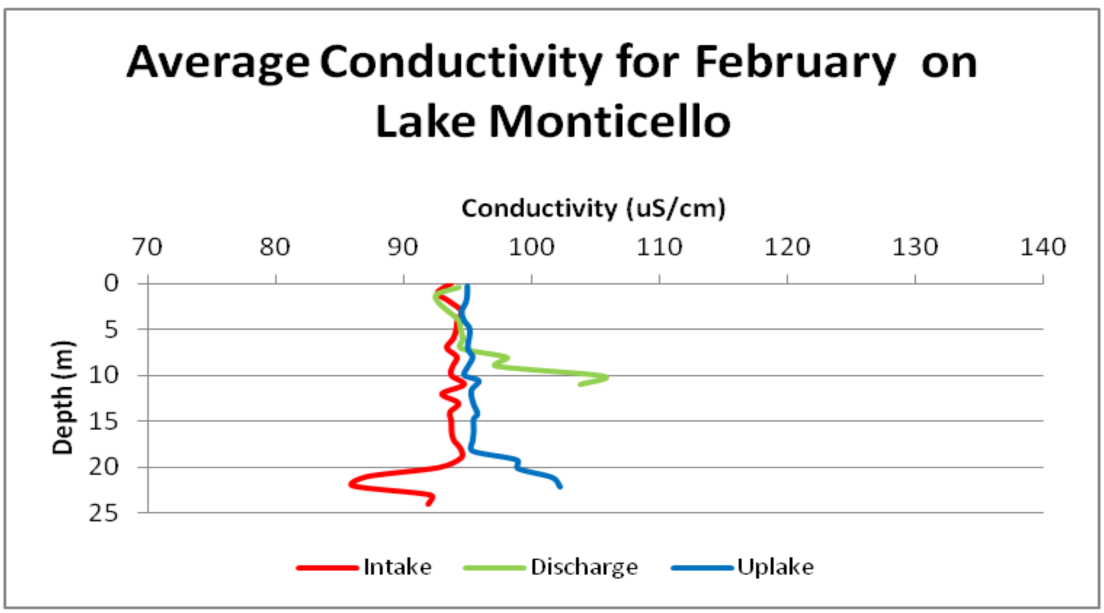


FIGURE 3-86 AVERAGE CONDUCTIVITY FOR FEBRUARY ON MONTICELLO RESERVOIR

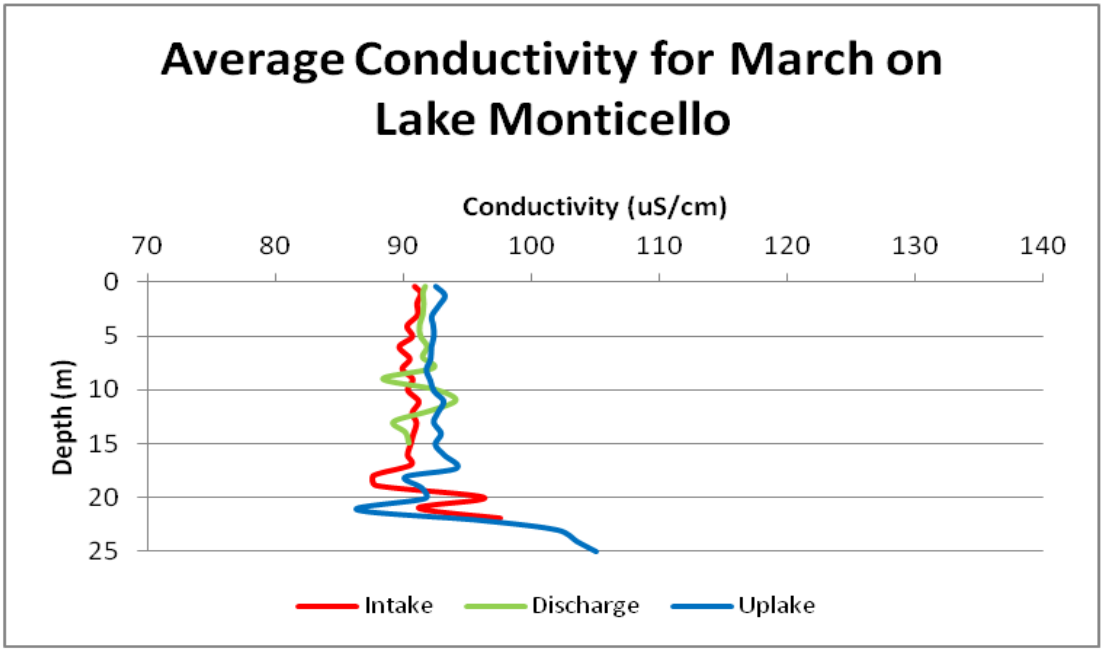


FIGURE 3-87 AVERAGE CONDUCTIVITY FOR MARCH ON MONTICELLO RESERVOIR

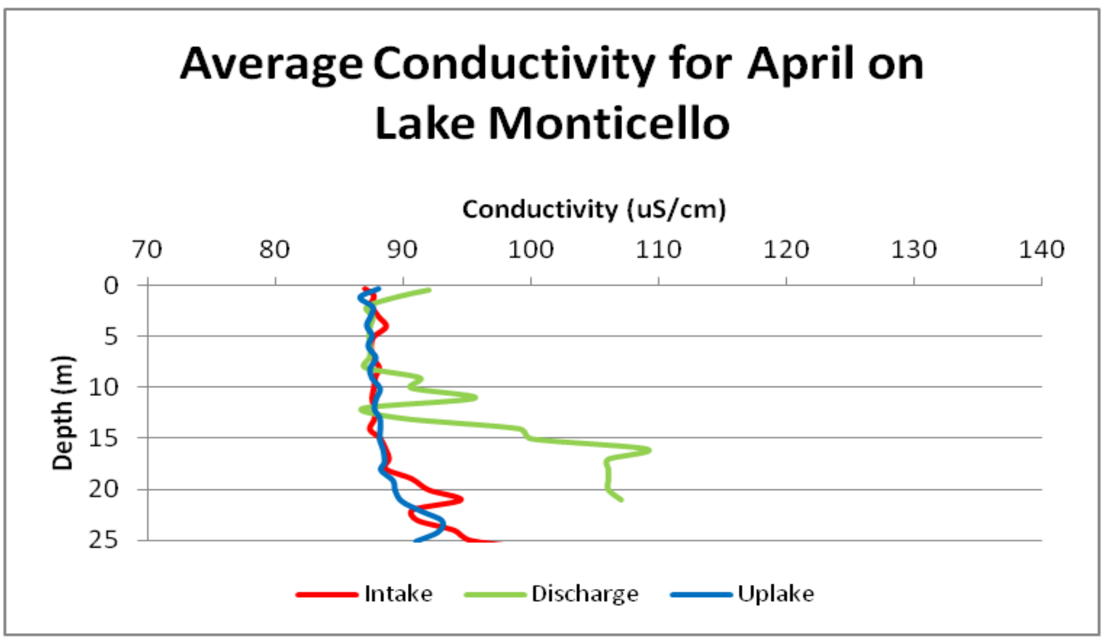


FIGURE 3-88 AVERAGE CONDUCTIVITY FOR APRIL ON MONTICELLO RESERVOIR

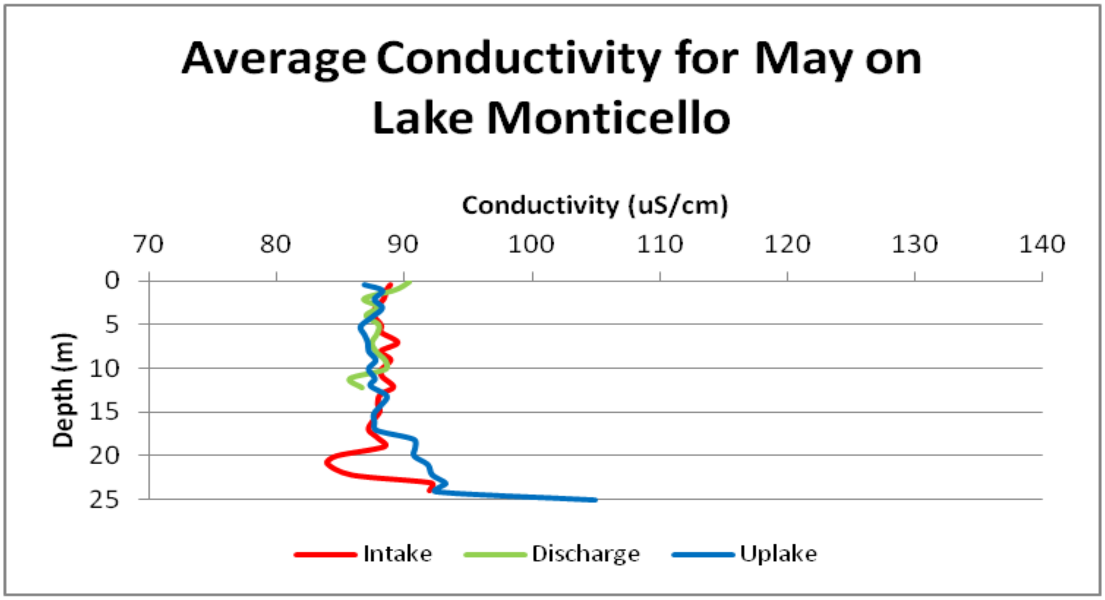


FIGURE 3-89 AVERAGE CONDUCTIVITY FOR MAY ON MONTICELLO RESERVOIR

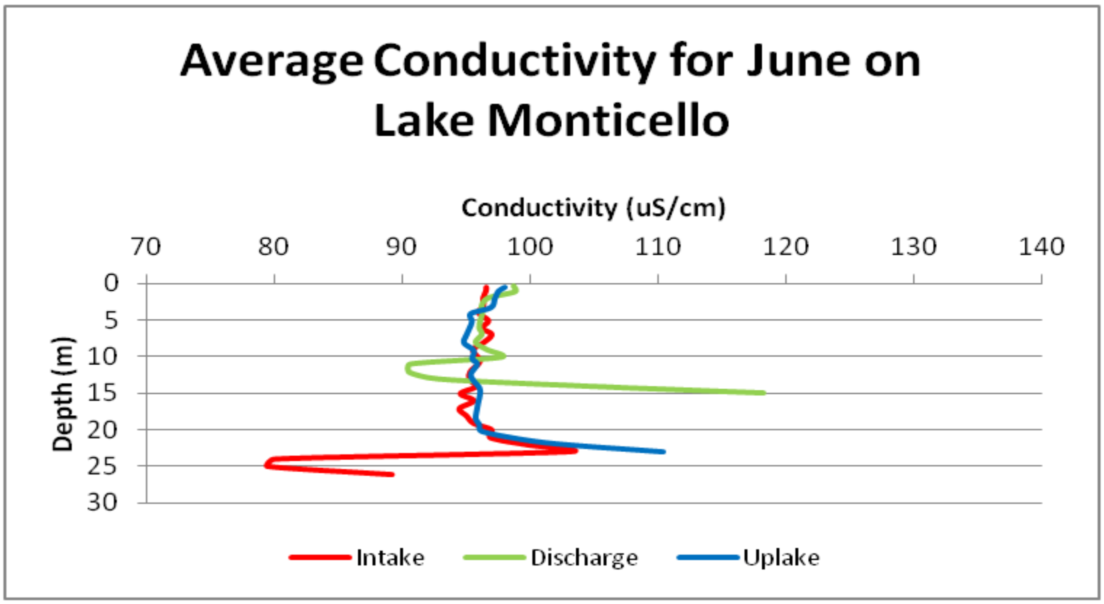


FIGURE 3-90 AVERAGE CONDUCTIVITY FOR JUNE ON MONTICELLO RESERVOIR

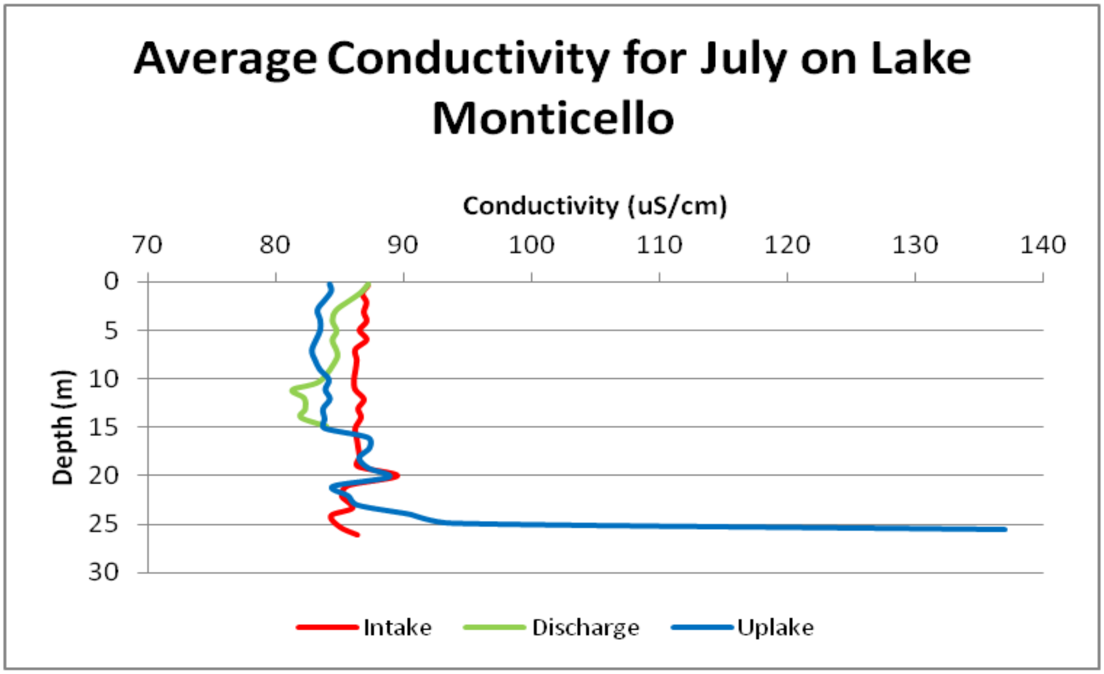


FIGURE 3-91 AVERAGE CONDUCTIVITY FOR JULY ON MONTICELLO RESERVOIR

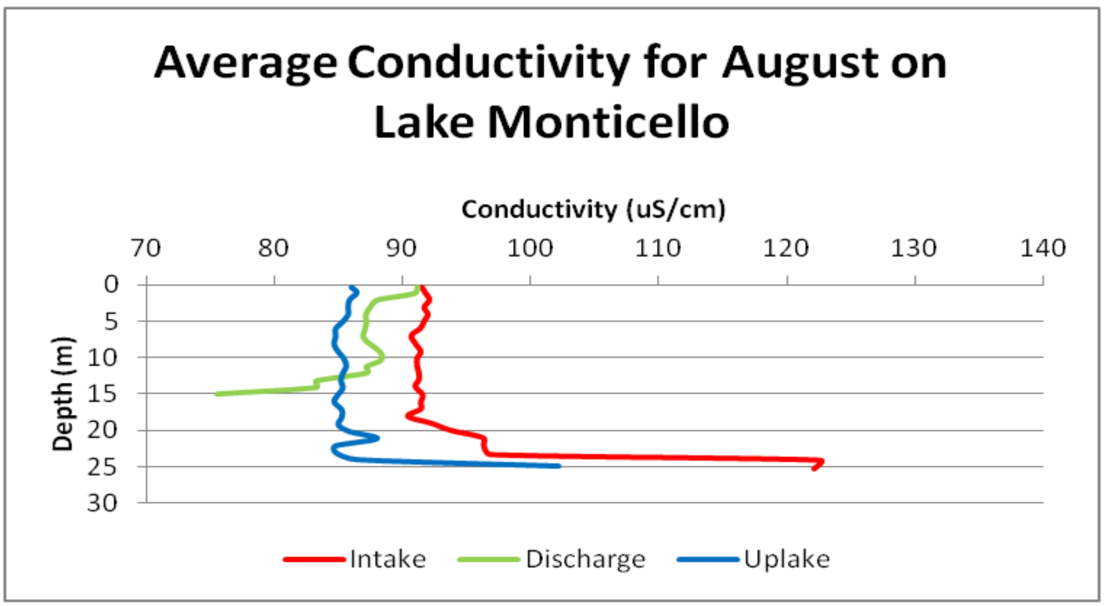


FIGURE 3-92 AVERAGE CONDUCTIVITY FOR AUGUST ON MONTICELLO RESERVOIR

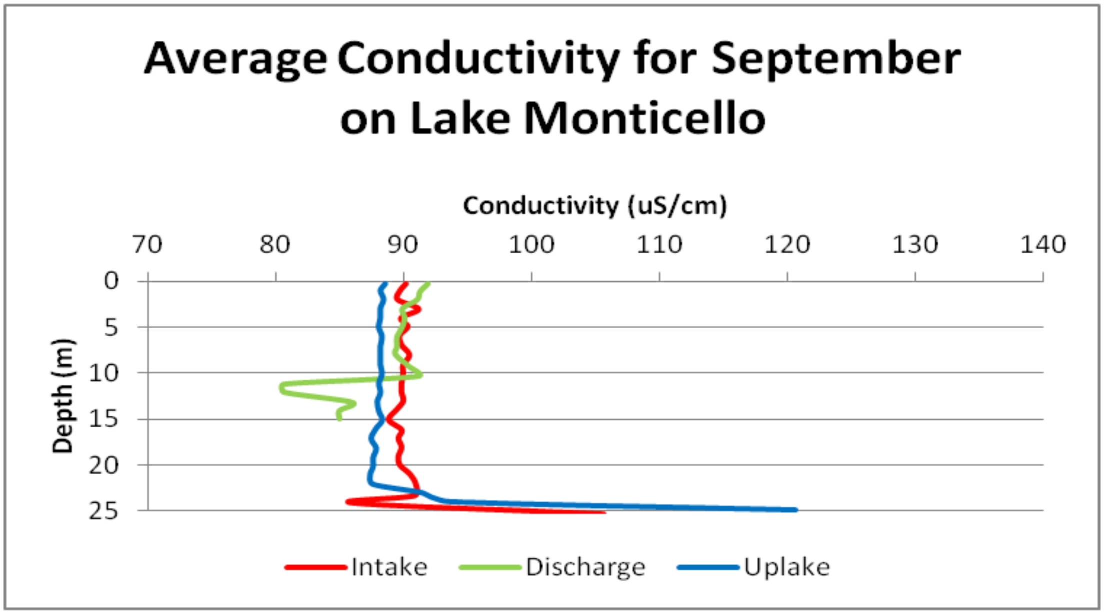


FIGURE 3-93 AVERAGE CONDUCTIVITY FOR SEPTEMBER ON MONTICELLO RESERVOIR

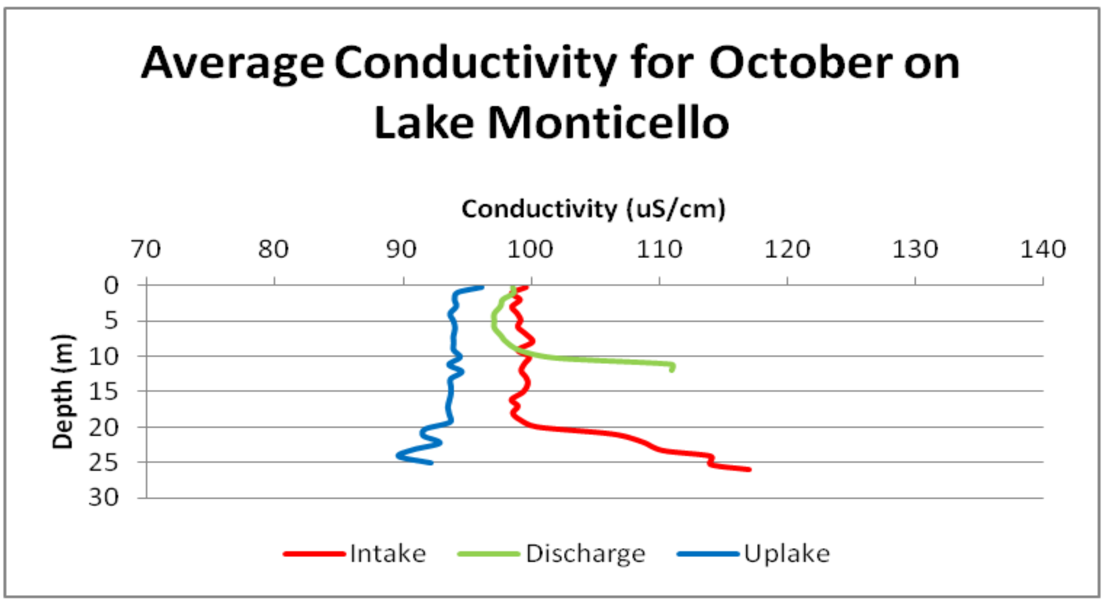


FIGURE 3-94 AVERAGE CONDUCTIVITY FOR OCTOBER ON MONTICELLO RESERVOIR

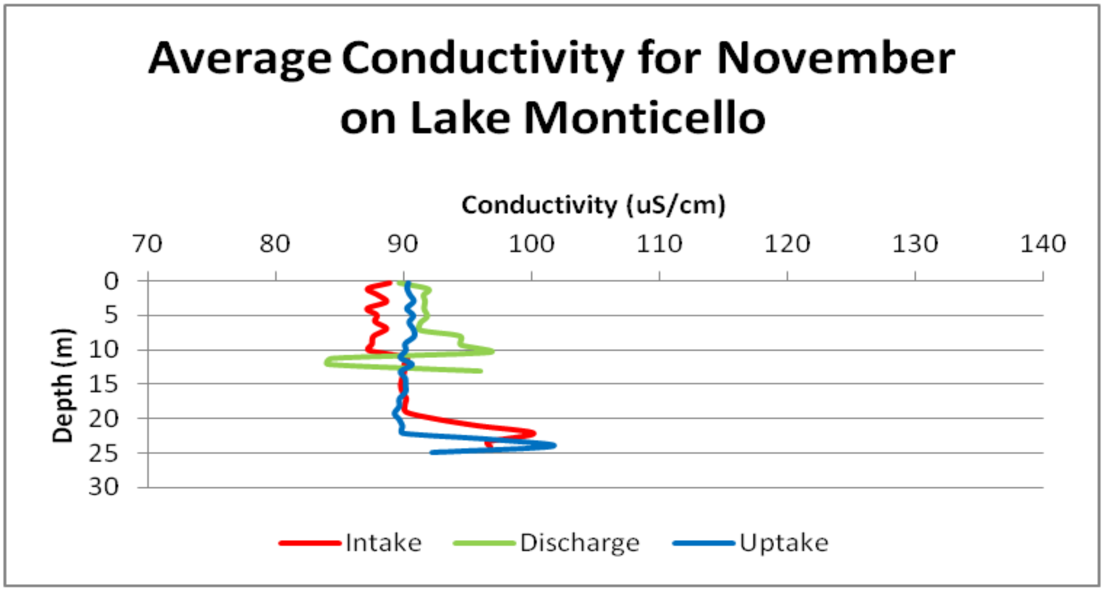


FIGURE 3-95 AVERAGE CONDUCTIVITY FOR NOVEMBER ON MONTICELLO RESERVOIR

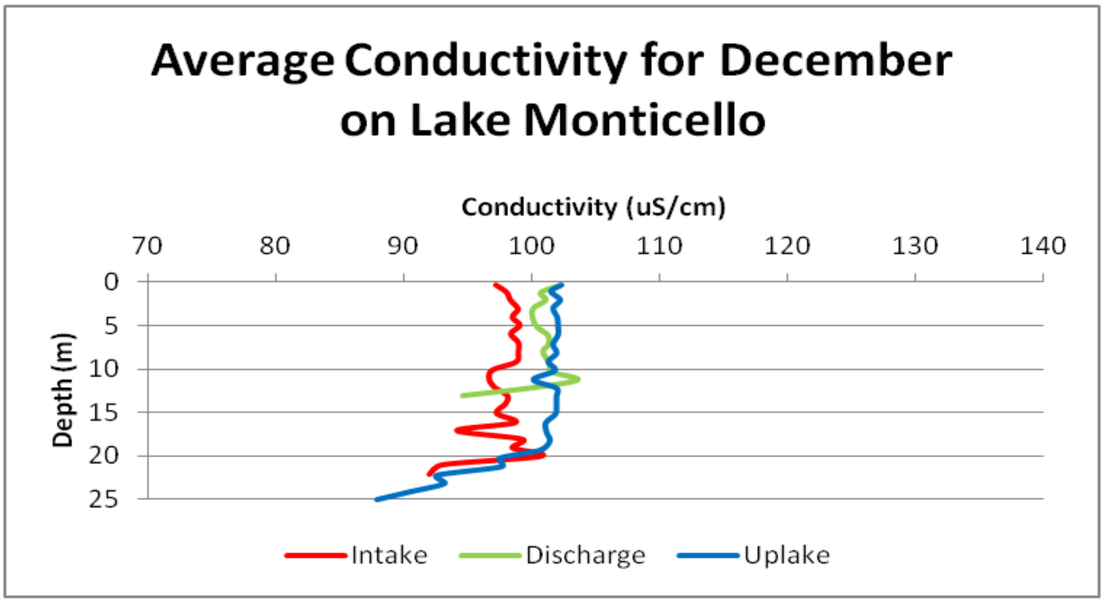


FIGURE 3-96 AVERAGE CONDUCTIVITY FOR DECEMBER ON MONTICELLO RESERVOIR

3.2.1.4 pH

pH values depicted in the graphs below are an average of ten years of monthly readings collected by SCANA personnel, beginning in January of 2003 to December 2012. The data corresponding to the "intake" refers to that collected at the monitoring site located in the channel near the circulating water intake for the VCSNS. The data corresponding to the "discharge" refers to that collected at the monitoring site located just outside the northern end of the circulating water discharge canal for VCSNS. The data corresponding to the "uplake" refers to that collected at the monitoring site located near the northern end of the reservoir.

The pH values at the monitoring sites near the intake and discharge of the VCSNS are consistently around 7.5, with the full range extending from 6.8 to 8.0. The pH at the uplake location is slightly more alkaline, with pH values being just a bit higher than those on the southern end of Monticello Reservoir. Generally, throughout the lake, the pH decreases as the depth of the reservoir increases.

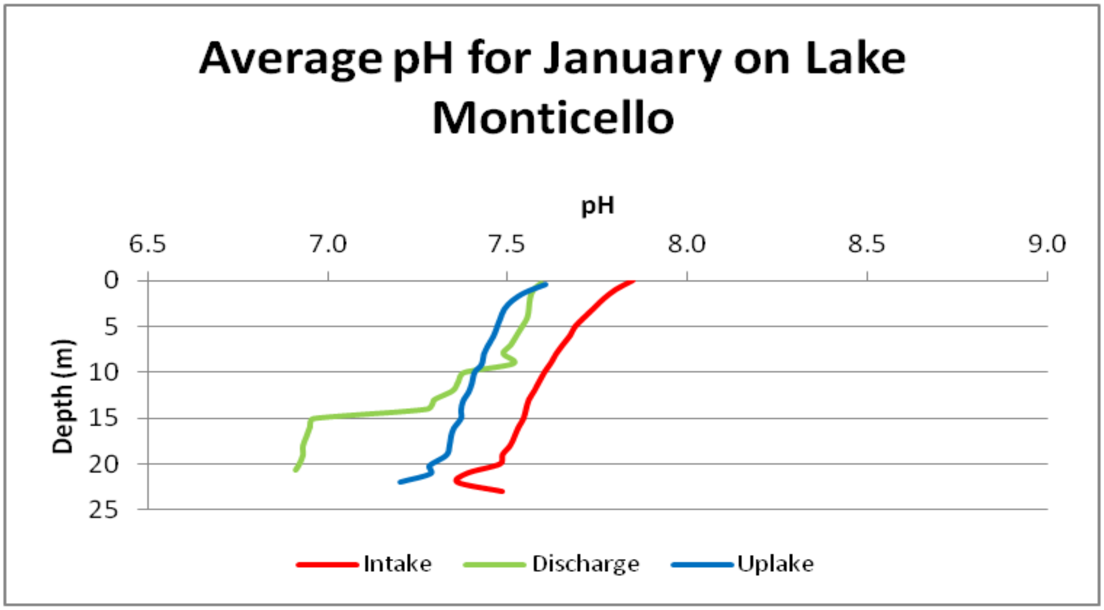


FIGURE 3-97 AVERAGE PH FOR JANUARY ON MONTICELLO RESERVOIR

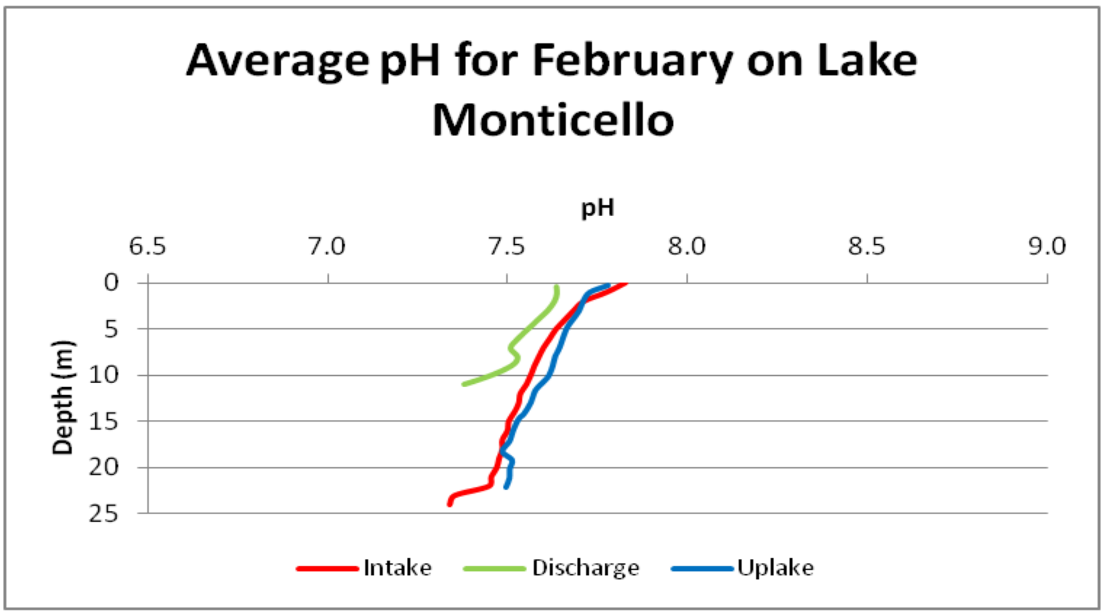


FIGURE 3-98 AVERAGE PH FOR FEBRUARY ON MONTICELLO RESERVOIR

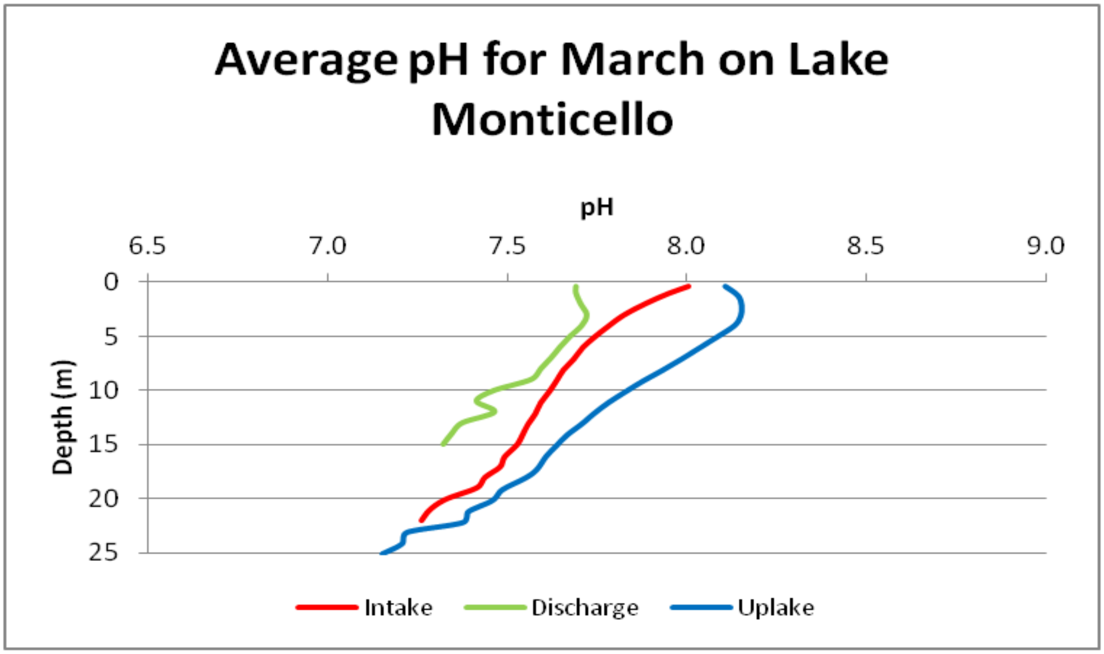


FIGURE 3-99 AVERAGE PH FOR MARCH ON MONTICELLO RESERVOIR

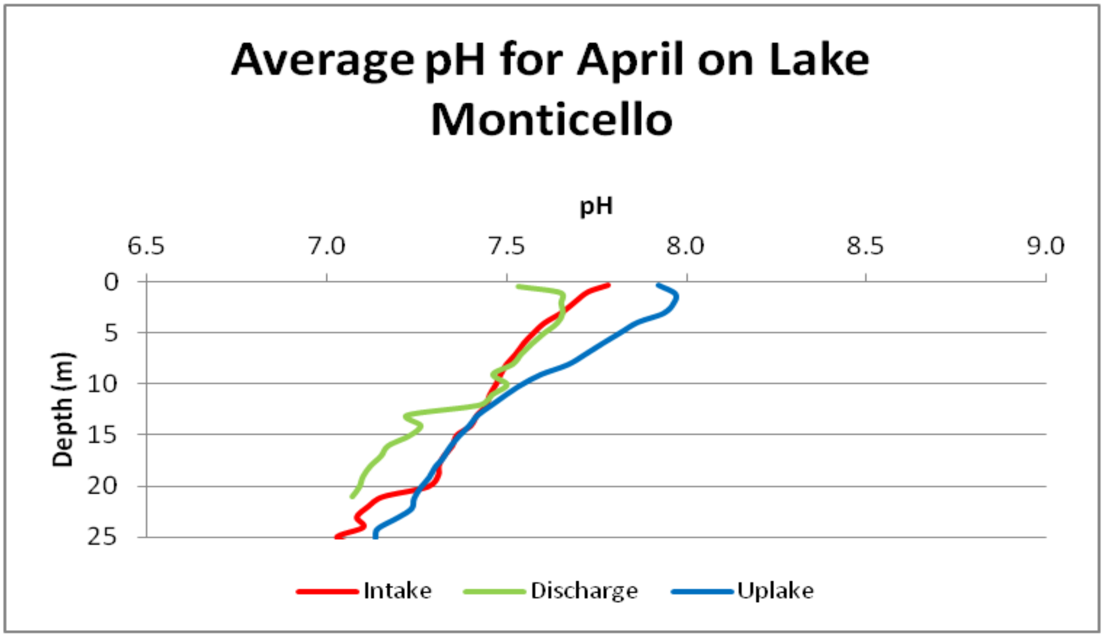


FIGURE 3-100 AVERAGE PH FOR APRIL ON MONTICELLO RESERVOIR

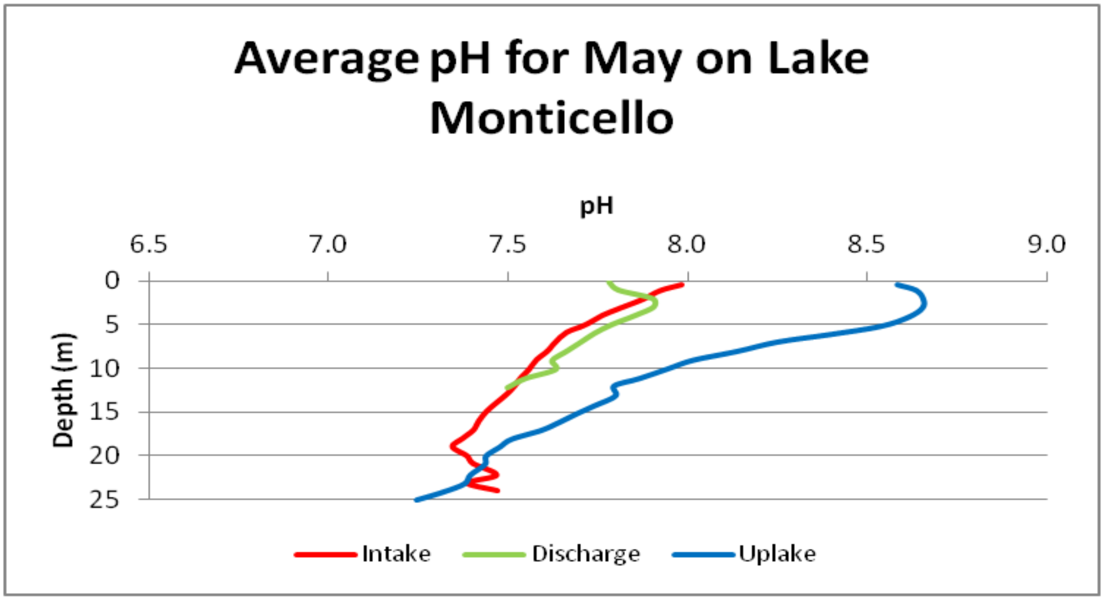


FIGURE 3-101 AVERAGE PH FOR MAY ON MONTICELLO RESERVOIR

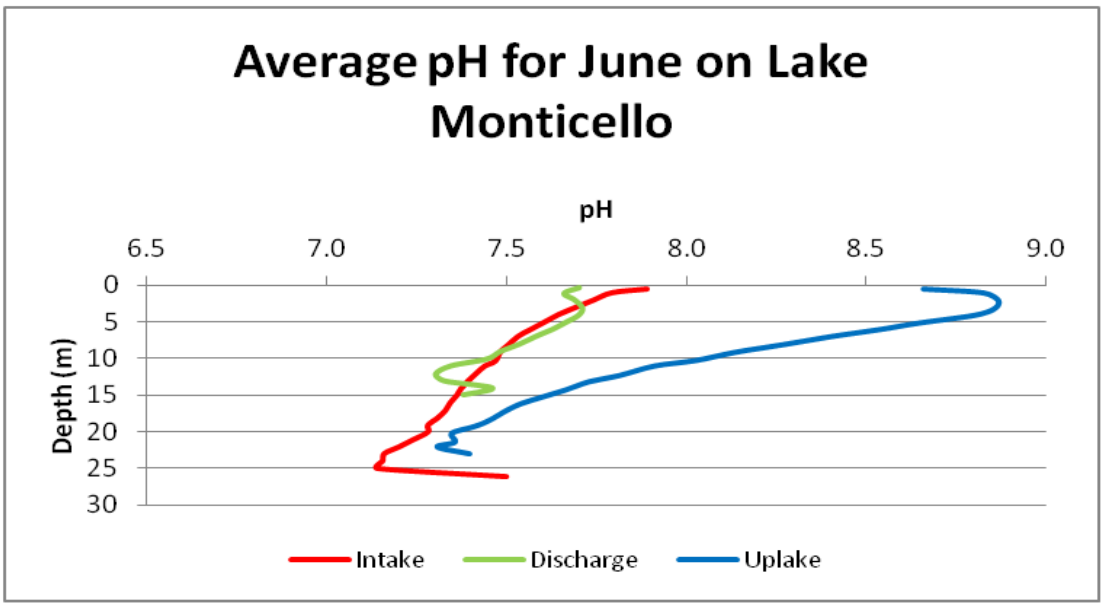


FIGURE 3-102 AVERAGE PH FOR JUNE ON MONTICELLO RESERVOIR

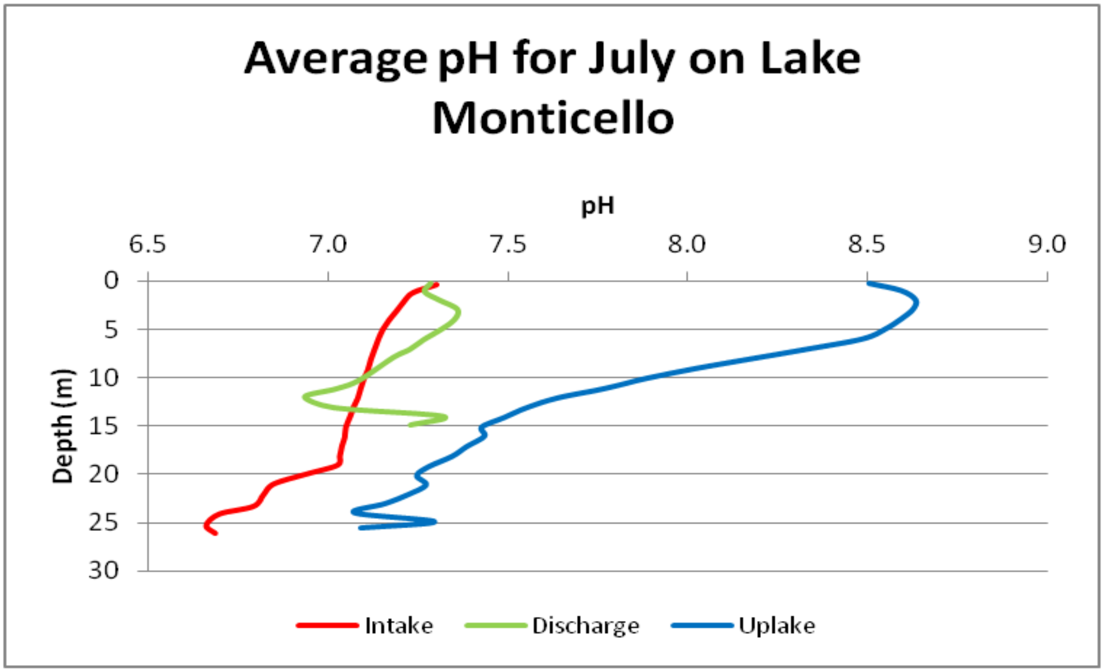


FIGURE 3-103 AVERAGE PH FOR JULY ON MONTICELLO RESERVOIR

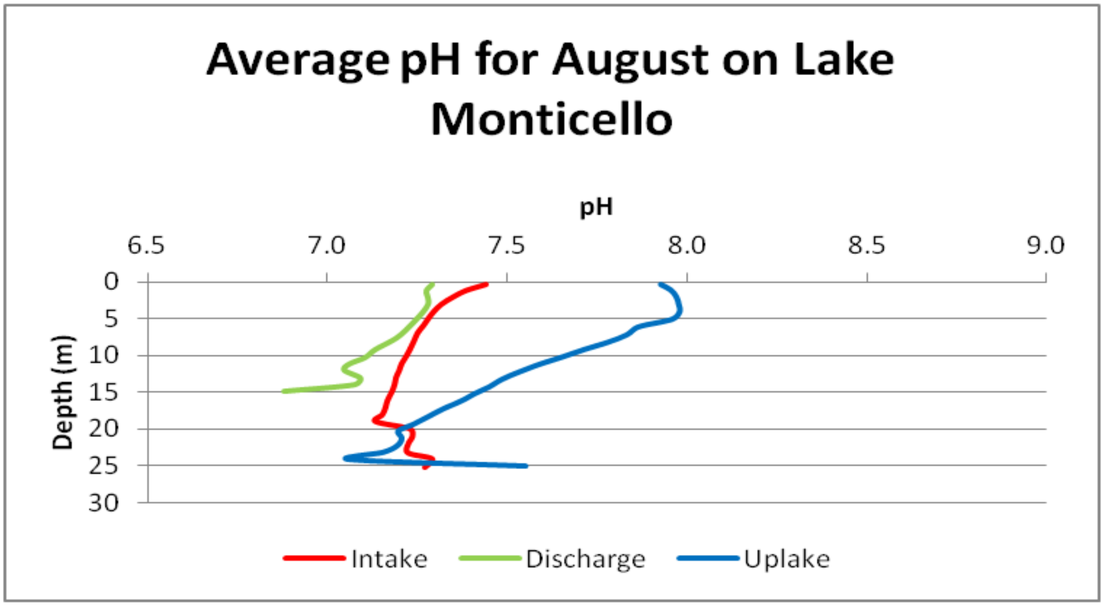


FIGURE 3-104 AVERAGE PH FOR AUGUST ON MONTICELLO RESERVOIR

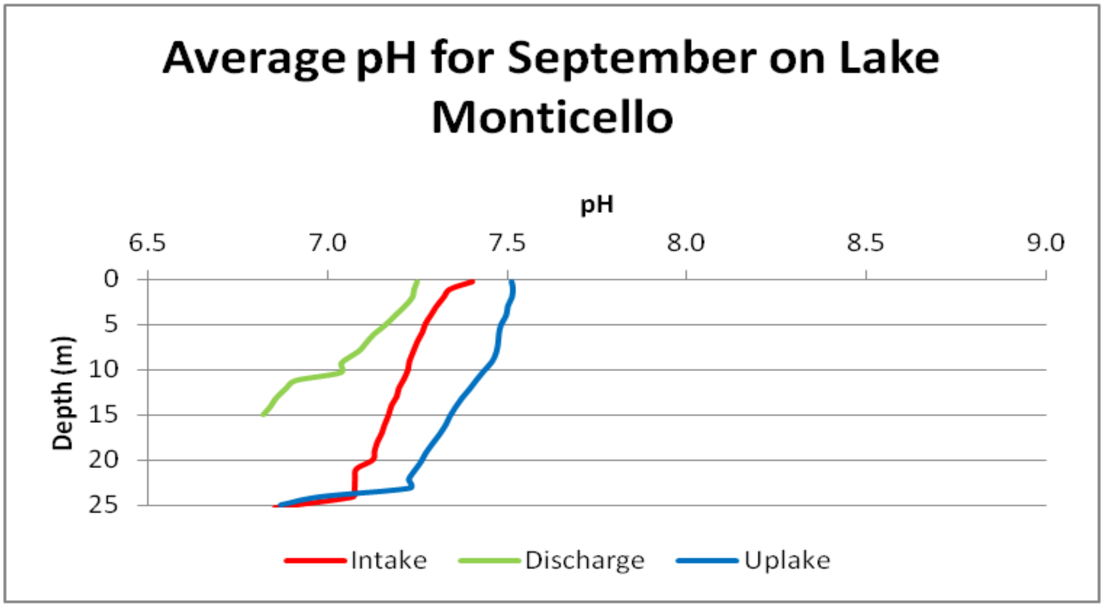


FIGURE 3-105 AVERAGE PH FOR SEPTEMBER ON MONTICELLO RESERVOIR

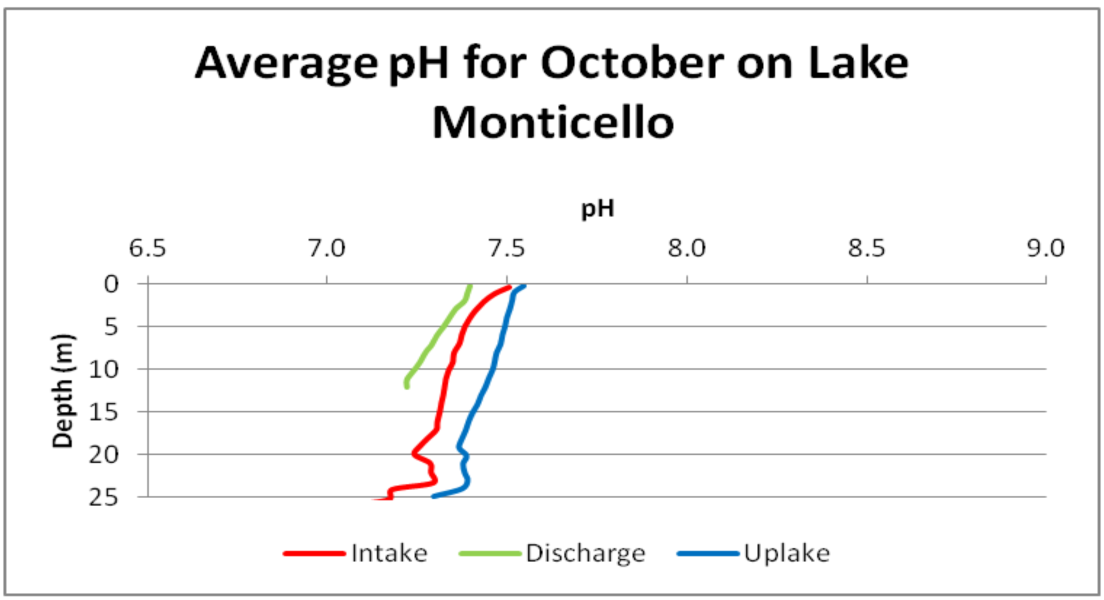


FIGURE 3-106 AVERAGE PH FOR OCTOBER ON MONTICELLO RESERVOIR

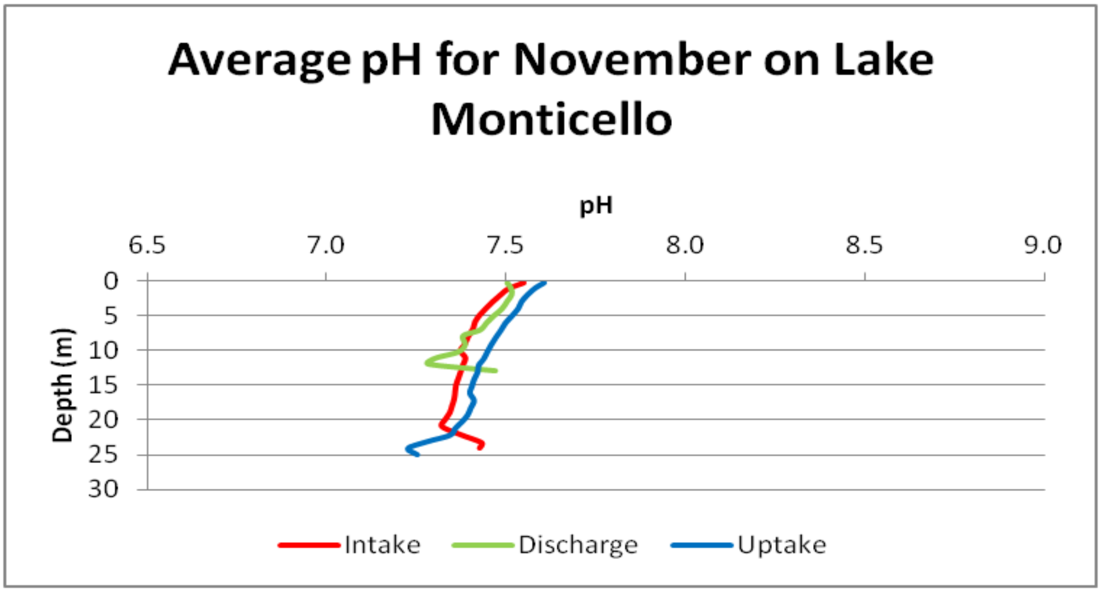


FIGURE 3-107 AVERAGE PH FOR NOVEMBER ON MONTICELLO RESERVOIR

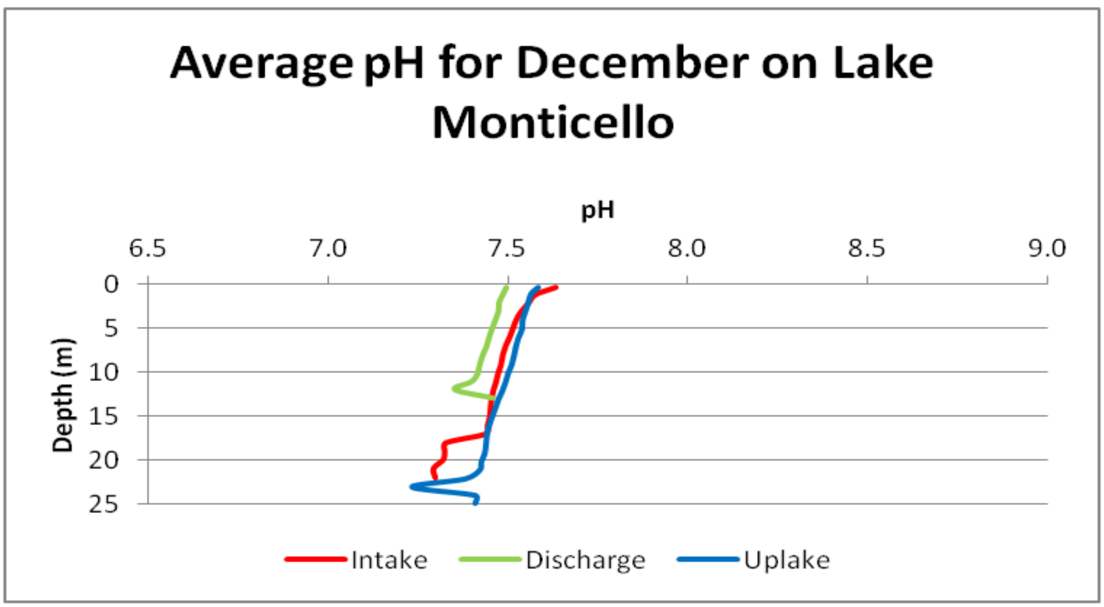


FIGURE 3-108 AVERAGE PH FOR DECEMBER ON MONTICELLO RESERVOIR

3.2.1.5 SUMMARY

Vertical profile data was collected on a monthly basis at three sites in Monticello Reservoir, beginning in 2003. Table 3-11 displays the maximum, minimum and mean temperature, DO, conductivity, and pH values on Monticello Reservoir for each collection year at each collection location. The data presented below was collected at a depth of 2 meters.

TABLE 3-11 SUMMARY TABLE FOR MONTICELLO RESERVOIR

		INTAKE					DISCHARGE					UPLAKE			
		Temp	SpCond	DO Conc	pH		Temp	SpCond	DO Conc	pH		Temp	SpCond	DO Conc	pH
		C	uS/cm	mg/L			C	uS/cm	mg/L			C	uS/cm	mg/L	
2003	MAX	26.73	126	13.39	8.65		28.77	132	12.96	8.22		29.95	140	13.98	9.31
	MIN	8.62	98	7.13	6.97		11.48	102	7.17	6.96		10.38	102	9.60	7.38
	AVG	18.47	110	9.60	7.54		20.52	113	9.92	7.51		20.30	115	11.41	8.31
2004	MAX	29.01	129	14.28	8.09		29.27	120	14.59	7.96		29.89	129	14.07	9.06
	MIN	6.50	68	4.70	7.02		9.46	67	5.13	6.95		6.76	67	7.53	7.19
	AVG	17.12	100	9.06	7.65		18.22	97	11.19	7.57		18.53	99	11.72	8.11
2005	MAX	28.49	78	12.34	7.80		31.29	96	14.01	7.82		31.52	77	12.79	8.80
	MIN	9.64	63	5.30	6.68		10.46	63	5.28	7.02		10.72	60	7.72	6.91
	AVG	19.92	71	8.32	7.33		21.43	73	8.76	7.41		20.79	69	9.83	7.73
2006	MAX	28.98	101	12.09	8.16		29.51	102	13.08	7.93		30.69	101	12.16	8.97
	MIN	10.88	73	4.84	7.08		10.55	73	5.10	7.12		11.61	68	7.45	7.37
	AVG	19.04	85	8.62	7.52		19.60	84	9.36	7.53		20.26	84	9.59	7.98
2007	MAX	29.96	147	11.21	8.28		31.67	129	11.85	8.20		30.41	126	11.82	9.19
	MIN	9.52	78	5.45	7.35		13.29	79	5.32	7.33		10.52	80	6.62	7.39
	AVG	20.61	98	8.06	7.71		23.02	100	8.57	7.60		21.79	95	9.41	8.03
2008	MAX	27.90	166	11.55	8.11		28.44	169	12.49	7.70		28.28	169	12.51	9.28
	MIN	10.44	99	5.96	7.16		11.19	98	5.30	7.11		10.48	98	5.56	7.08
	AVG	19.32	118	8.55	7.54		20.14	119	9.12	7.48		19.66	119	9.75	7.83
2009	MAX	29.33	101	11.68	8.16		29.67	103	13.01	7.86		30.33	105	11.73	8.79
	MIN	10.18	66	5.64	7.31		10.88	66	5.61	7.27		11.57	66	6.85	7.31
	AVG	19.67	86	8.65	7.70		21.31	87	9.07	7.55		20.56	86	9.57	7.86
2010	MAX	30.50	85	16.31	8.32		31.53	85	15.35	7.95		32.13	88	14.27	8.71
	MIN	8.90	58	5.83	7.53		8.53	57	5.81	7.38		8.81	58	7.99	7.66
	AVG	20.52	74	9.93	7.91		21.93	74	9.57	7.67		21.98	75	10.00	8.10
2011	MAX	29.76	101	12.49	8.14		32.61	101	13.56	8.55		30.67	101	12.25	8.90
	MIN	9.00	75	4.98	7.09		9.14	73	5.03	7.03		8.91	75	5.82	7.12
	AVG	20.88	91	8.50	7.46		23.09	89	8.86	7.61		21.44	89	9.06	7.84
2012	MAX	28.74	100	11.73	8.52		30.29	101	12.15	7.81		30.57	98	12.75	9.01
	MIN	11.85	83	4.48	6.58		12.42	80	4.57	6.98		12.23	81	5.31	7.13
	AVG	19.69	92	9.05	7.42		20.72	92	8.95	7.41		20.68	91	9.95	7.94

3.2.1.6

3.2.2 SCE&G METALS DATA

Monticello Reservoir water samples were analyzed for a variety of parameters, including metals, in 2007 and 2008 as part of the VCSNS expansion. Data was collected in the vicinity of the new nuclear intake site on Monticello Reservoir. All parameters analyzed, including metals, are displayed below.

TABLE 3-12 WATER QUALITY DATA AT NEW NUCLEAR INTAKE SITE ON MONTICELLO RESERVOIR

		New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello	New Intake Lake Monticello
Sample Date		6/26/2007	7/26/2007	8/28/2007	9/13/2007	10/28/2007	11/19/2007	12/11/2007	1/28/2008	2/21/2008	3/6/2008	4/24/2008
Analysis	**MDL /Units**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
Phosphorus	0.050 mg/l	0	0	0.06		0	0			0.11	0.14	0.08
Arsenic	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Barium	10.0 PPB	17	17	20	18	16	0	15	14	20	14	18
Cadmium	1.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Calcium	100.0 PPB	4035	3799	3609	3552	3536	3732	3887	4496	4751	4725	5218
Chromium	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Copper	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Iron	10.0 PPB	201	241	473	111	143	126	179	295	1400	208	509
Lead	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Magnesium	100 .0 PPB	1898	1925	2071	2107	2185	1940	2174	2141	2079	2004	2137
mercury (liquid)	0.4 PPB	0	0	0	0	0	0	0	0	0	0	0
Potassium	100.0 PPB	1889	2042	2536	2121	2244	2574	2395	2423	2165	2168	2007
Selenium	5.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Silver	10.0 PPB	0	0	0	0	0	0	0	0	0	0	0
Sodium	1000.0 PPB	9713	10510	14600	12750	14450	16120	16600	14750	12380	13410	11140
Total Hardness (calc)	0.0 mg/l	18	18	18	18	18	17	19	20	21	20	22
Chlorides	0.5 mg/l	7.3	8.4	10.7	10.1	10.8	10.9	11.5	10.9	10	10.3	8.3
Conductivity	0.05 umhos	88.9	95.33	105.9	105.2	112.8	108.7	130.9	107.2	104.7	119.9	94.4
Nitrate-N	0.11 mg/l as N	0.22	0.36	0.14	0.14	0.26	0.28	0.32	0.43	0.45	0.38	0.36
Othrophosphate	0.010 mg/l	0	0	0.023	0	0.02	0.026	0.045	0.05	0.07	0.039	0.04
pH	0.0 S.U.	7.35		7.33	7.37							
Sulfates	0.5 mg/l	3.16	4	7.9	4.13	3.5	4.6	5.8	9	8.9	8.5	6.9
Total Alkalinity	1.0 mg/l	34.1	31.5	36.4	33.48	35.37	35.4	43.88	28.5	26	32.1	24.5
Total Dissolved Solid	2.0 mg/l	111	76	70	64	68	85	81	66	74	72	65
Total Suspended Solid	1.0 mg/l	13	4	8	3	2	1	1.4	2	23	2	6
Turbidity	0.05 NTU	5.59	5.42	8.88	2.95	3.43	2.4	2.82	3.75	22.4	3.78	8.24
Fecal Coliform	1.0 #/100ml	14	14	21	5	4	0			7	2	0
Total Coliform	Present/Absent	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present	Present

0 -Represents in results column shows that values are less than the MDL for that particular parameter.

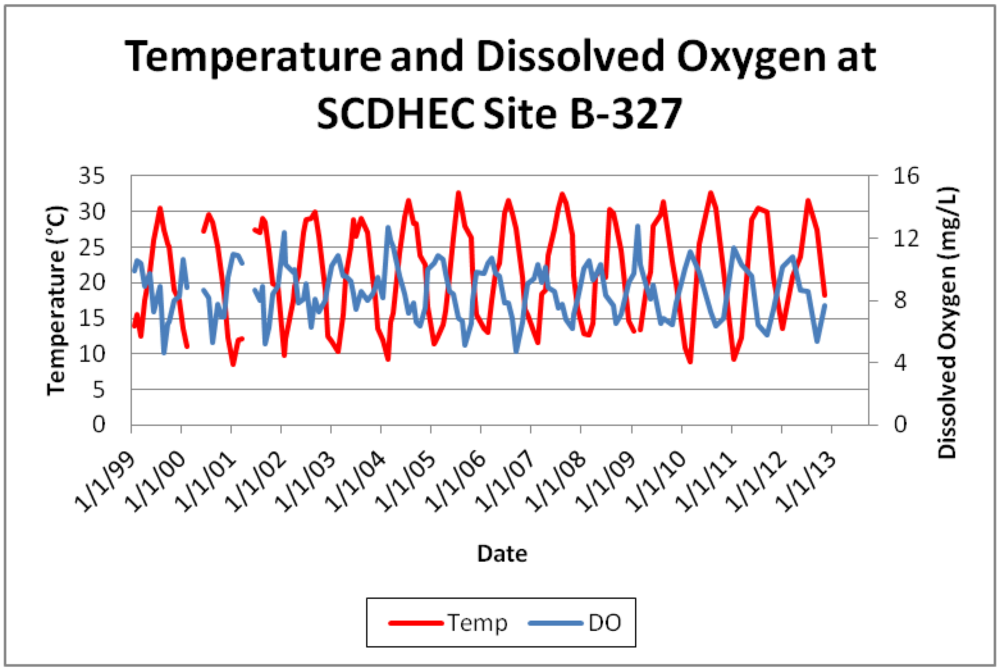
3.2.3 SCDHEC DATA

3.2.3.1 MONITORING STATION B-327

Temperature, DO, pH, and turbidity levels in the Monticello Reservoir are all consistent with state standards. SCDHEC monitoring site B-327, lower impoundment (see Figure 2-6), is not listed on the 2012 303(d) list.

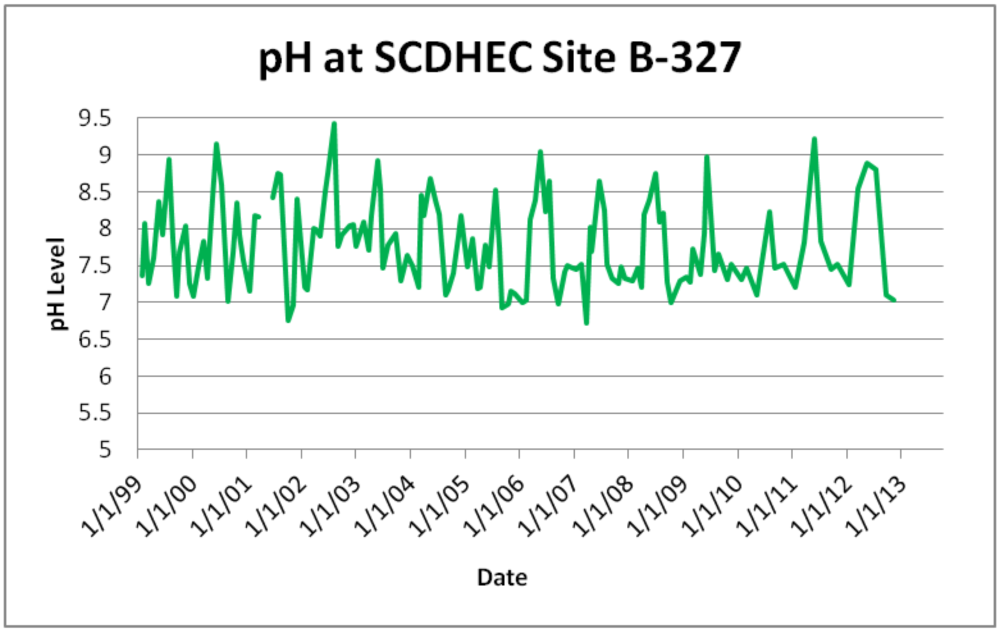
Temperature, DO, pH, and Turbidity

The following data was collected from 1999 through 2012 at the SCDHEC monitoring station B-327 located in the Monticello Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



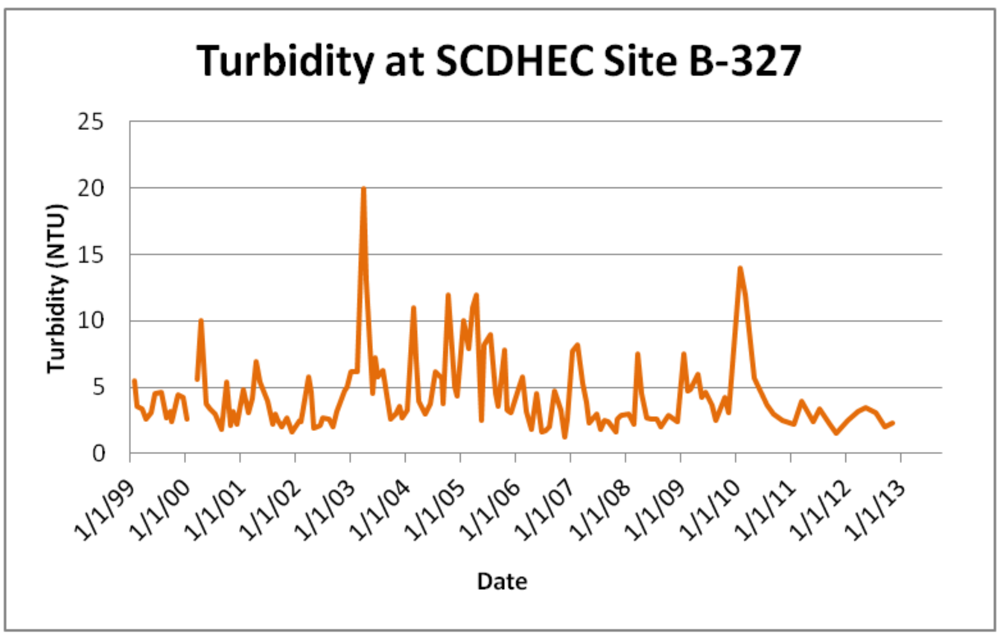
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-109 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION B-327 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-110 pH AT SCDHEC MONITORING STATION B-327 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-111 TURBIDITY AT SCDHEC MONITORING STATION B-327[A]

Metals

Water samples from monitoring station B-327 were collected on a quarterly basis from 1999 through 2012. As shown in Table 3-13, the SCDHEC core indicator metals (Table 2-3) have been consistently measured as Present Below Quantification Limit (PBQL) at site B-327, indicating the reservoir supports aquatic life use.

TABLE 3-13 METALS PRESENT AT SCDHEC MONITORING STATION B-327[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/18/99	PBQL	PBQL	-	0.5	PBQL	-	PBQL	PBQL	PBQL	0.01
5/20/99	PBQL	PBQL	-	0.23	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/26/99	PBQL	PBQL	-	0.12	PBQL	-	0.01	PBQL	PBQL	PBQL
11/16/99	PBQL	PBQL	-	0.17	PBQL	-	0.01	PBQL	PBQL	PBQL
5/18/00	PBQL	PBQL	-	0.14	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/24/00	PBQL	PBQL	-	0.14	PBQL	-	0.01	PBQL	PBQL	PBQL
11/16/00	PBQL	PBQL	-	0.22	PBQL	-	0.03	PBQL	PBQL	PBQL
2/21/01	PBQL	PBQL	-	0.12	PBQL	-	PBQL	PBQL	PBQL	PBQL
5/7/01	PBQL	PBQL	-	0.25	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/16/01	PBQL	PBQL	-	0.069	PBQL	-	PBQL	PBQL	PBQL	PBQL
11/6/01	PBQL	PBQL	-	0.16	PBQL	-	0.014	PBQL	PBQL	PBQL
2/7/02	PBQL	PBQL	-	0.11	PBQL	1.9	PBQL	PBQL	PBQL	PBQL
5/6/02	PBQL	PBQL	-	0.25	PBQL	-	PBQL	PBQL	PBQL	0.011
8/8/02	PBQL	PBQL	-	0.057	PBQL	-	0.01	PBQL	PBQL	PBQL
11/21/02	PBQL	PBQL	-	0.28	PBQL	-	0.011	PBQL	PBQL	0.016
2/19/03	PBQL	PBQL	-	0.37	PBQL	1.6	0.014	PBQL	PBQL	PBQL
5/28/03	PBQL	PBQL	-	0.82	PBQL	-	0.023	PBQL	PBQL	PBQL
8/7/03	PBQL	PBQL	-	0.2	PBQL	-	PBQL	PBQL	PBQL	PBQL
11/20/03	PBQL	PBQL	-	0.17	PBQL	-	0.015	PBQL	PBQL	PBQL
2/25/04	PBQL	PBQL	-	0.6	PBQL	1.6	0.018	PBQL	PBQL	PBQL
5/13/04	PBQL	PBQL	-	0.16	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/26/04	PBQL	PBQL	-	0.13	PBQL	-	0.011	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	-	0.28	PBQL	-	PBQL	PBQL	PBQL	0.021
2/23/05	PBQL	PBQL	-	0.35	PBQL	1.3	PBQL	PBQL	PBQL	PBQL
5/18/05	PBQL	PBQL	-	0.19	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/18/05	PBQL	PBQL	-	0.19	PBQL	-	0.016	PBQL	PBQL	0.01
11/2/05	PBQL	PBQL	-	0.15	PBQL	-	0.015	PBQL	PBQL	PBQL
2/16/06	PBQL	PBQL	-	0.5	PBQL	1.7	0.013	PBQL	PBQL	PBQL
5/18/06	PBQL	PBQL	-	0.2	PBQL	-	0.01	PBQL	PBQL	PBQL
8/17/06	PBQL	PBQL	-	0.095	PBQL	-	0.012	PBQL	PBQL	0.024
11/20/06	PBQL	PBQL	-	0.18	PBQL	-	0.021	PBQL	PBQL	PBQL
2/20/07	PBQL	PBQL	-	0.4	PBQL	1.5	0.015	PBQL	PBQL	PBQL
5/2/07	PBQL	PBQL	-	0.11	PBQL	1.5	PBQL	PBQL	PBQL	0.017
8/13/07	PBQL	PBQL	-	0.063	PBQL	1.7	PBQL	PBQL	PBQL	0.011
11/8/07	PBQL	PBQL	-	0.35	PBQL	1.8	0.042	PBQL	PBQL	PBQL
2/28/08	PBQL	PBQL	-	0.19	PBQL	1.7	PBQL	PBQL	PBQL	PBQL
5/22/08	PBQL	PBQL	-	0.12	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/19/08	PBQL	PBQL	-	0.051	PBQL	1.6	0.013	PBQL	PBQL	PBQL
2/12/09	PBQL	PBQL	-	0.27	PBQL	1.8	PBQL	PBQL	PBQL	0.039
5/20/09	PBQL	PBQL	-	0.17	PBQL	1.8	0.012	PBQL	PBQL	PBQL
8/20/09	0.00013	PBQL	-	0.06	PBQL	1.8	0.014	PBQL	PBQL	PBQL
11/19/09	0.00015	PBQL	-	0.22	PBQL	1.6	0.012	PBQL	PBQL	PBQL
1/28/10	PBQL	PBQL	-	0.55	PBQL	-	0.019	PBQL	PBQL	PBQL
5/6/10	PBQL	PBQL	-	0.2	PBQL	-	PBQL	PBQL	PBQL	PBQL
7/29/10	PBQL	PBQL	-	0.094	PBQL	-	0.012	PBQL	PBQL	PBQL
11/4/10	PBQL	PBQL	-	0.082	PBQL	1.6	0.013	PBQL	PBQL	PBQL
1/19/11	PBQL	PBQL	-	0.14	PBQL	-	0.014	PBQL	PBQL	PBQL
5/31/11	PBQL	PBQL	-	0.044	PBQL	-	PBQL	PBQL	PBQL	PBQL
7/14/11	PBQL	PBQL	-	0.052	PBQL	-	0.013	PBQL	PBQL	PBQL
11/3/11	PBQL	PBQL	-	0.08	PBQL	1.8	0.015	PBQL	PBQL	PBQL
1/12/12	PBQL	PBQL	-	0.1	PBQL	-	0.01	PBQL	PBQL	PBQL
5/15/12	PBQL	PBQL	-	0.11	PBQL	-	PBQL	PBQL	PBQL	PBQL
7/17/12	PBQL	PBQL	-	0.033	PBQL	-	PBQL	PBQL	PBQL	PBQL
11/8/12	PBQL	PBQL	-	0.062	PBQL	1.6	0.036	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station B-327 from 1999 through 2012 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-14 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION B-327[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)	Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/28/99	0.55	-	-	5/18/05	0.8	0.031	5.42
2/18/99	0.57	-	-	6/9/05	0.83	0.036	25.73
3/18/99	0.37	-	-	7/21/05	0.64	0.028	14.11
4/15/99	0.61	-	-	8/18/05	0.35	0.032	11.6
5/20/99	0.56	-	-	9/8/05	0.57	PBQL	2.62
6/17/99	0.57	-	-	10/20/05	0.62	0.022	-
7/29/99	0.58	-	-	11/2/05	0.6	PBQL	-
8/26/99	0.41	-	-	12/1/05	0.74	PBQL	-
9/23/99	0.6	-	-	1/17/06	0.68	0.025	-
10/5/99	0.56	-	-	2/16/06	0.81	0.021	-
11/16/99	0.47	-	-	3/16/06	0.7	PBQL	-
12/16/99	0.67	-	-	4/20/06	0.91	PBQL	-
1/13/00	0.34	-	-	5/18/06	0.54	PBQL	25.81
3/16/00	0.68	-	-	6/22/06	0.49	PBQL	2.62
4/13/00	0.6	-	-	7/20/06	PBQL	PBQL	5.26
5/18/00	0.51	-	-	8/17/06	0.83	PBQL	9.55
6/15/00	0.38	-	10.7	9/14/06	0.68	0.02	3.83
7/20/00	PBQL	-	15.1	10/26/06	0.56	0.025	2.59
8/24/00	0.38	-	5.91	11/20/06	0.5	0.029	-
9/28/00	0.43	-	10.5	12/7/06	0.59	0.031	-
10/26/00	0.46	-	4.2	1/17/07	0.59	0.021	-
11/16/00	0.46	-	-	2/20/07	0.66	0.031	-
12/12/00	0.48	-	-	3/22/07	-	0.033	-
2/21/01	0.61	-	-	4/19/07	-	PBQL	-
4/17/01	0.97	-	-	5/2/07	-	PBQL	4.87
5/7/01	-	-	2.66	6/21/07	0.31	PBQL	10.61
6/26/01	0.44	0.036	10.9	7/19/07	0.539	PBQL	9.17
7/30/01	-	0.02	6.94	8/13/07	0.287	PBQL	6.82
8/16/01	0.475	0.024	13.3	9/10/07	0.338	PBQL	6.31
9/5/01	-	PBQL	4.84	10/25/07	-	0.024	3.67
10/4/01	PBQL	0.02	4.88	11/8/07	0.54	0.024	-
11/6/01	-	0.02	-	12/4/07	PBQL	-	-
12/6/01	0.43	PBQL	-	1/24/08	0.58	0.048	-
1/24/02	0.59	0.023	-	2/28/08	0.63	0.036	-
2/7/02	-	0.023	-	3/25/08	0.59	0.044	-
3/27/02	0.72	PBQL	-	3/25/08	0.59	-	-
4/11/02	-	0.022	-	4/17/08	0.51	0.029	-
5/6/02	0.5	PBQL	2.48	4/17/08	0.51	-	-
6/13/02	0.308	PBQL	5.87	5/22/08	0.27	0.032	-
7/1/02	PBQL	PBQL	13.6	6/26/08	-	0.022	6.48
8/8/02	-	PBQL	8.37	7/29/08	-	12.27	
9/5/02	PBQL	PBQL	14.8	8/19/08	0.282	0.03	5.29
10/2/02	-	0.023	12	9/11/08	0.19	PBQL	5.04
11/21/02	0.48	0.024	-	10/14/08	-	0.033	2.81
12/12/02	0.39	0.029	-	12/9/08	1.14	0.039	-
1/6/03	0.53	0.031	-	1/22/09	0.57	0.038	-
2/19/03	-	0.029	-	2/12/09	0.78	0.04	-
3/27/03	0.63	0.037	-	3/5/09	0.69	0.026	-
4/17/03	-	0.034	-	4/23/09	PBQL	0.023	-
5/28/03	0.52	PBQL	-	5/20/09	0.55	0.023	5.86
6/16/03	-	PBQL	-	6/11/09	0.564	PBQL	6.42
7/2/03	0.46	PBQL	-	7/30/09	PBQL	0.026	12.03
8/7/03	-	PBQL	-	8/20/09	PBQL	0.024	12.21
9/25/03	0.85	PBQL	10.77	10/22/09	0.42	0.031	4.22
10/30/03	-	PBQL	1.74	11/19/09	0.46	0.034	-
11/20/03	0.98	PBQL	-	1/28/10	PBQL	0.036	-
12/11/03	-	PBQL	-	3/4/10	PBQL	0.039	-
1/15/04	0.69	PBQL	-	5/6/10	0.32	PBQL	12.67
2/25/04	-	0.023	-	7/29/10	0.247	0.023	10.96
3/11/04	0.91	PBQL	-	9/9/10	0.34	PBQL	10.08
4/1/04	0.76	PBQL	-	11/4/10	0.62	0.024	-
5/13/04	0.42	0.027	12.75	1/19/11	PBQL	0.046	-
6/17/04	0.71	0.034	12	3/17/11	0.68	0.03	-
7/15/04	0.71	0.039	13.28	5/31/11	-	0.023	9.84
8/26/04	0.53	0.029	9.57	7/14/11	0.264	0.03	14.67
9/9/04	0.55	0.024	1.99	9/15/11	0.35	0.022	9.28
10/14/04	0.73	0.027	-	11/3/11	0.81	0.028	-
11/22/04	0.78	0.035	-	1/12/12	PBQL	0.039	-
12/7/04	0.63	0.021	-	3/19/12	0.59	0.03	-
1/20/05	0.96	0.037	-	5/15/12	0.31	0.021	19.76
2/23/05	0.92	0.038	-	7/17/12	0.339	0.023	-
3/24/05	0.81	0.033	-	9/20/12	PBQL	PBQL	6.47
4/14/05	0.74	0.033	-	11/8/12	0.68	0.028	-

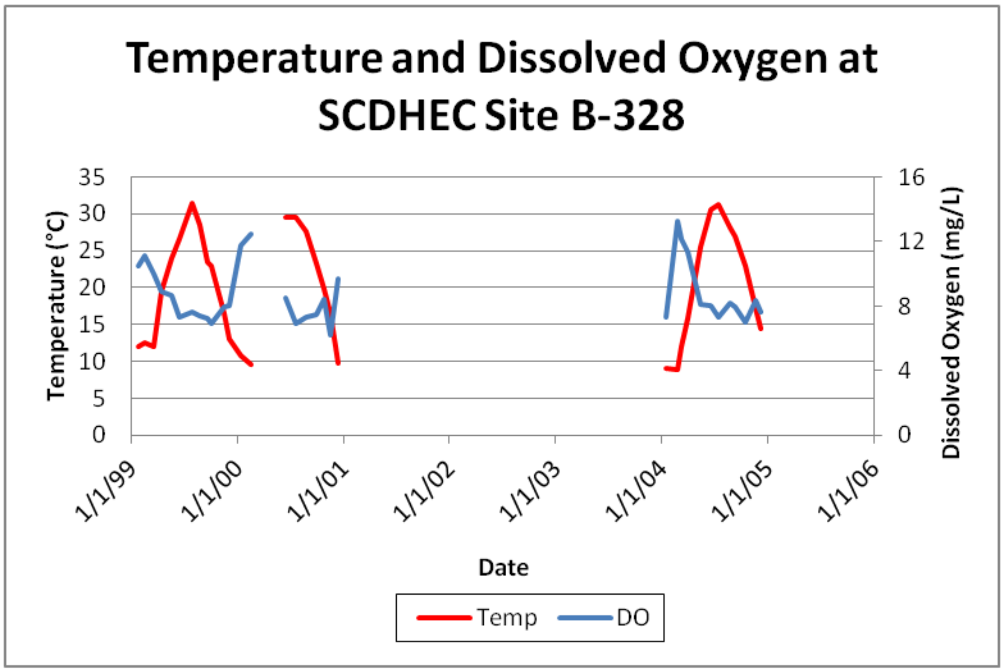
[A] PBQL is Present Below Quantification Limit.

3.2.3.2 MONITORING STATION B-328

The SCDHEC monitoring station B-328, at buoy in the middle of the reservoir, is located in the area of Monticello Reservoir set aside solely for recreation, known as the Recreation Lake. The data presented below shows all parameters reading well within normal and safe limits.

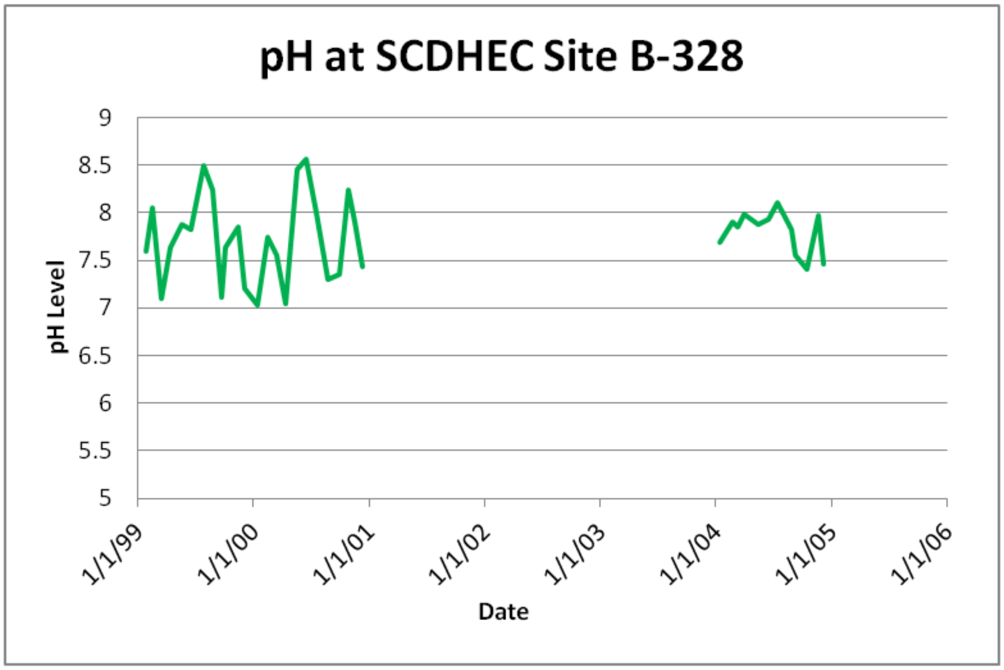
Temperature, DO, pH, and Turbidity

The following data was collected in 1999, 2000 and 2004 at the SCDHEC monitoring station B-328 located in the Monticello Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



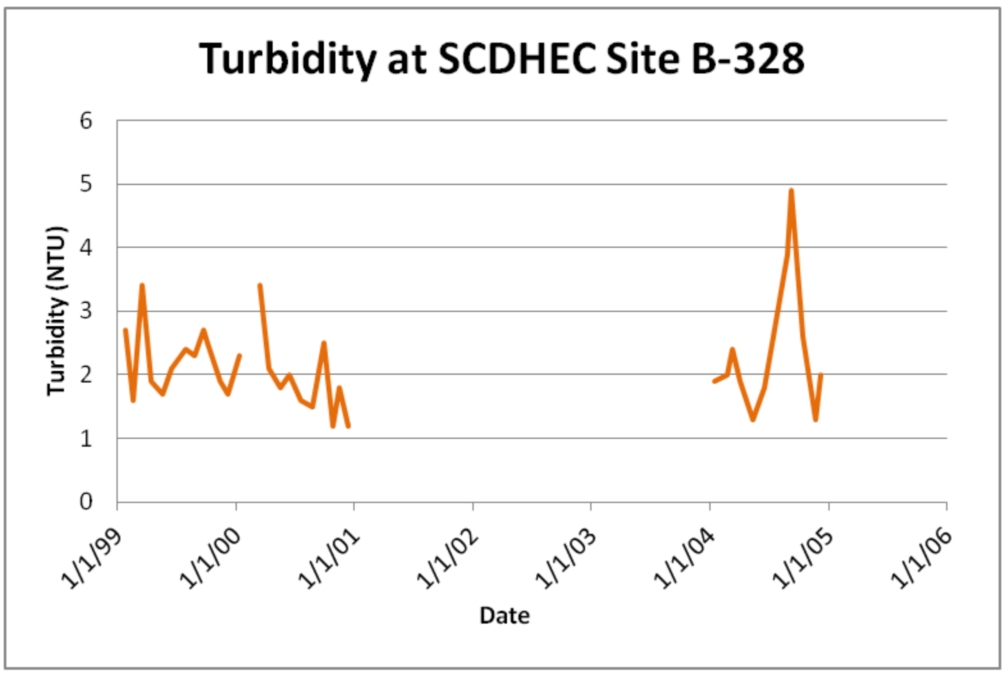
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-112 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION B-328 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-113 PH AT SCDHEC MONITORING STATION B-328 [a]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-114 TURBIDITY AT SCDHEC MONITORING STATION B-328 [a]

Metals

Water samples from monitoring station B-328 were collected on a quarterly basis for the years 1999, 2000 and 2004. As shown in Table 3-15, the SCDHEC core indicator metals (Table 2-3) were consistently measured as Present Below Quantification Limit (PBQL) at site B-328, indicating the reservoir supports aquatic life use.

TABLE 3-15 METALS PRESENT AT SCDHEC MONITORING STATION B-328[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/18/99	PBQL	PBQL	PBQL	0.15	PBQL	-	0.02	PBQL	PBQL	0.03
5/20/99	PBQL	PBQL	PBQL	0.05	PBQL	-	0.03	PBQL	PBQL	PBQL
8/26/99	PBQL	PBQL	PBQL	0.06	PBQL	-	0.05	PBQL	PBQL	PBQL
11/16/99	PBQL	PBQL	PBQL	0.08	PBQL	-	0.16	PBQL	PBQL	0.01
5/18/00	PBQL	PBQL	PBQL	0.05	PBQL	-	0.03	PBQL	PBQL	PBQL
8/24/00	PBQL	PBQL	PBQL	0.07	PBQL	-	0.05	PBQL	PBQL	PBQL
11/16/00	PBQL	PBQL	PBQL	0.09	PBQL	-	0.32	PBQL	PBQL	PBQL
2/25/04	PBQL	PBQL	PBQL	0.16	PBQL	2	0.019	PBQL	PBQL	PBQL
5/13/04	PBQL	PBQL	PBQL	0.054	PBQL	-	0.043	PBQL	PBQL	PBQL
8/26/04	PBQL	PBQL	PBQL	0.042	PBQL	-	0.03	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	PBQL	0.06	PBQL	-	0.044	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Water samples collected at SCDHEC monitoring station B-328 in 1999, 2000 and 2004 were analyzed for total nitrogen, total phosphorus and chlorophyll-a. See Table 2-2 for SCDHEC standards for nutrients. As of 2004, these parameters were measured at levels deemed acceptable by SCDHEC.

TABLE 3-16 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION B-328[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/28/99	0.37	-	-
2/18/99	0.27	-	-
3/18/99	0.37	-	-
4/15/99	PBQL	-	-
5/20/99	PBQL	-	-
6/17/99	PBQL	-	-
7/29/99	PBQL	-	-
8/26/99	PBQL	-	-
9/23/99	PBQL	-	-
10/5/99	0.7	-	-
11/16/99	0.39	-	-
12/6/99	0.39	-	-
1/13/00	0.63	-	-
3/16/00	PBQL	-	-
4/13/00	PBQL	-	-
5/18/00	PBQL	-	-
6/15/00	PBQL	-	1.86
7/20/00	PBQL	-	3.03
8/24/00	PBQL	-	6.52
9/28/00	PBQL	-	7.09
10/26/00	PBQL	-	4.42
11/16/00	PBQL	-	-
12/12/00	0.45	-	-
1/15/04	0.602	PBQL	-
2/25/04	-	PBQL	-
3/11/04	0.512	PBQL	-
4/1/04	PBQL	PBQL	-
5/13/04	PBQL	PBQL	1.57
6/17/04	PBQL	PBQL	1.89
7/15/04	PBQL	PBQL	3.09
8/26/04	PBQL	PBQL	3.7
9/9/04	PBQL	0.021	-
10/14/04	PBQL	PBQL	4.67
11/22/04	PBQL	PBQL	-
12/7/04	0.372	PBQL	-

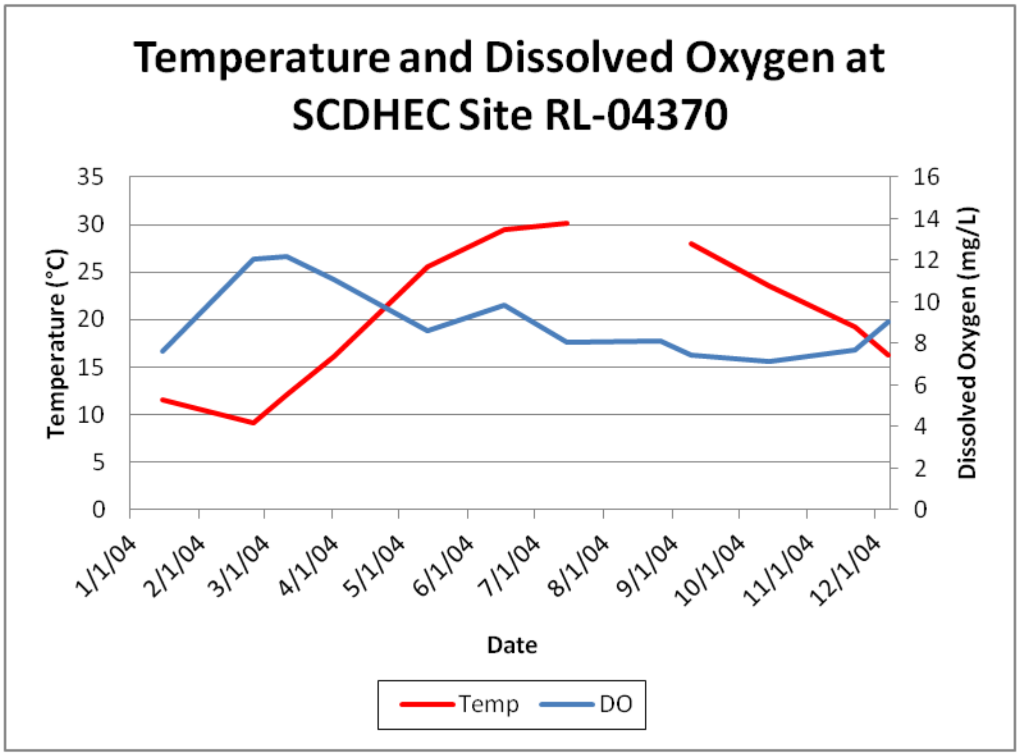
[A] PBQL is Present Below Quantification Limit.

3.2.3.3 MONITORING STATION RL-04370

SCDHEC monitoring site RL-04370 was established for water quality monitoring during the year 2004. During this time, this site was included on the state 303(d) list due pH excursions. See information included below for further details.

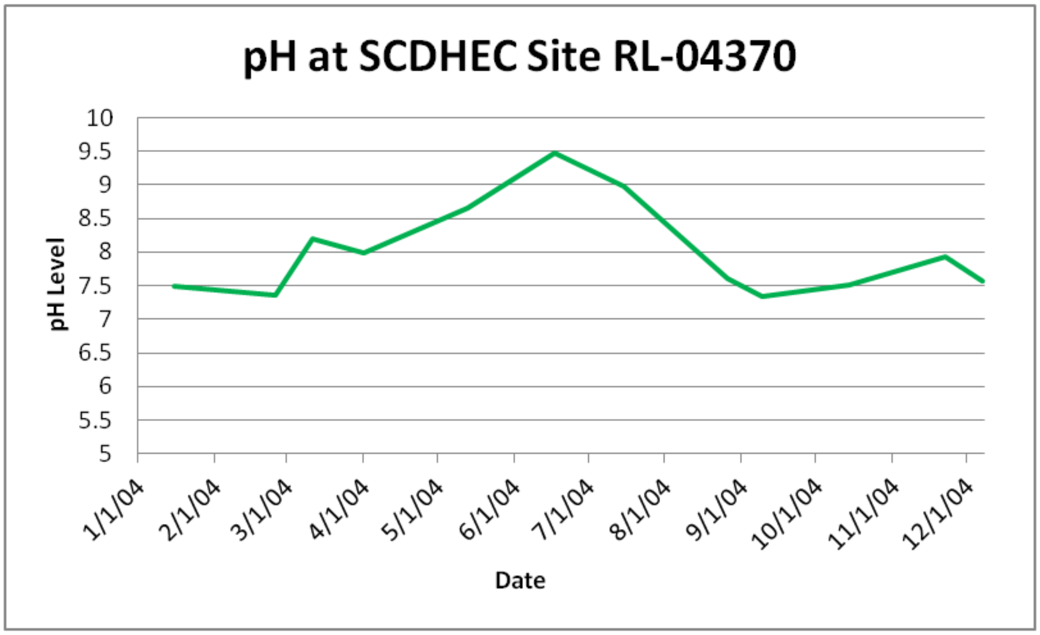
Temperature, DO, pH, and Turbidity

In 2004, the pH levels at SCDHEC monitoring site RL-04370, approximately 1.7 miles NW of the town of Monticello, were measured above the SCDHEC standard. During the summer months, pH values reached nearly 9.5. Due to these excursions, this site was included on the 303(d) list. DO and turbidity values were well within state limits at this site during 2004. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



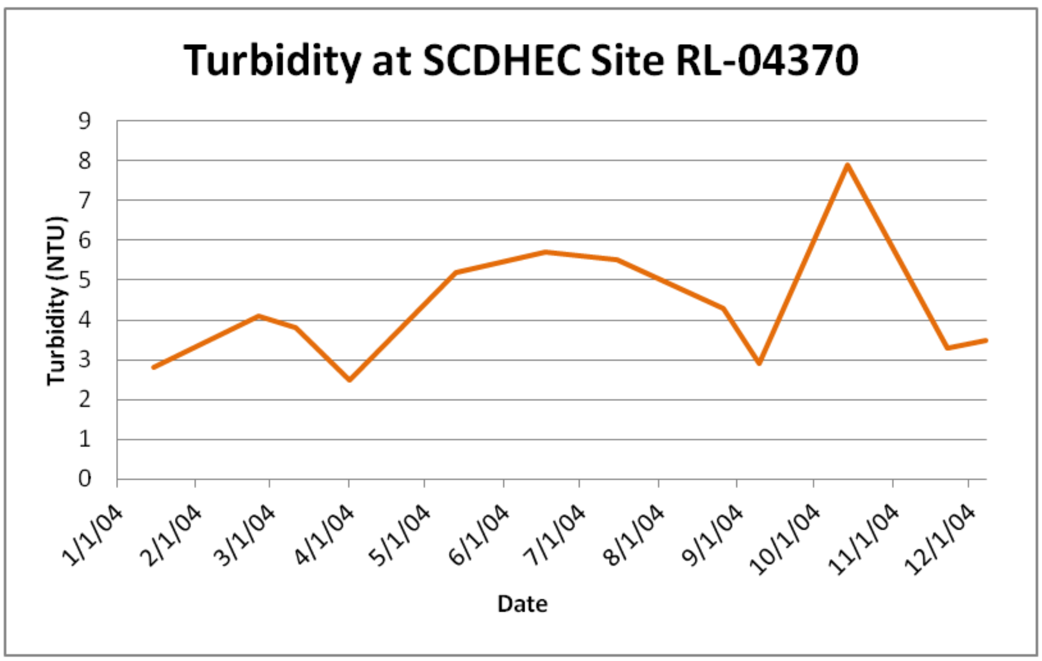
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-115 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION RL-04370[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-116 PH AT SCDHEC MONITORING STATION RL-04370[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-117 TURBIDITY AT SCDHEC MONITORING STATION RL-04370[A]

Metals

Water samples from monitoring station RL-04370 were collected on a quarterly basis during 2004 and analyzed for various metals. Results of these analyses are included below. Analysis of the SCDHEC core indicator metals (Table 2-3) signify the reservoir supports aquatic life use at monitoring site RL-04370.

TABLE 3-17 METALS PRESENT AT SCDHEC MONITORING STATION RL-04370[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/25/04	PBQL	PBQL	PBQL	0.24	PBQL	1.5	PBQL	PBQL	PBQL	0.028
5/13/04	PBQL	PBQL	PBQL	0.2	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/26/04	PBQL	PBQL	PBQL	0.09	PBQL	-	PBQL	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	PBQL	0.22	PBQL	-	PBQL	PBQL	PBQL	PBQL
1/19/11	PBQL	PBQL	PBQL	0.11	-	-	PBQL	PBQL	PBQL	PBQL
5/31/11	PBQL	PBQL	PBQL	0.1	-	-	PBQL	PBQL	PBQL	PBQL
7/14/11	PBQL	PBQL	PBQL	0.04	-	-	PBQL	PBQL	PBQL	PBQL
11/3/11	PBQL	PBQL	PBQL	0.048	-	1.8	0.012	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station RL-04370 in 2004 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-18 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION RL-04370[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/15/04	0.62	PBQL	-
2/25/04	-	PBQL	-
3/11/04	0.99	PBQL	-
4/1/04	0.55	PBQL	-
5/13/04	0.39	PBQL	4.47
6/17/04	PBQL	0.044	25.6
7/15/04	0.405	0.027	12.11
8/26/04	0.47	PBQL	11.17
9/9/04	0.6	0.021	-
10/14/04	0.63	0.024	7.13
11/22/04	0.58	0.024	-
12/7/04	0.62	0.02	-
1/19/11	PBQL	0.042	-
2/16/11	0.7	0.046	-
3/17/11	0.66	0.029	-
4/14/11	-	0.027	-
5/31/11	-	0.027	8.77
6/29/11	PBQL	0.041	-
7/14/11	PBQL	0.034	17.95
8/11/11	PBQL	0.025	8.85
9/15/11	PBQL	PBQL	7.62
10/20/11	0.43	PBQL	6.74
11/3/11	0.65	0.027	-
12/5/11	0.84	0.035	-

[A] PBQL is Present Below Quantification Limit.

3.2.3.4 MONITORING STATION RL-04374

SCDHEC monitoring site RL-04374, approximately 3.5 miles N of Jenkinsville, was established for water quality monitoring during the year 2004. This site was added to the state 303(d) list due to pH excursions. See information included below for further details.

Temperature, DO, pH, and Turbidity

In 2004, the pH levels at SCDHEC monitoring site RL-04374 were measured above the SCDHEC standard range (see Table 2-1). During the summer months, pH values were recorded between 8.5 and 9.0. Due to these excursions, this site was included on the 303(d) list. DO and turbidity values were well within state limits at this site during 2004.

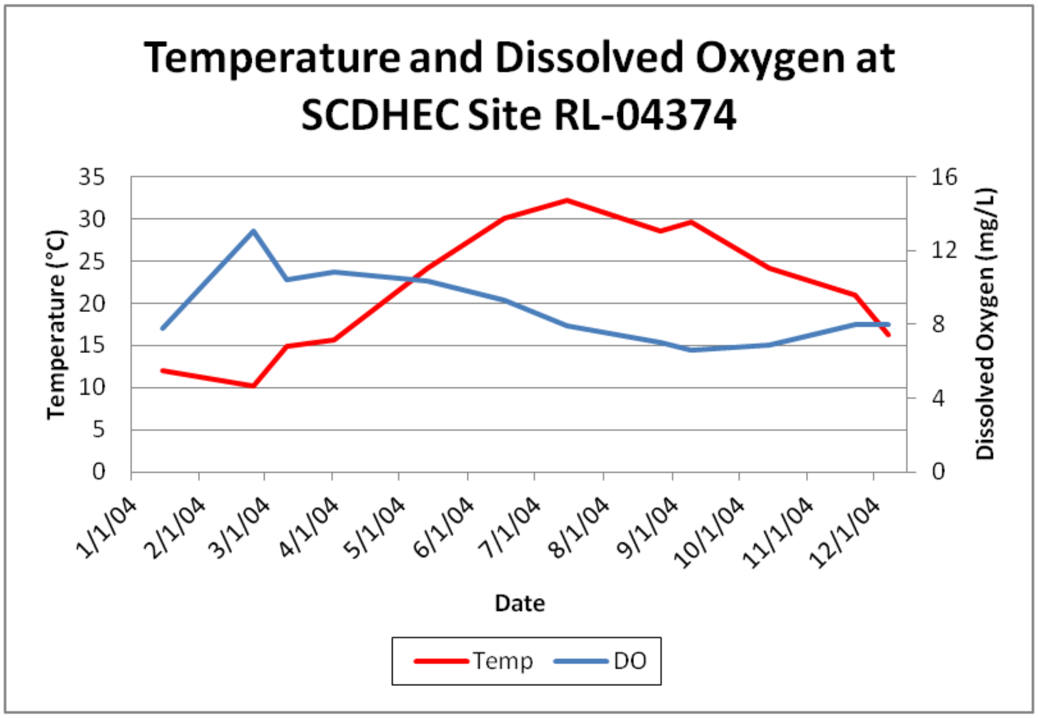


FIGURE 3-118 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION RL-04374

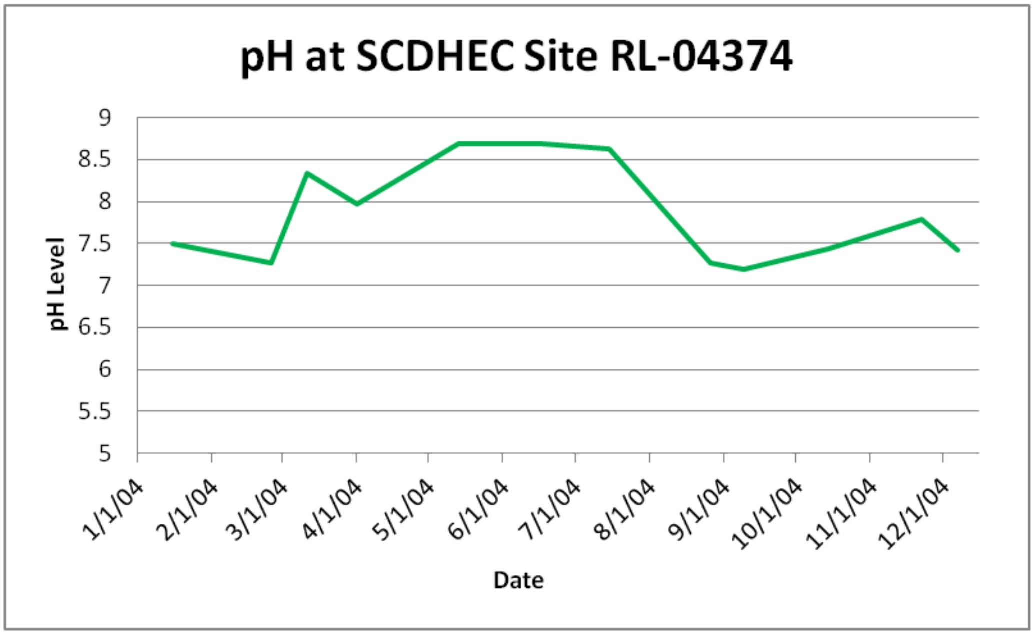


FIGURE 3-119 PH AT SCDHEC MONITORING STATION RL-04374

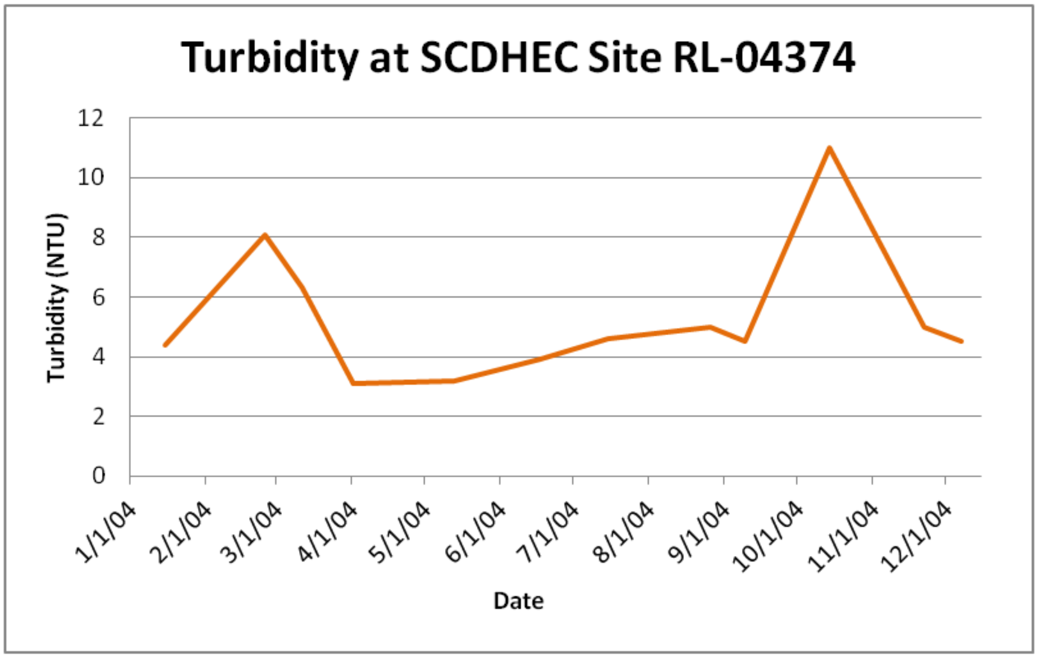


FIGURE 3-120 TURBIDITY AT SCDHEC MONITORING STATION RL-04374

Metals

Water samples from monitoring station RL-04374 were collected on a quarterly basis during 2004 and analyzed for various metals. Results of these analyses are included below. Analysis of the SCDHEC core indicator metals (Table 2-3) signify the reservoir supports aquatic life use at monitoring site RL-04374.

TABLE 3-19 METALS PRESENT AT SCDHEC MONITORING STATION RL-04374[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/25/04	PBQL	PBQL	PBQL	0.51	PBQL	1.6	0.012	PBQL	PBQL	PBQL
5/13/04	PBQL	PBQL	PBQL	0.11	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/26/04	PBQL	PBQL	PBQL	0.16	PBQL	-	PBQL	PBQL	PBQL	PBQL
11/22/04	PBQL	PBQL	PBQL	0.31	PBQL	-	PBQL	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station RL-04374 in 2004 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-20 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION RL-04374[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/15/04	0.73	-	-
2/25/04	-	PBQL	-
3/11/04	0.85	PBQL	-
4/1/04	0.63	PBQL	-
5/13/04	0.61	PBQL	13.36
6/17/04	0.71	0.031	15.31
7/15/04	0.46	0.048	19.41
8/26/04	0.5	0.021	8.72
9/9/04	0.52	0.024	-
10/14/04	0.64	0.029	4.36
11/22/04	0.69	0.056	-
12/7/04	0.64	0.026	-

[A] PBQL is Present Below Quantification Limit.

3.2.3.5 MONITORING STATION RL-08055

SCDHEC monitoring station RL-08055, as close to the outflow at dam as possible, was established for water quality monitoring in Monticello Reservoir during 2008. The data presented below shows all parameters reading well within SCDHEC-established limits.

Temperature, DO, pH, and Turbidity

Data collected in 2008 at the SCDHEC monitoring station RL-08055 located in the Monticello Reservoir is presented in the graphs below. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity. It should be noted that this monitoring site is located in close proximity to the Fairfield Pumped Storage Development. Although turbidity may be a concern at this location due to the pumping operations of the facility, it was consistently measured as below the SCDHEC turbidity standard of 25 NTU.

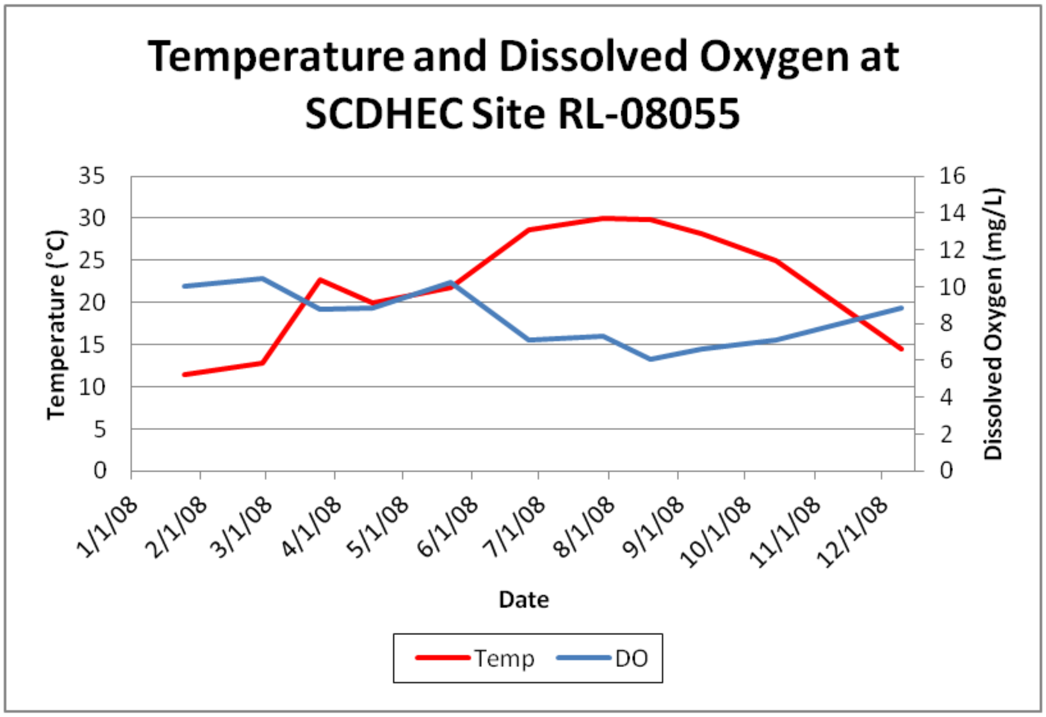


FIGURE 3-121 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION RL-08055

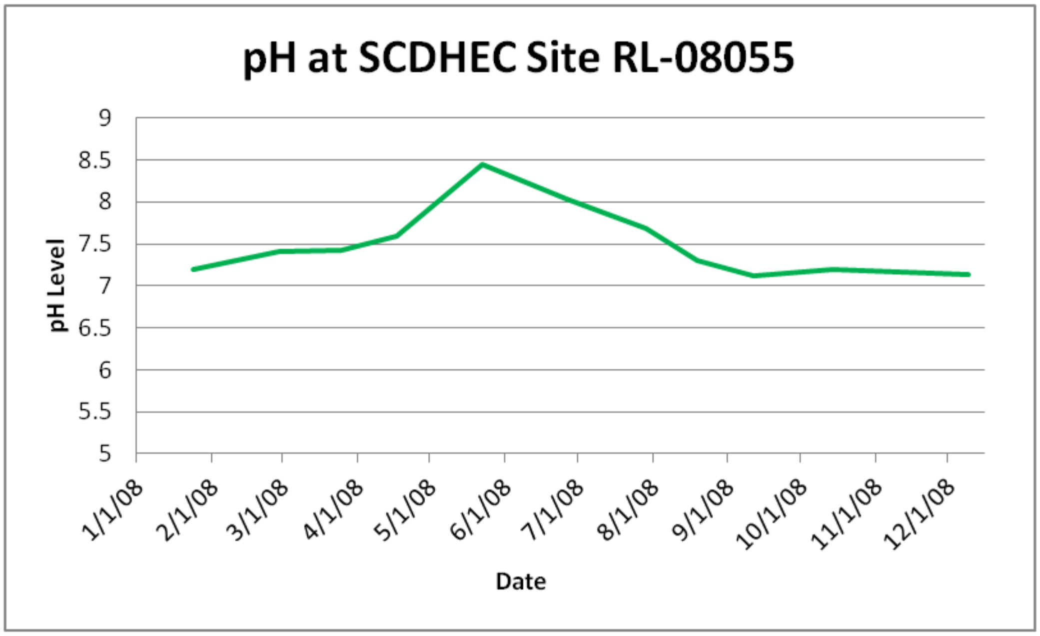


FIGURE 3-122 PH AT SCDHEC MONITORING STATION RL-08055

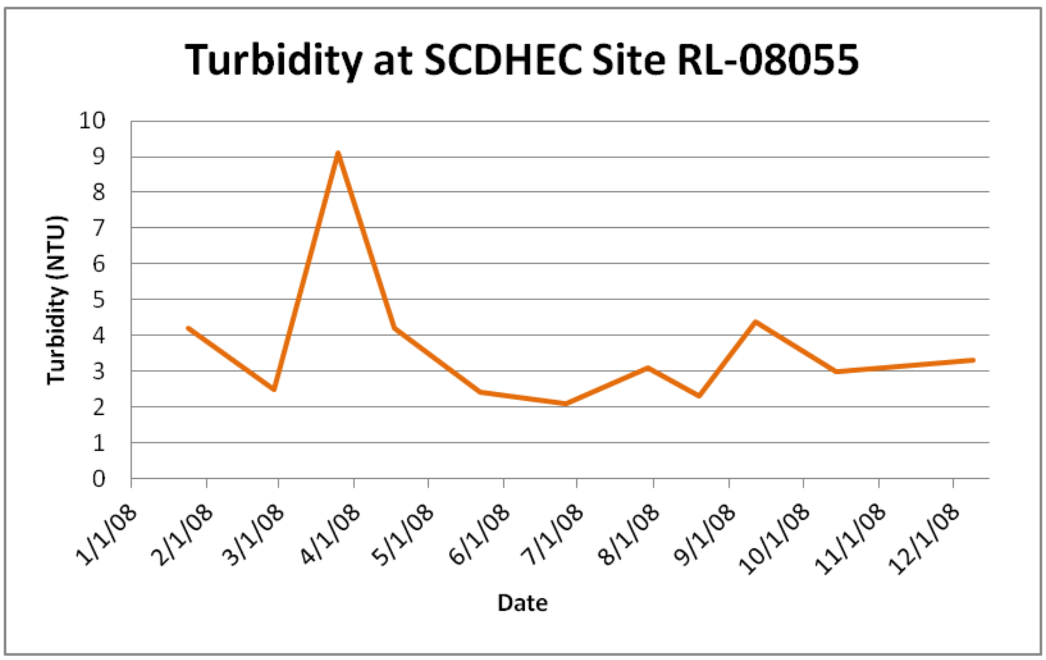


FIGURE 3-123 TURBIDITY AT SCDHEC MONITORING STATION RL-08055

Metals

Water samples from monitoring station RL-08055 were collected on a quarterly basis during 2008 and analyzed for various metals. Results of these analyses are included below. Analysis of the SCDHEC core indicator metals (Table 2-3) signify the reservoir supports aquatic life use at monitoring site RL-08055.

TABLE 3-21 METALS PRESENT AT SCDHEC MONITORING STATION RL-08055[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/28/2008	PBQL	PBQL	PBQL	0.2	PBQL	1.8	PBQL	PBQL	PBQL	PBQL
4/10/2008	PBQL	PBQL	PBQL	0.14	PBQL	-	0.015	PBQL	PBQL	0.014
5/22/2008	PBQL	PBQL	PBQL	0.12	PBQL	-	PBQL	PBQL	PBQL	PBQL
8/19/2008	PBQL	PBQL	PBQL	0.062	PBQL	0.19	PBQL	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station RL-08055 in 2008 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-22 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION RL-08055[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/24/2008	0.61	0.05	-
2/28/2008	0.53	0.038	-
3/18/2008	PBQL	PBQL	-
3/25/2008	1.65	0.059	-
4/10/2008	0.41	PBQL	-
4/17/2008	0.53	0.025	-
5/22/2008	0.39	0.036	-
6/26/2008	-	0.026	7.02
7/29/2008	-	-	12.85
8/19/2008	PBQL	0.026	6.2
9/11/2008	PBQL	PBQL	5.49
10/14/2008	0.41	0.034	3.29
12/9/2008	1.24	0.043	-

[A] PBQL is Present Below Quantification Limit.

3.2.3.6 MONITORING STATION RL-11031

SCDHEC monitoring station RL-11031 was established for water quality monitoring in Monticello Reservoir during 2011. This monitoring station occurs in the same location as site RL-04370, approximately 1.7 miles NW of the town of Monticello. Similar to the pH data collected at site RL-04370 in 2004, pH at site RL-11031 was outside of the SCDHEC established range however these data have not yet been evaluated for potential §303(d) listing.

Temperature, DO, pH, and Turbidity

In 2011, the pH levels at SCDHEC monitoring site RL-11031 were measured above the SCDHEC standard range (see Table 2-1). During the summer months, pH values were recorded between 8.5 and 9.5. DO and turbidity values were well within state limits at this site during 2011.

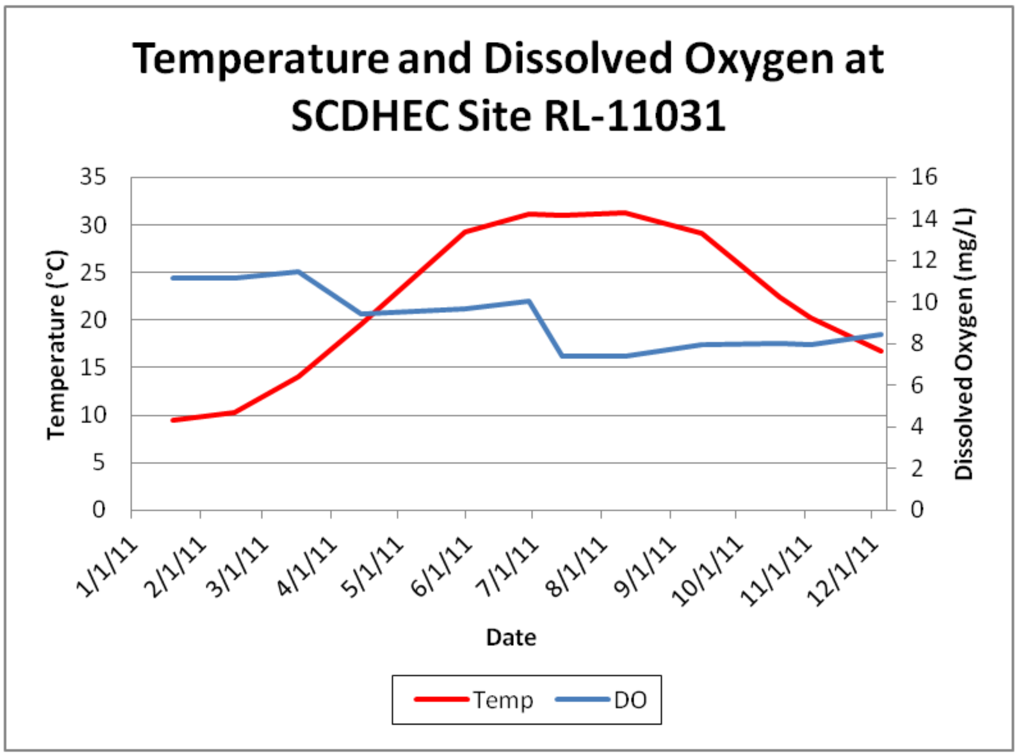


FIGURE 3-124 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION RL-11031

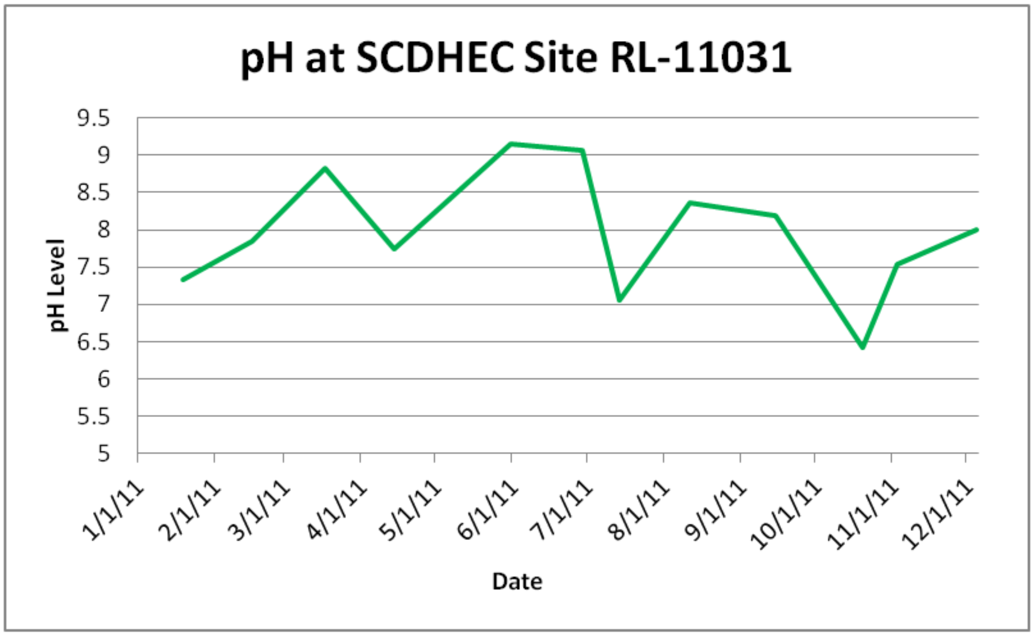


FIGURE 3-125 PH AT SCDHEC MONITORING STATION RL-11031

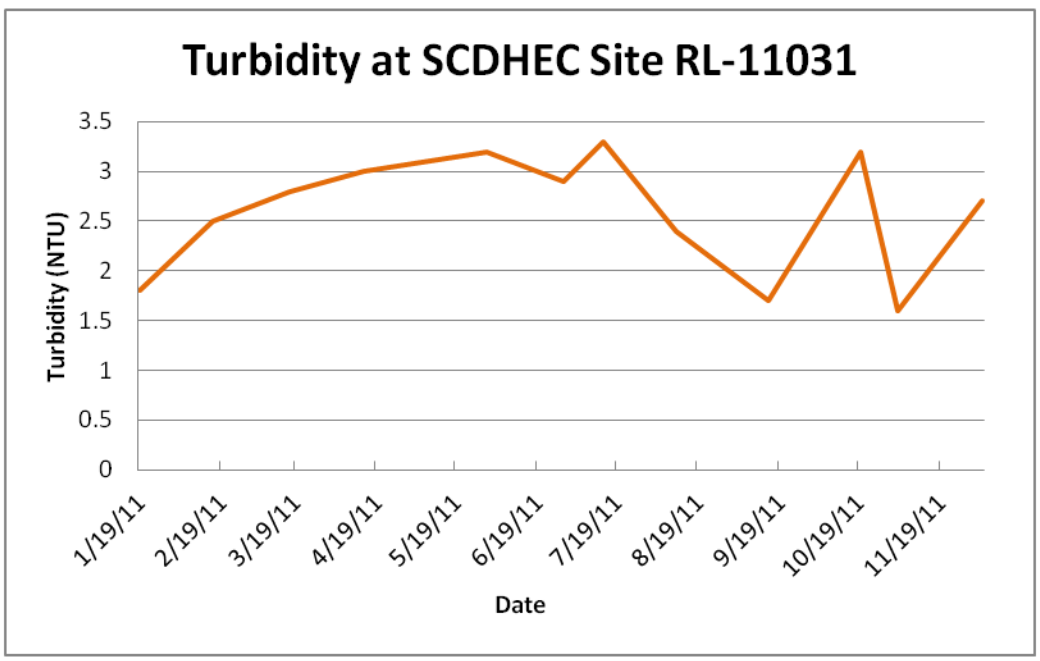


FIGURE 3-126 TURBIDITY AT SCDHEC MONITORING STATION RL-11031

Metals

Water samples from monitoring station RL-11031 were collected on a quarterly basis during 2011 and analyzed for various metals. Results of these analyses are included below. Analysis of the SCDHEC core indicator metals (Table 2-3) signify the reservoir supports aquatic life use at monitoring site RL-11031.

TABLE 3-23 METALS PRESENT AT SCDHEC MONITORING STATION RL-11031[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
1/19/11	PBQL	PBQL	PBQL	0.11	-	-	PBQL	PBQL	PBQL	PBQL
5/31/11	PBQL	PBQL	PBQL	0.1	-	-	PBQL	PBQL	PBQL	PBQL
7/14/11	PBQL	PBQL	PBQL	0.04	-	-	PBQL	PBQL	PBQL	PBQL
11/3/11	PBQL	PBQL	PBQL	0.048	-	1.8	0.012	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station RL-11031 in 2011 and is included in the table below. See Table 2-2 for SCDHEC standards for nutrients.

TABLE 3-24 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION RL-11031[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll a (ug/L)
1/19/11	PBQL	0.042	-
2/16/11	0.7	0.046	-
3/17/11	0.66	0.029	-
4/14/11	-	0.027	-
5/31/11	-	0.027	8.77
6/29/11	PBQL	0.041	-
7/14/11	PBQL	0.034	17.95
8/11/11	PBQL	0.025	8.85
9/15/11	PBQL	PBQL	7.62
10/20/11	0.43	PBQL	6.74
11/3/11	0.65	0.027	-
12/5/11	0.84	0.035	-

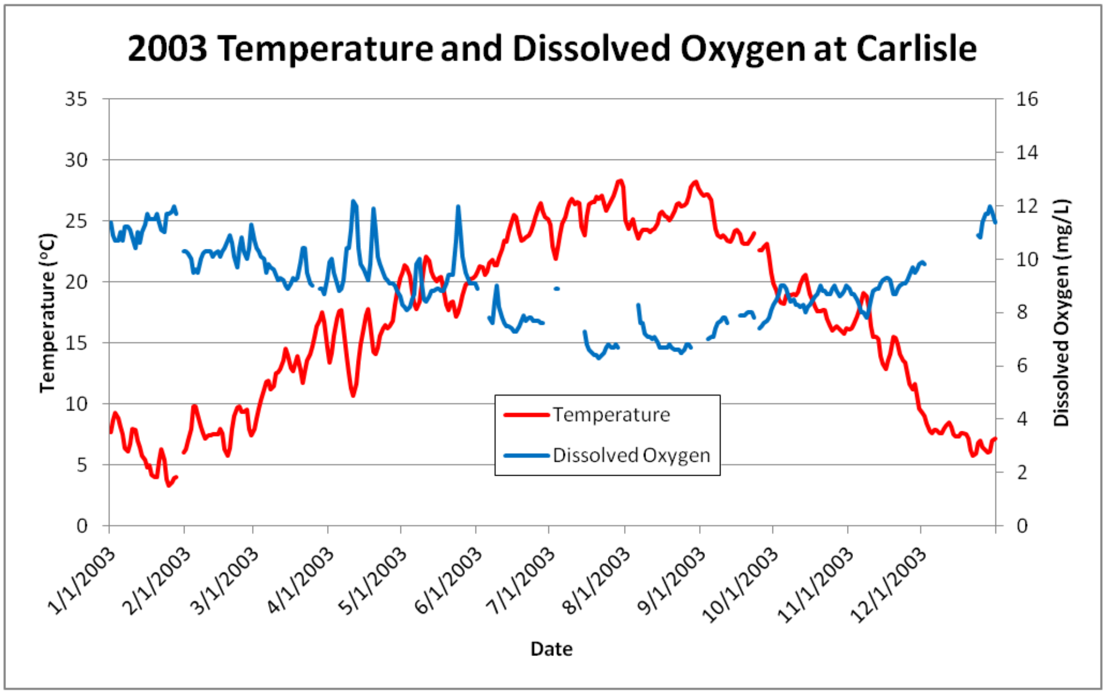
[A] PBQL is Present Below Quantification Limit.

3.3 BROAD RIVER UPSTREAM OF PARR RESERVOIR

3.3.1 USGS SITE 02156500

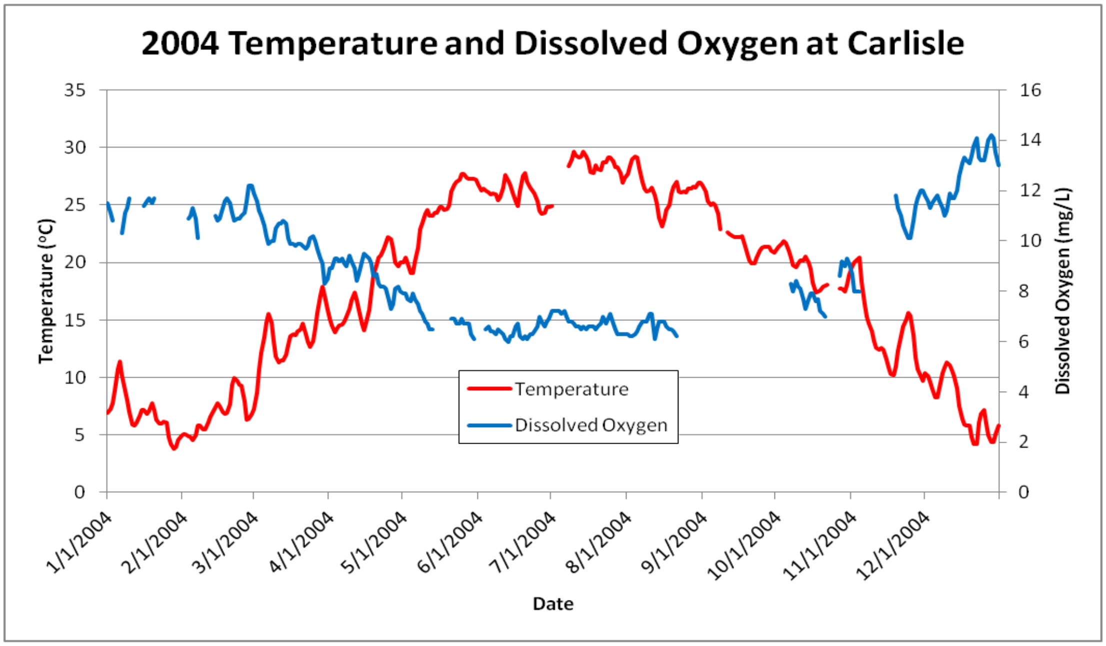
3.3.1.1 TEMPERATURE AND DISSOLVED OXYGEN

Water temperature at the USGS Site 02156500 ranges from approximately 4°C during the winter months to approximately 33°C during the summer. During the summer months, DO levels typically drop to around the 6-7 mg/L range.



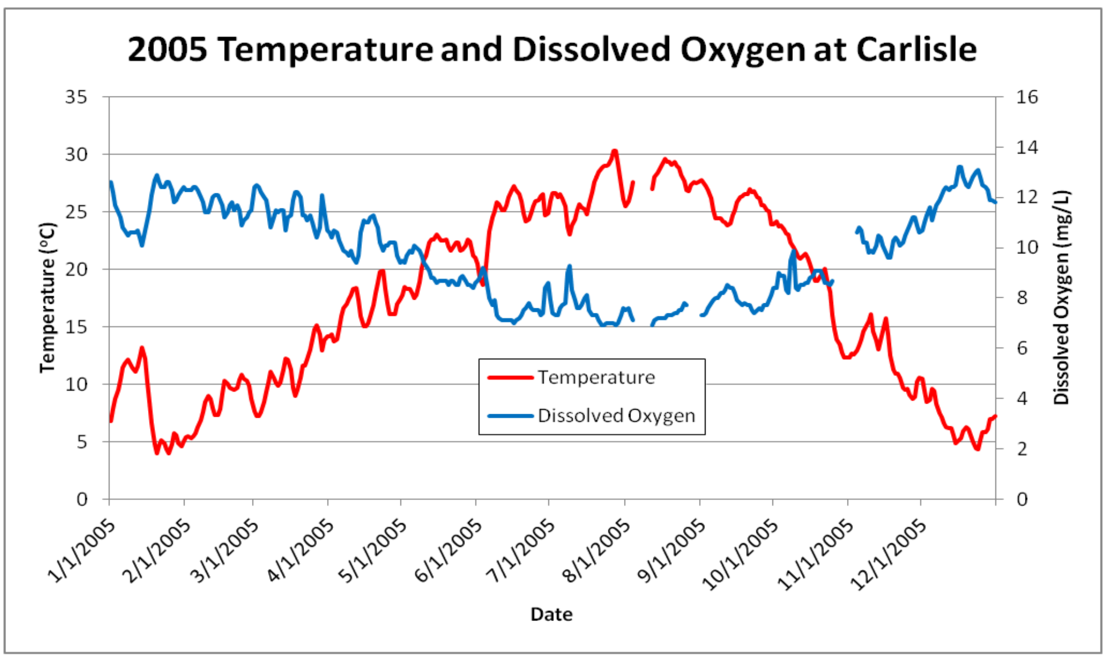
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-127 TEMPERATURE AND DISSOLVED OXYGEN FOR 2003: UPSTREAM OF PARR RESERVOIR[A]



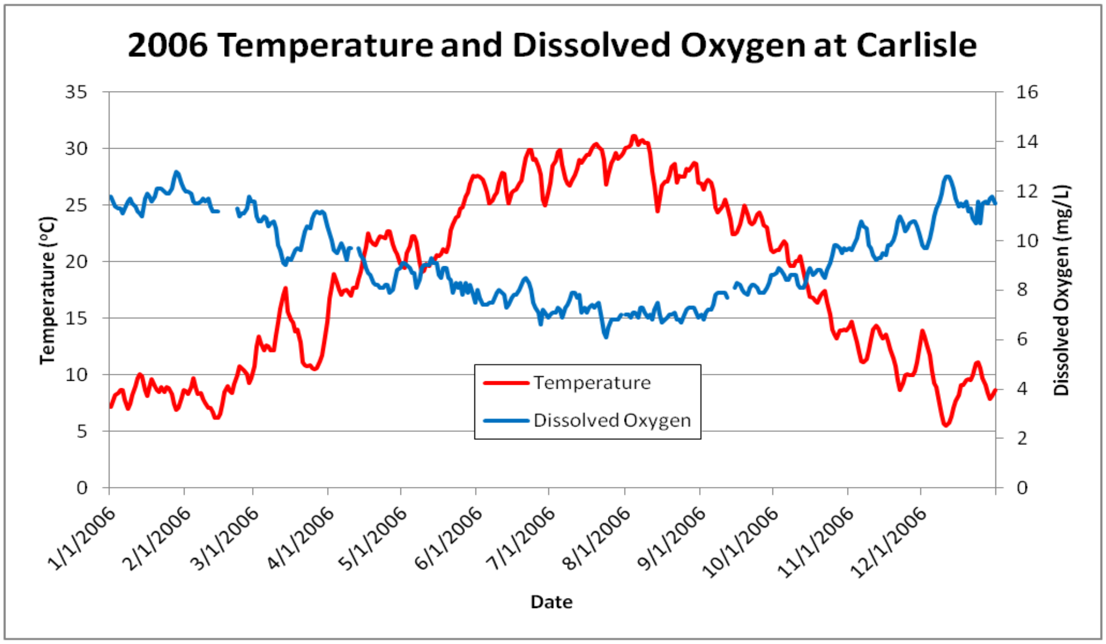
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-128 TEMPERATURE AND DISSOLVED OXYGEN FOR 2004: UPSTREAM OF PARR RESERVOIR[A]



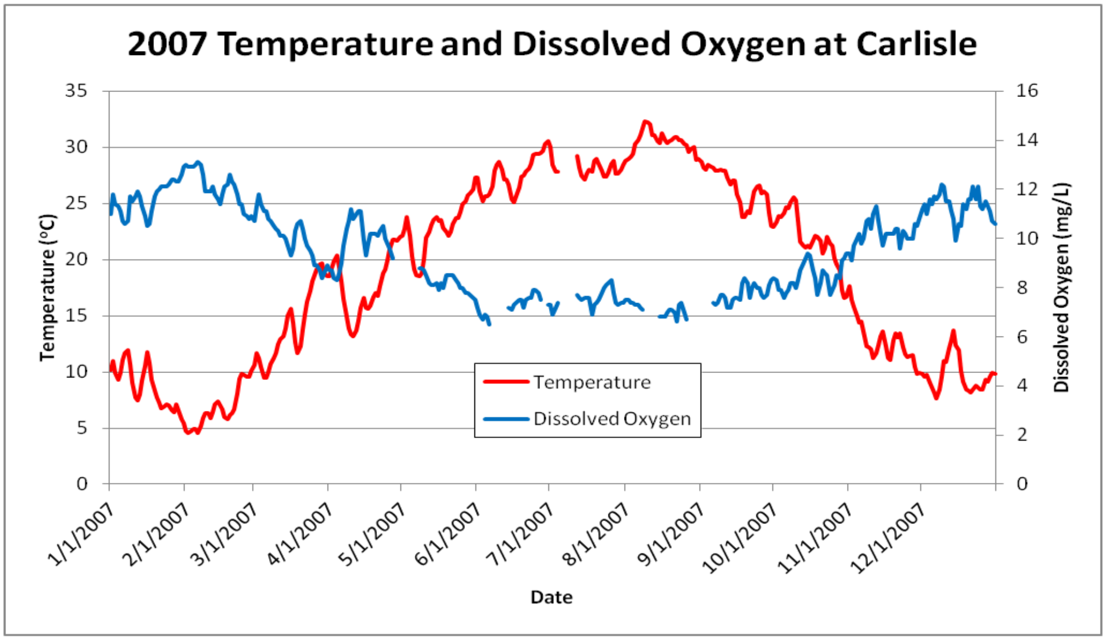
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-129 TEMPERATURE AND DISSOLVED OXYGEN FOR 2005: UPSTREAM OF PARR RESERVOIR[A]



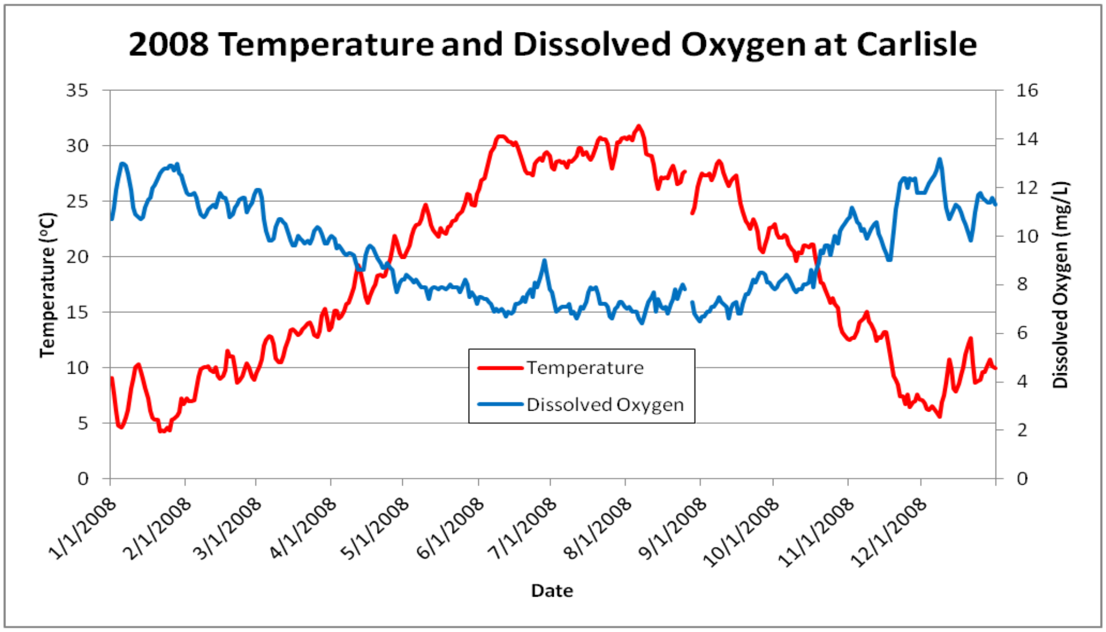
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-130 TEMPERATURE AND DISSOLVED OXYGEN FOR 2006: UPSTREAM OF PARR RESERVOIR[A]



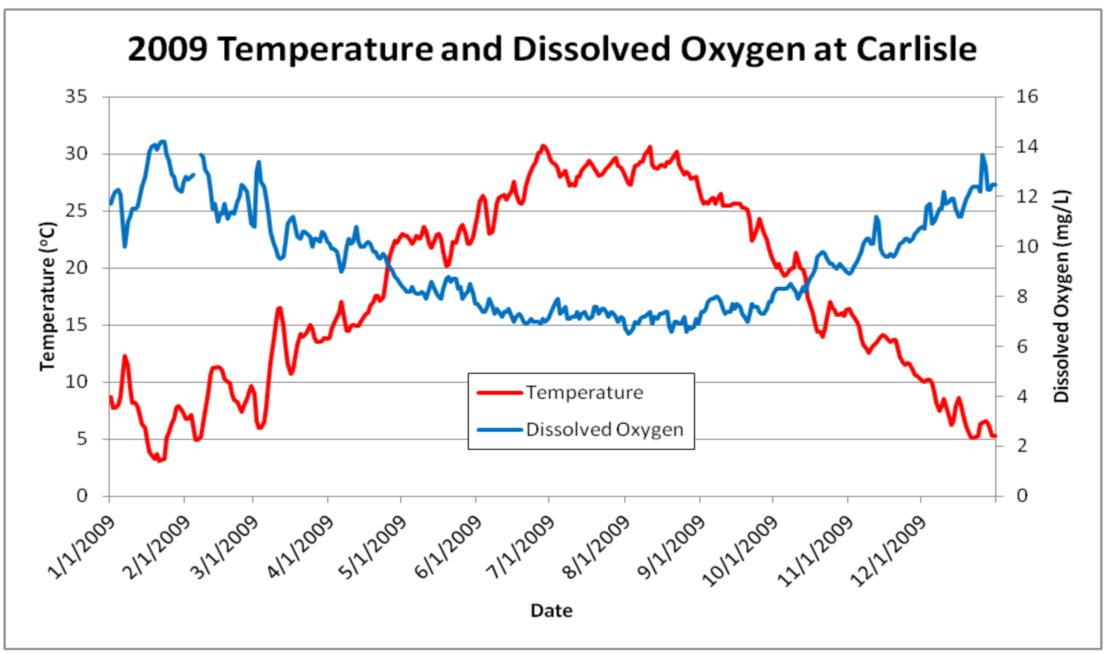
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-131 TEMPERATURE AND DISSOLVED OXYGEN FOR 2007: UPSTREAM OF PARR RESERVOIR[A]



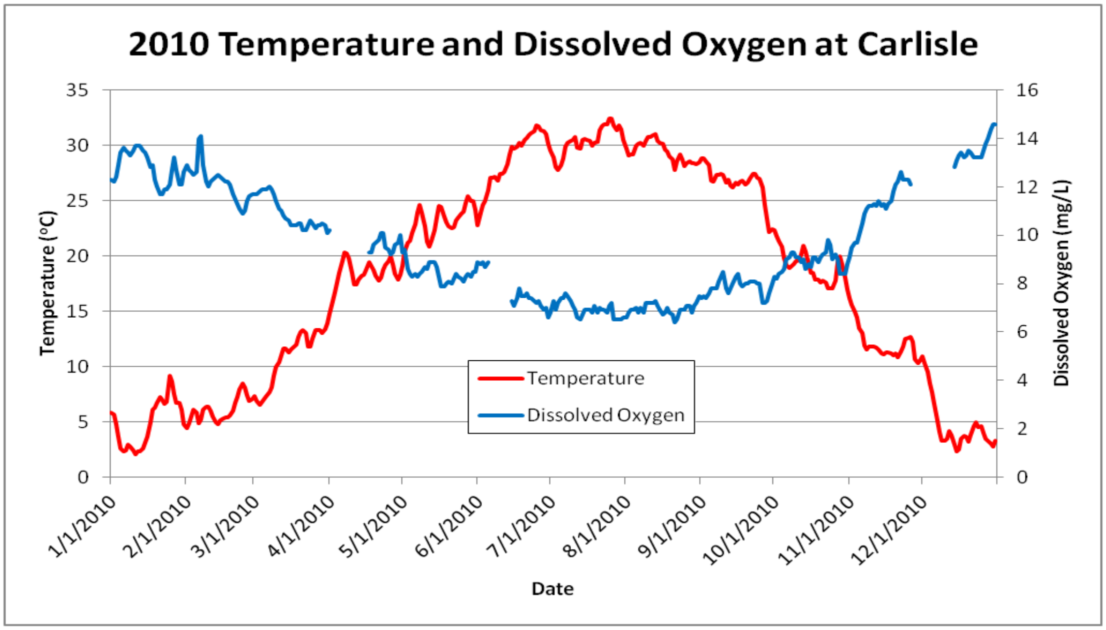
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-132 TEMPERATURE AND DISSOLVED OXYGEN FOR 2008: UPSTREAM OF PARR RESERVOIR[A]



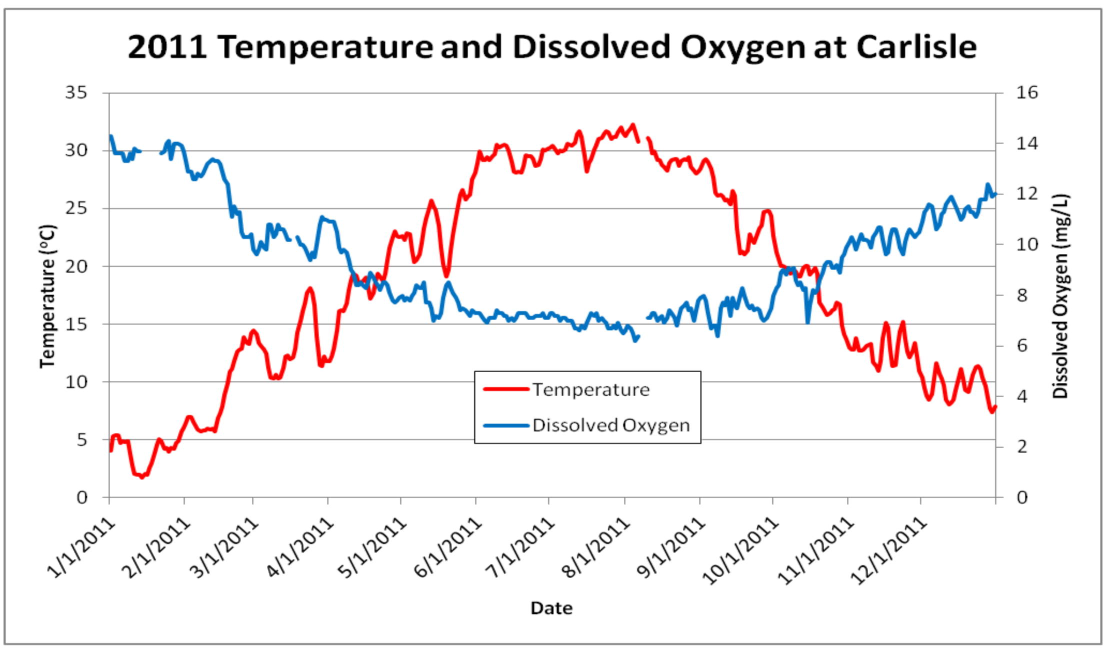
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-133 TEMPERATURE AND DISSOLVED OXYGEN FOR 2009: UPSTREAM OF PARR RESERVOIR[A]



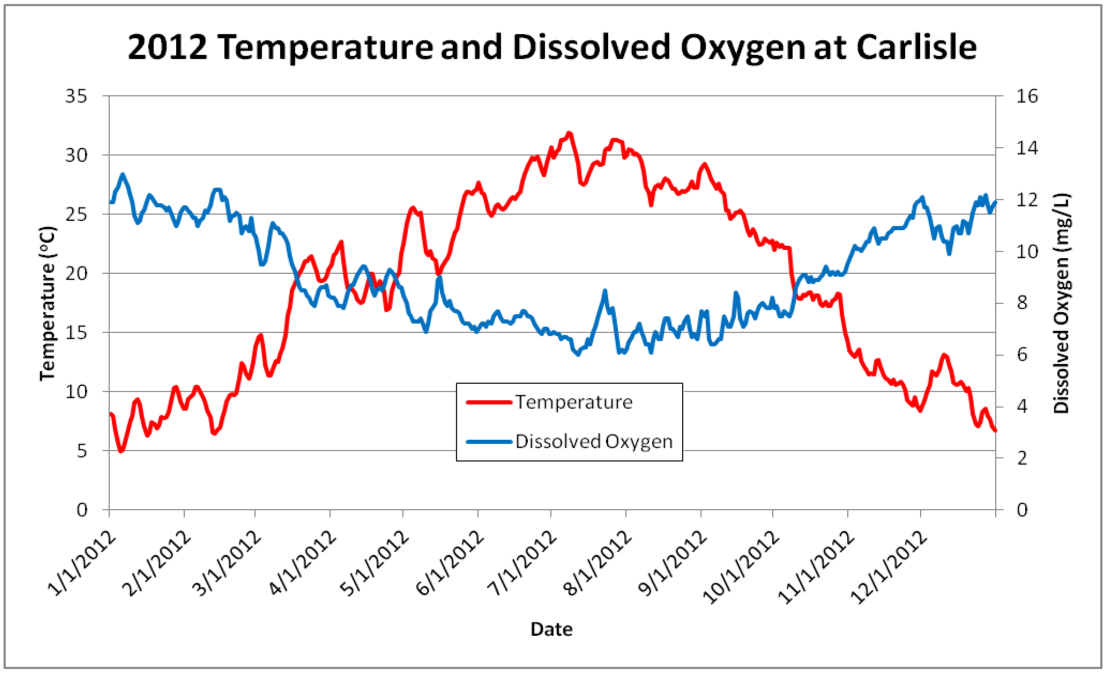
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-134 TEMPERATURE AND DISSOLVED OXYGEN FOR 2010: UPSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-135 TEMPERATURE AND DISSOLVED OXYGEN FOR 2011: UPSTREAM OF PARR RESERVOIR[A]

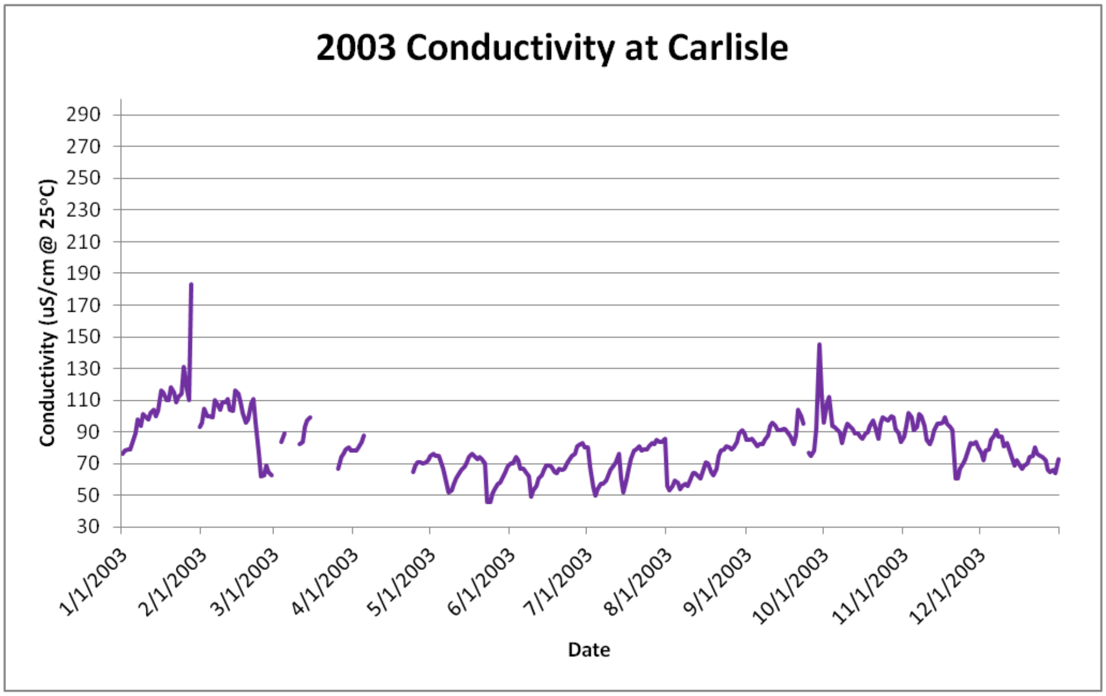


[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-136 TEMPERATURE AND DISSOLVED OXYGEN FOR 2012: UPSTREAM OF PARR RESERVOIR[A]

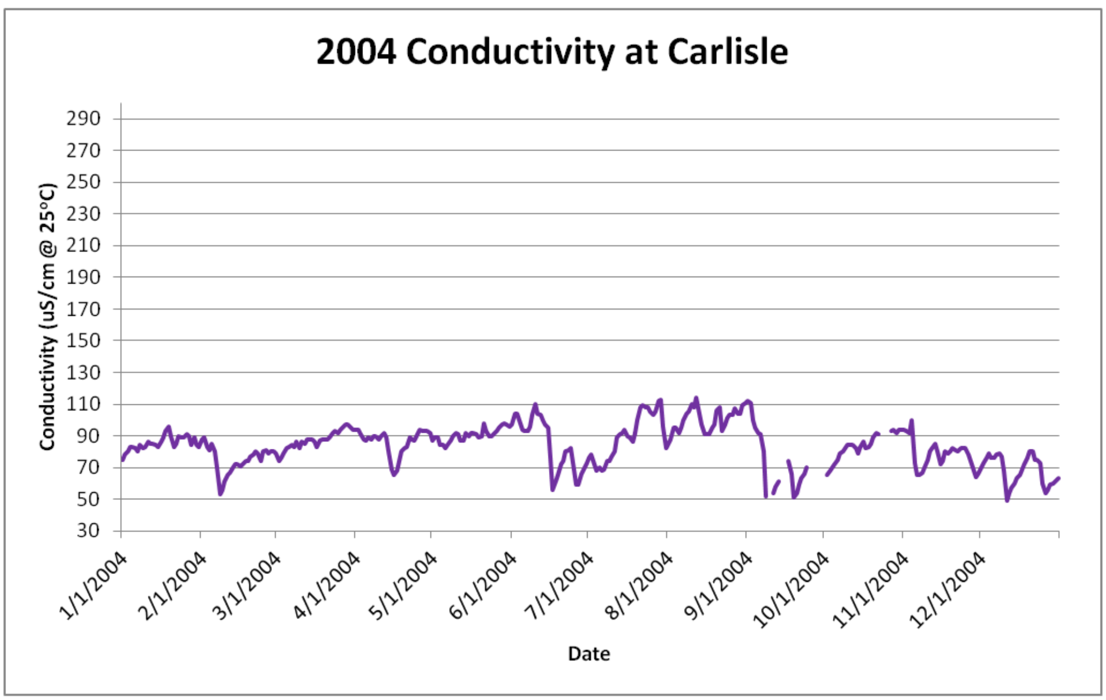
3.3.1.2 CONDUCTIVITY

The conductivity measured at the USGS site 02156500 ranged from approximately 50 µS/cm to 150 µS/cm over the last ten years, except for 2007 and 2008 when the conductivity spiked up to 270 µS/cm. Daily readings for conductivity from January of 2003 through December of 2012 at the USGS site located at Carlisle on the Broad River are shown in the figures below.



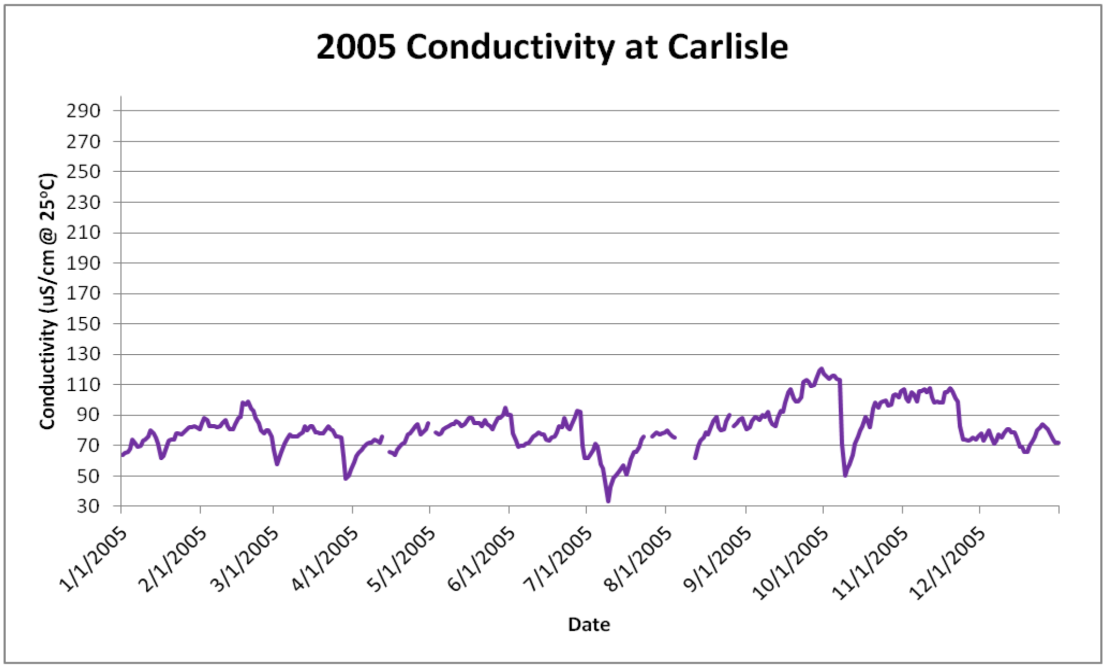
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-137 CONDUCTIVITY FOR 2003: UPSTREAM OF PARR RESERVOIR[A]



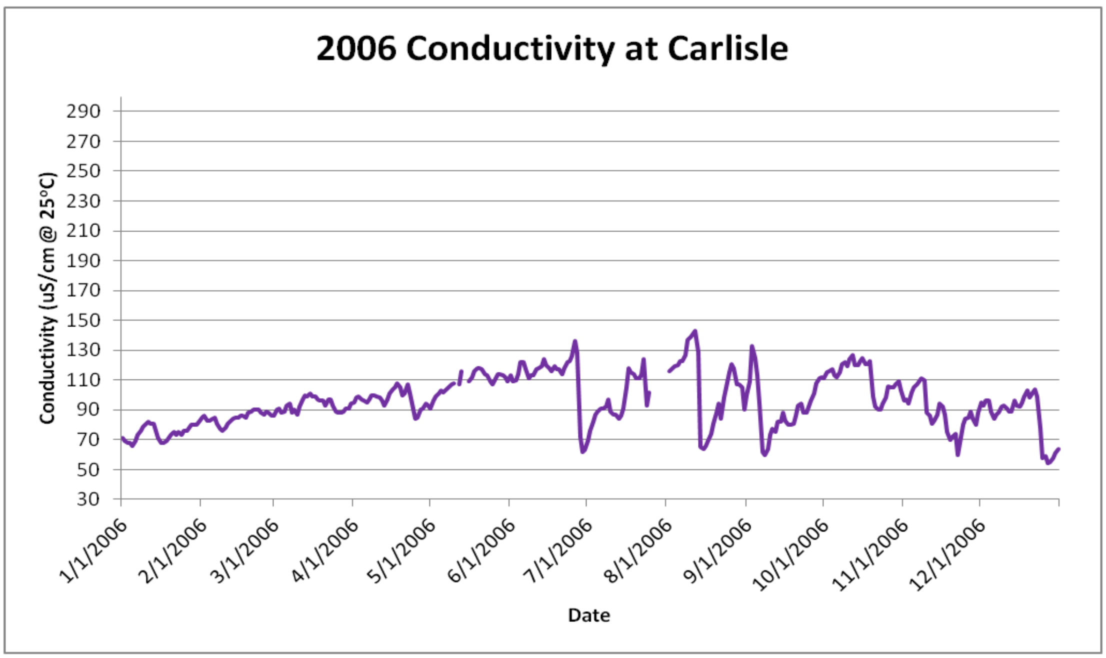
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-138 CONDUCTIVITY FOR 2004: UPSTREAM OF PARR RESERVOIR[A]



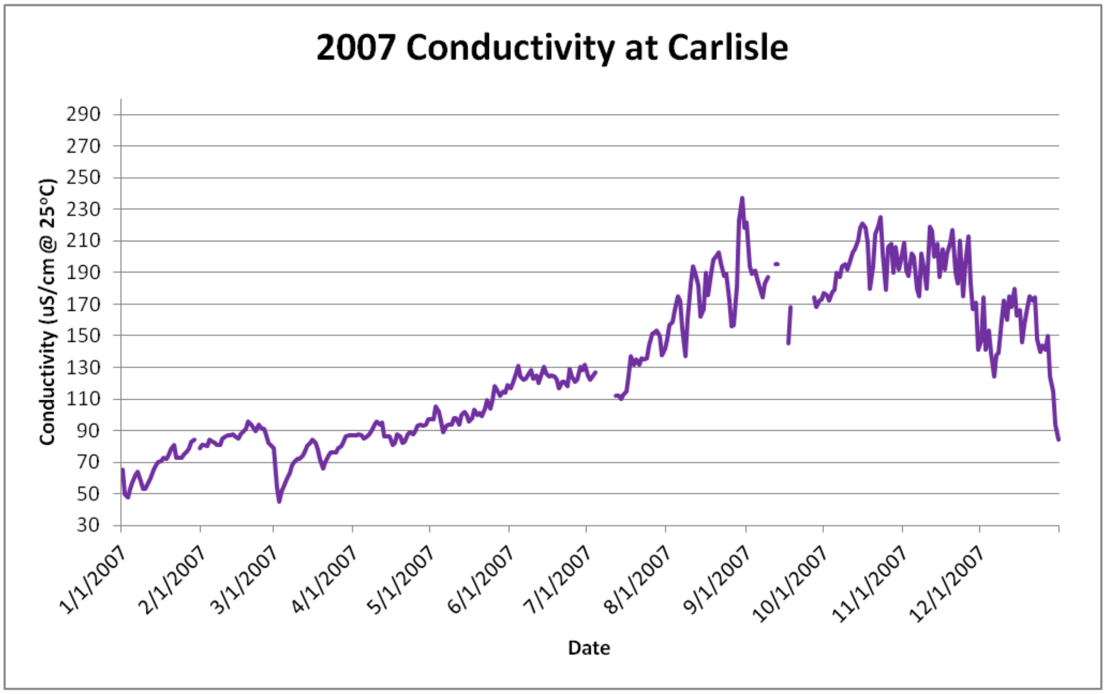
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-139 CONDUCTIVITY FOR 2005: UPSTREAM OF PARR RESERVOIR[A]



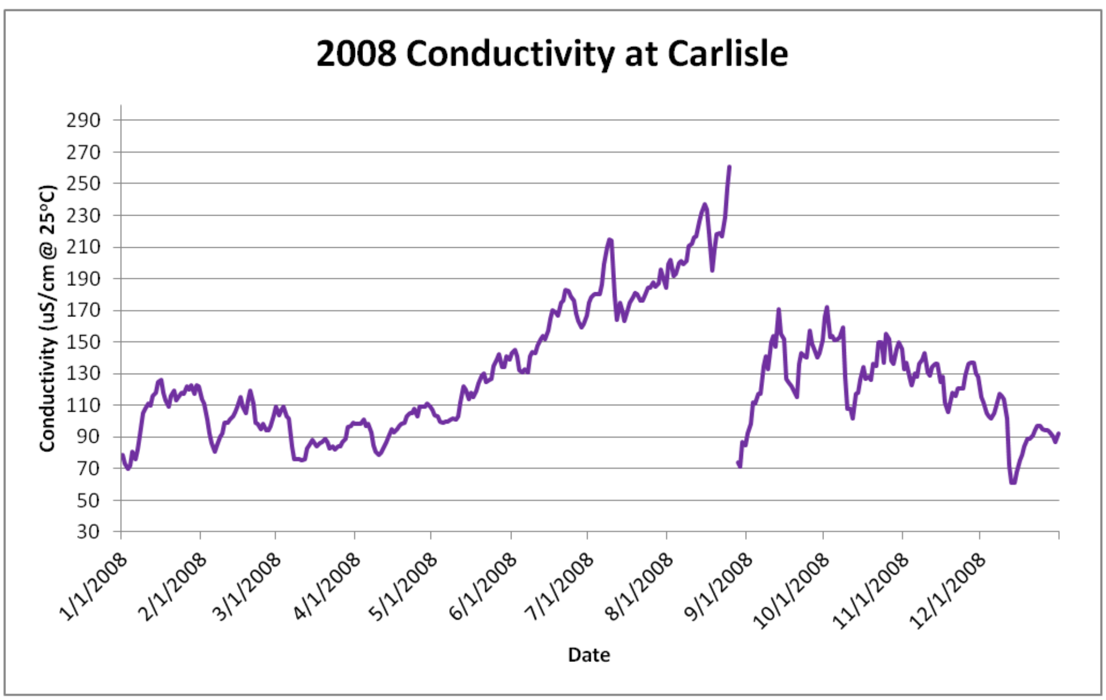
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-140 CONDUCTIVITY FOR 2006: UPSTREAM OF PARR RESERVOIR[A]



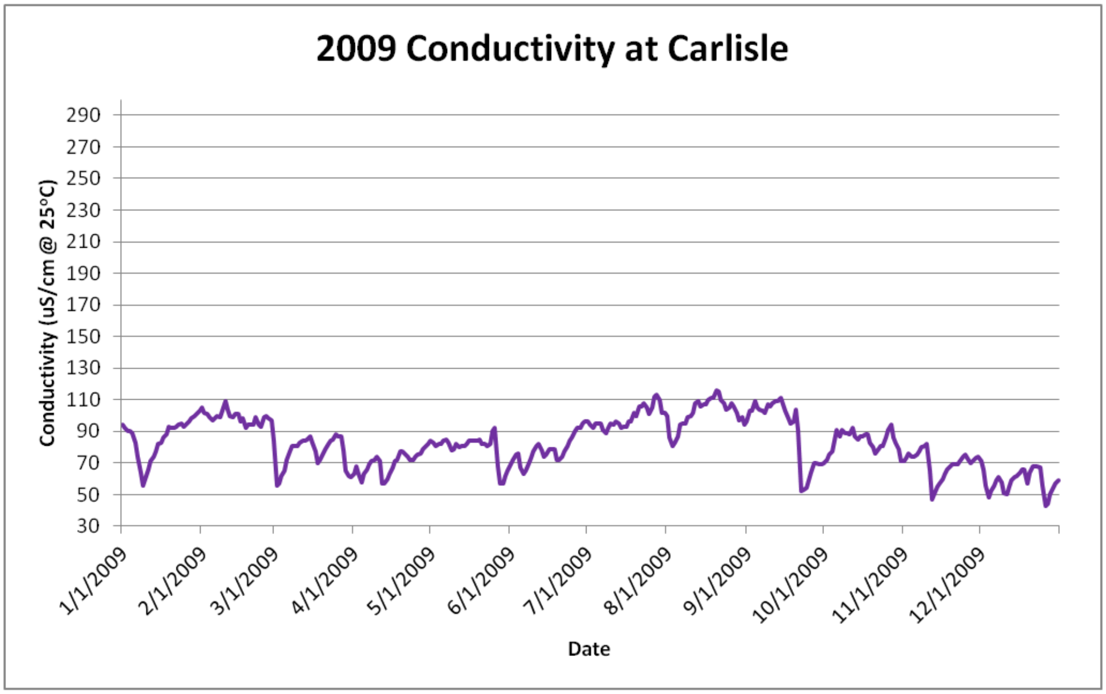
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-141 CONDUCTIVITY FOR 2007: UPSTREAM OF PARR RESERVOIR[A]



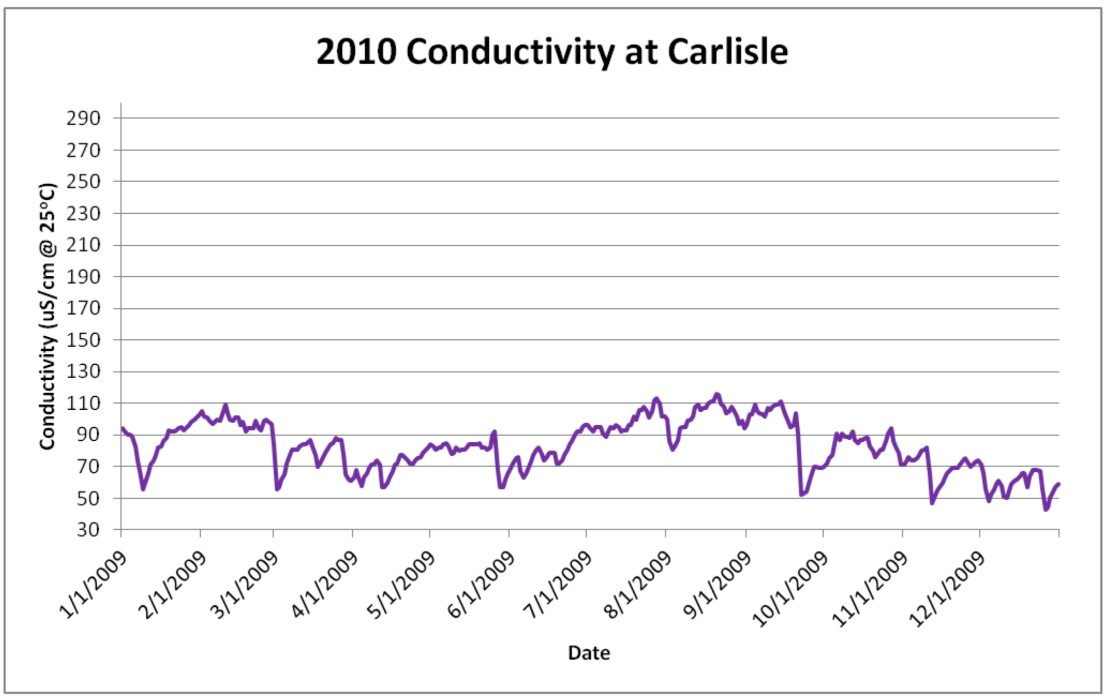
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-142 CONDUCTIVITY FOR 2008: UPSTREAM OF PARR RESERVOIR[A]



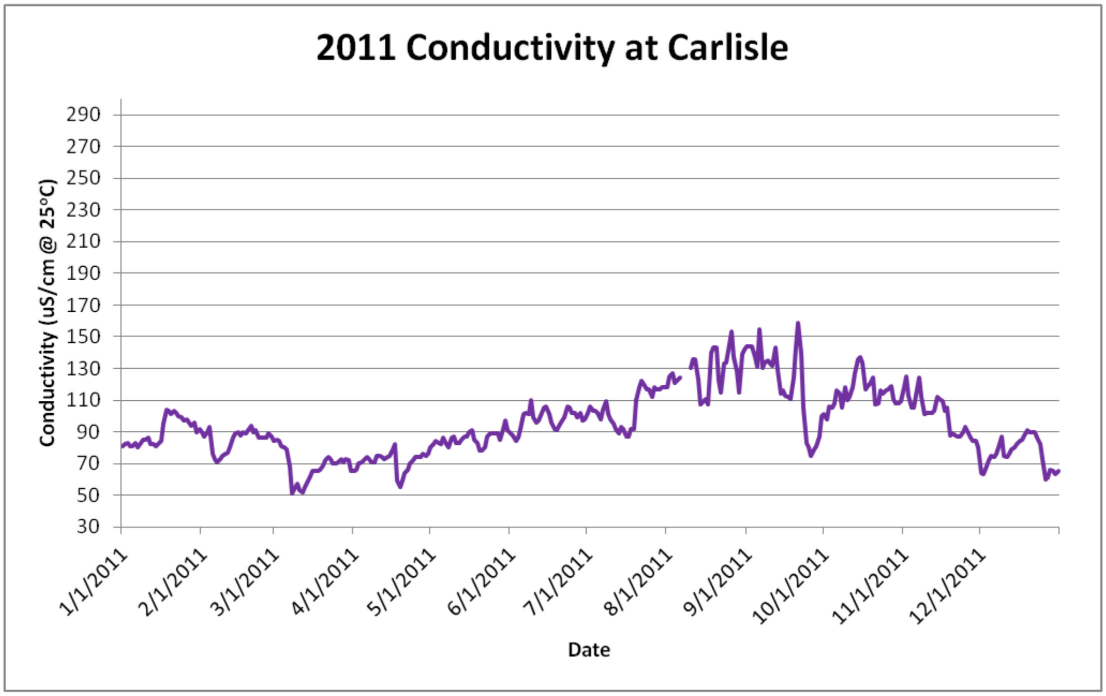
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-143 CONDUCTIVITY FOR 2009: UPSTREAM OF PARR RESERVOIR[A]



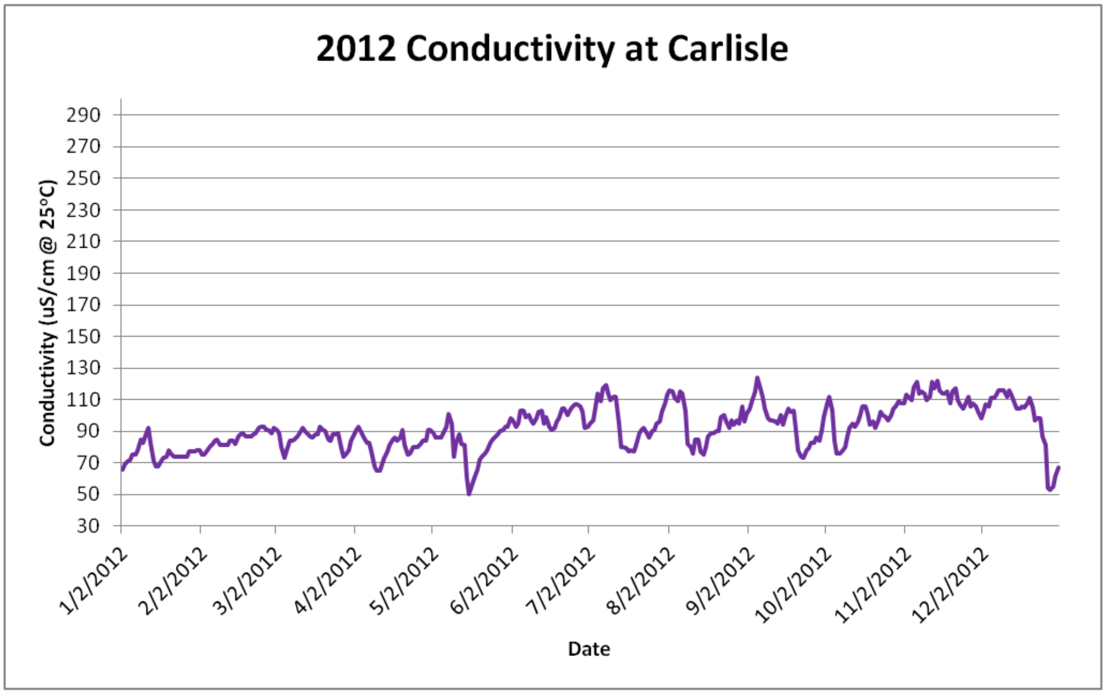
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-144 CONDUCTIVITY FOR 2010: UPSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-145 CONDUCTIVITY FOR 2011: UPSTREAM OF PARR RESERVOIR[A]

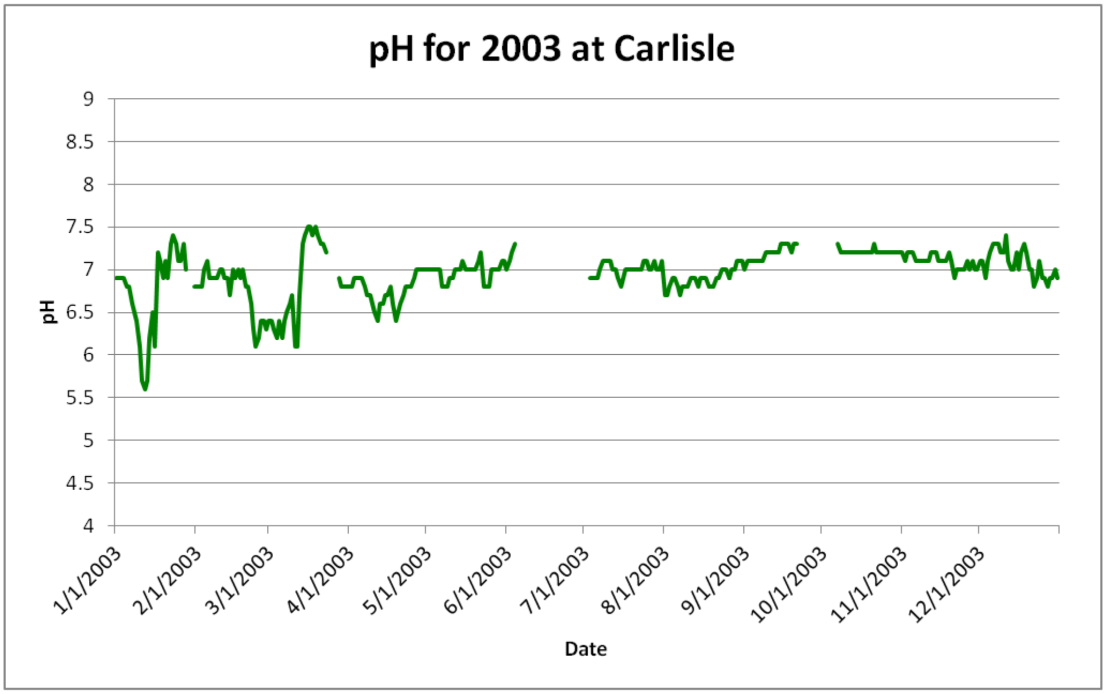


[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-146 CONDUCTIVITY FOR 2012: UPSTREAM OF PARR RESERVOIR[A]

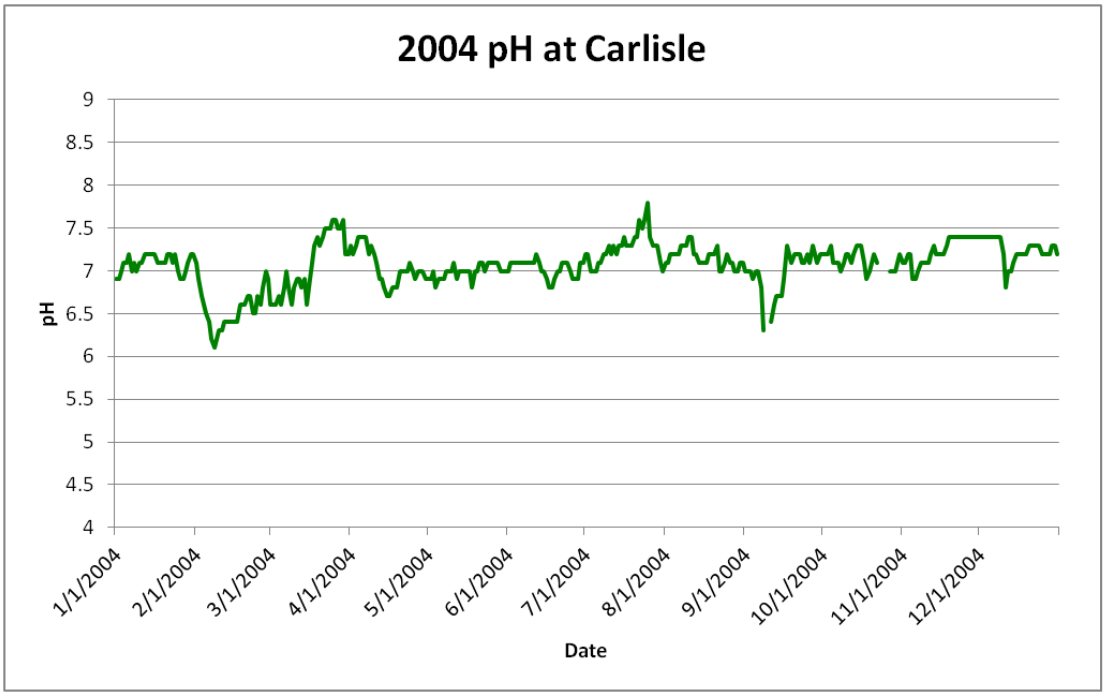
3.3.1.3 PH

Generally, the pH at the USGS monitoring site 02156500 is within the State Standards of 6.5 to 8.0, with few instances of a daily pH reading of below 6.5 in 2003 and 2004.



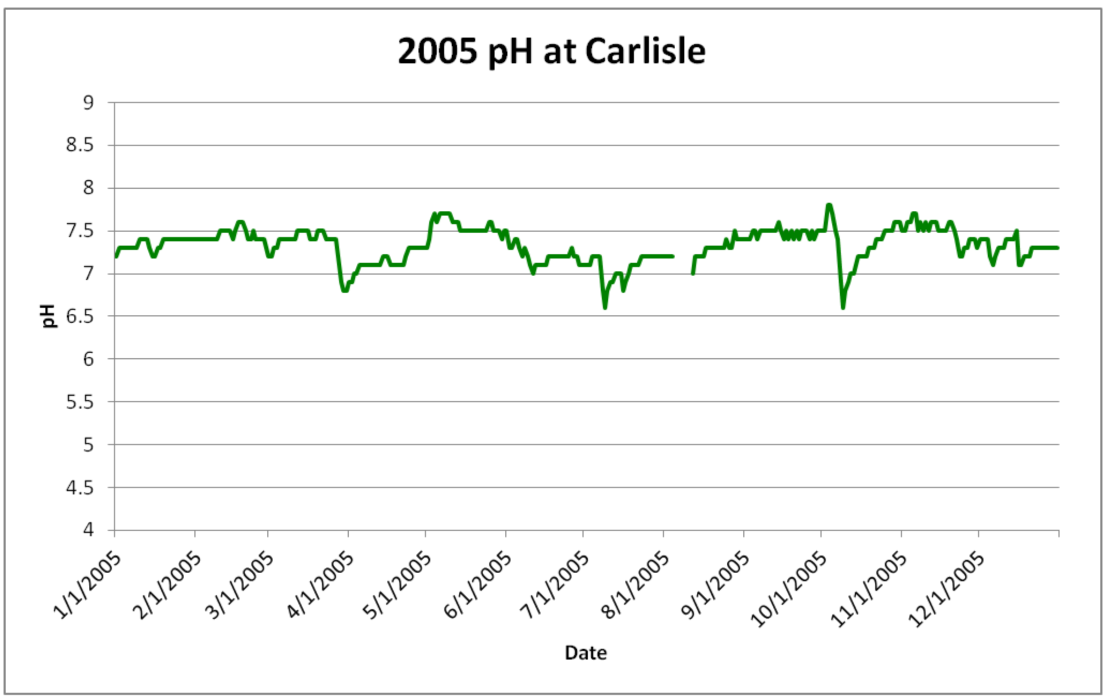
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-147 PH FOR 2003: UPSTREAM OF PARR RESERVOIR[A]



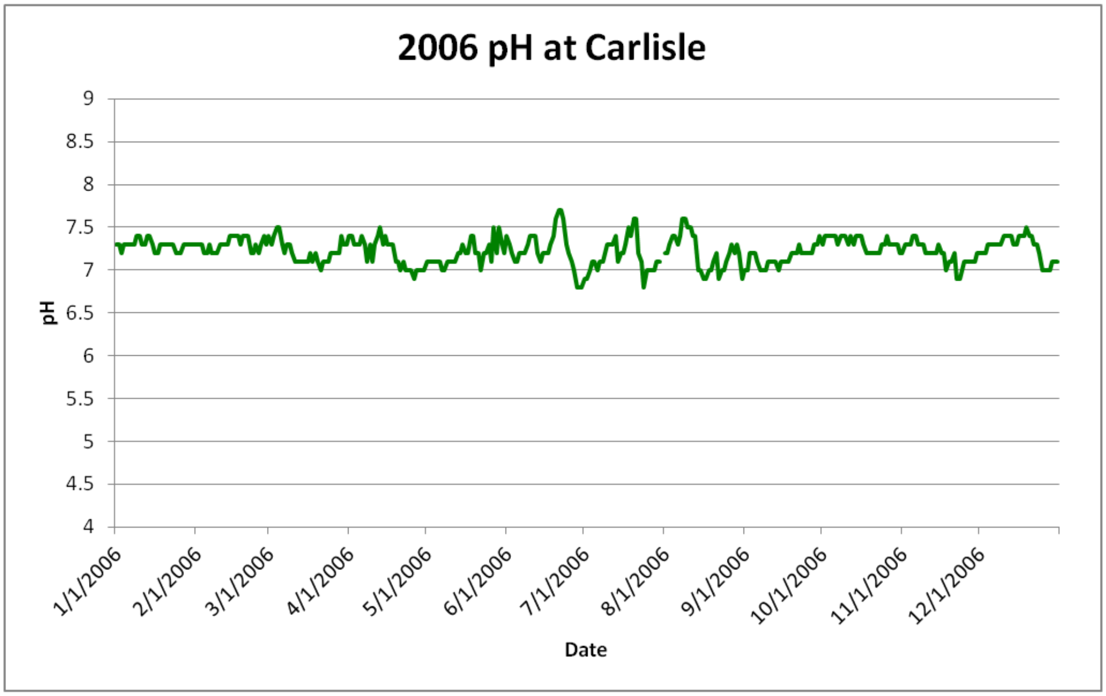
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-148 PH FOR 2004: UPSTREAM OF PARR RESERVOIR[A]



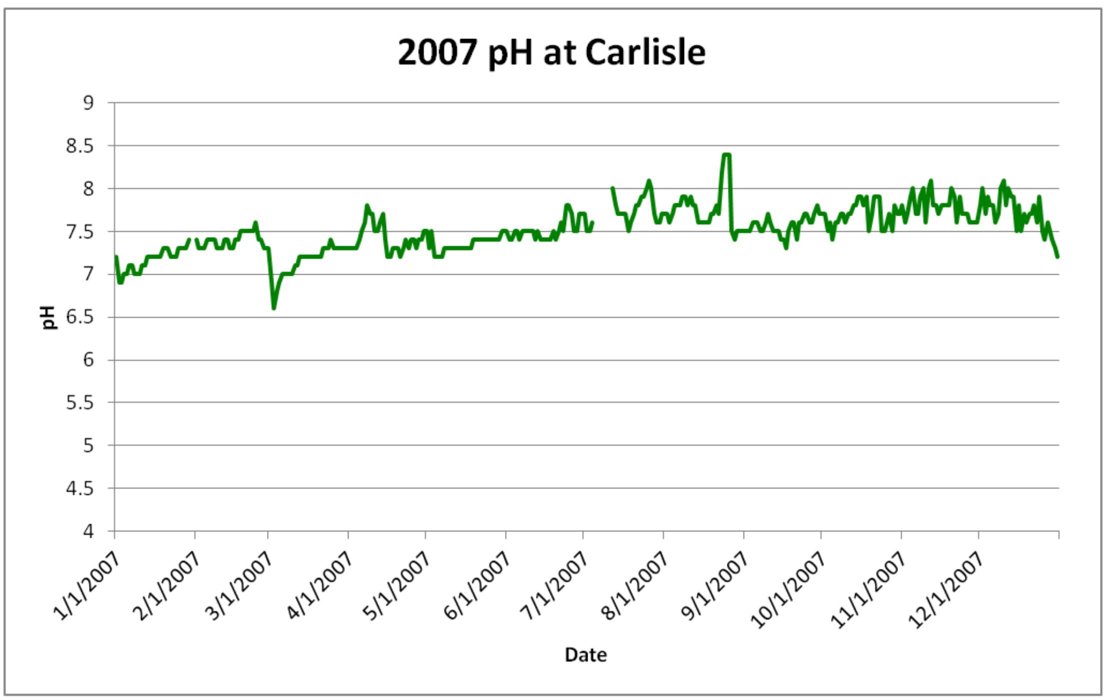
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-149 PH FOR 2005: UPSTREAM OF PARR RESERVOIR[A]



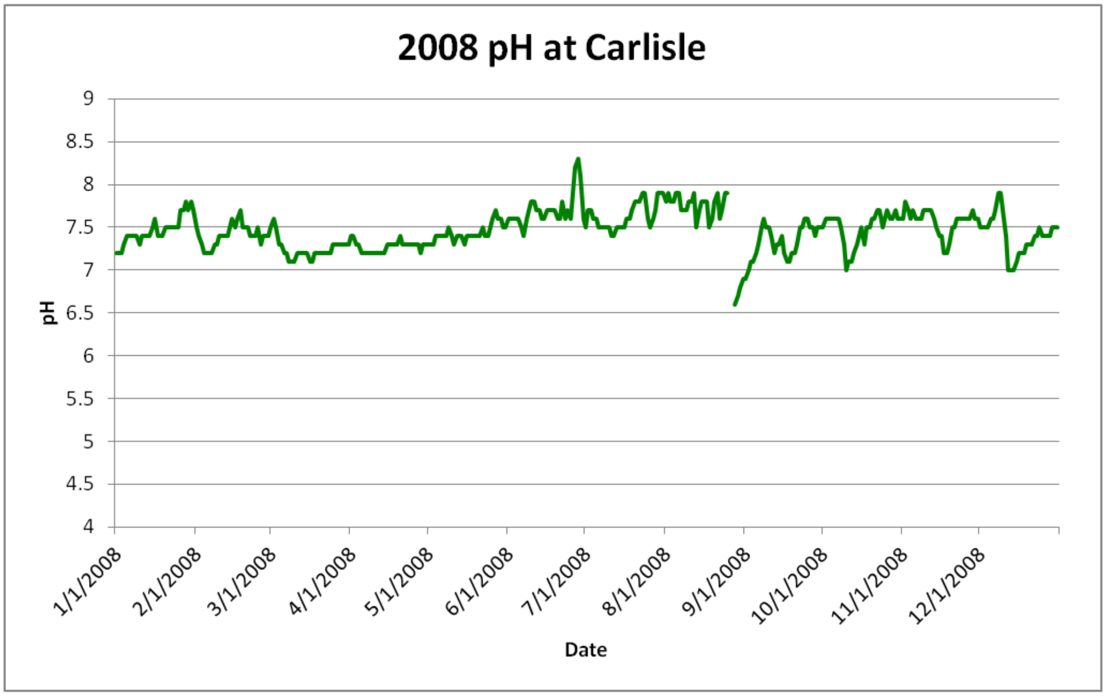
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-150 PH FOR 2006: UPSTREAM OF PARR RESERVOIR[A]



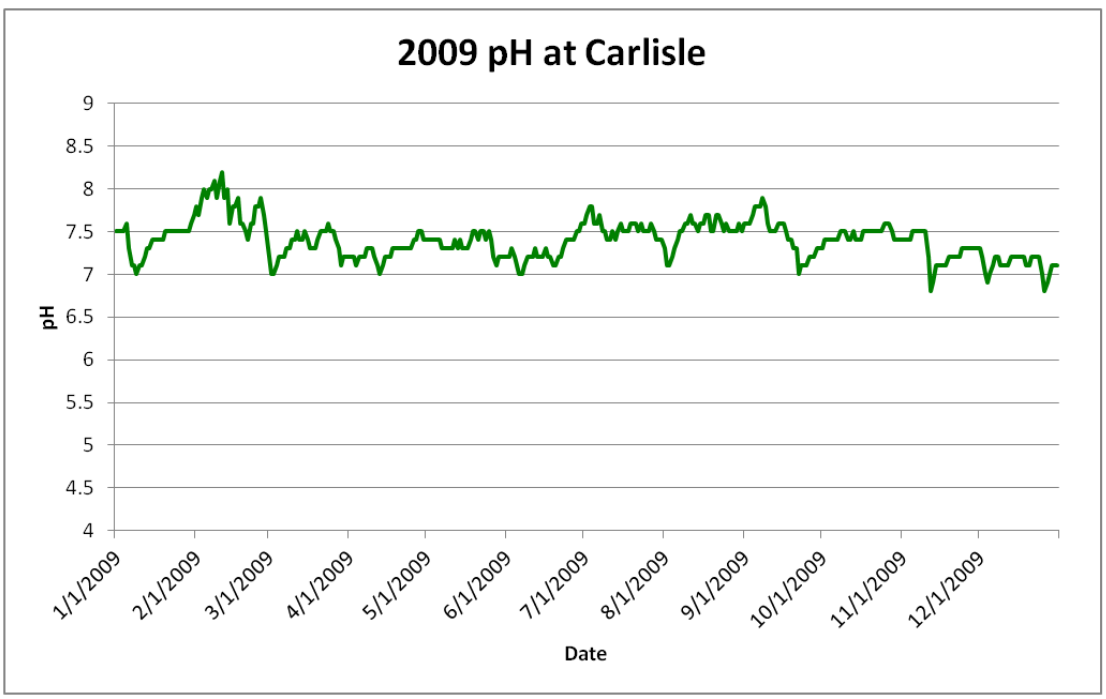
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-151 PH FOR 2007: UPSTREAM OF PARR RESERVOIR[A]



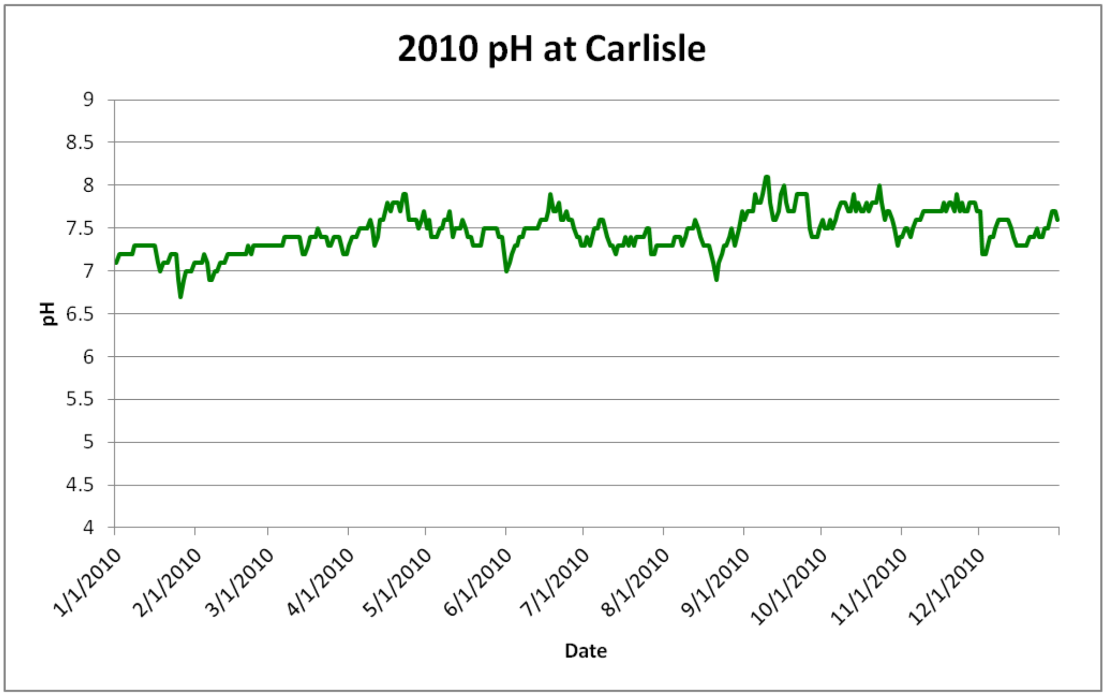
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-152 PH FOR 2008: UPSTREAM OF PARR RESERVOIR[A]



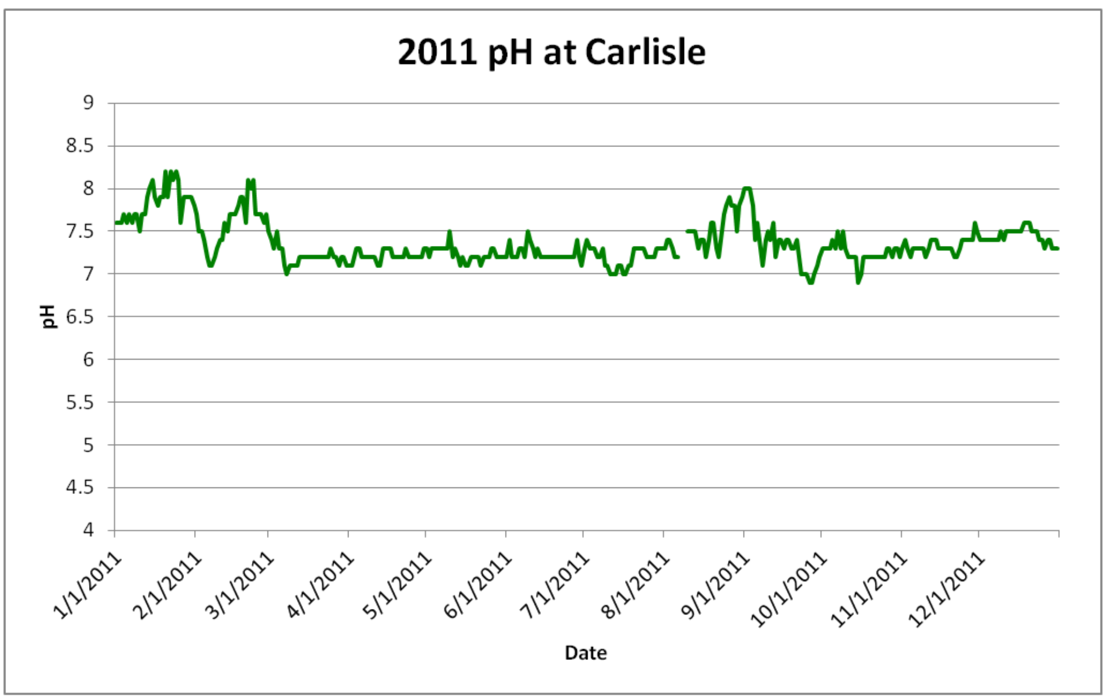
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-153 PH FOR 2009: UPSTREAM OF PARR RESERVOIR[A]



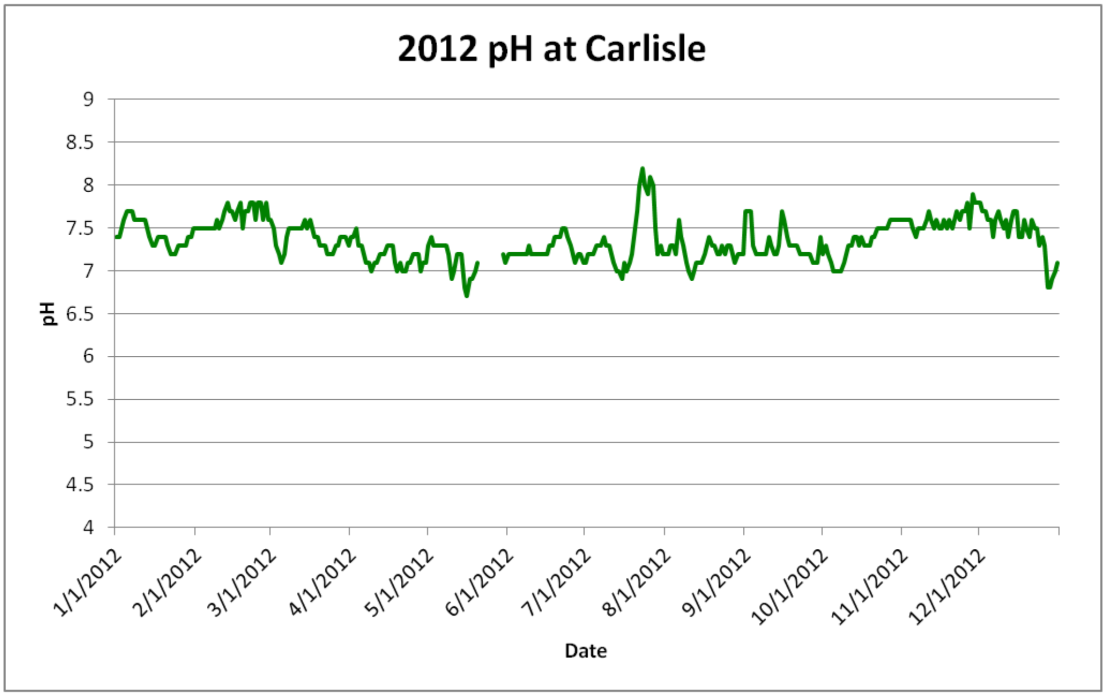
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-154 pH FOR 2010: UPSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-155 pH FOR 2011: UPSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-156 pH FOR 2012: UPSTREAM OF PARR RESERVOIR[A]

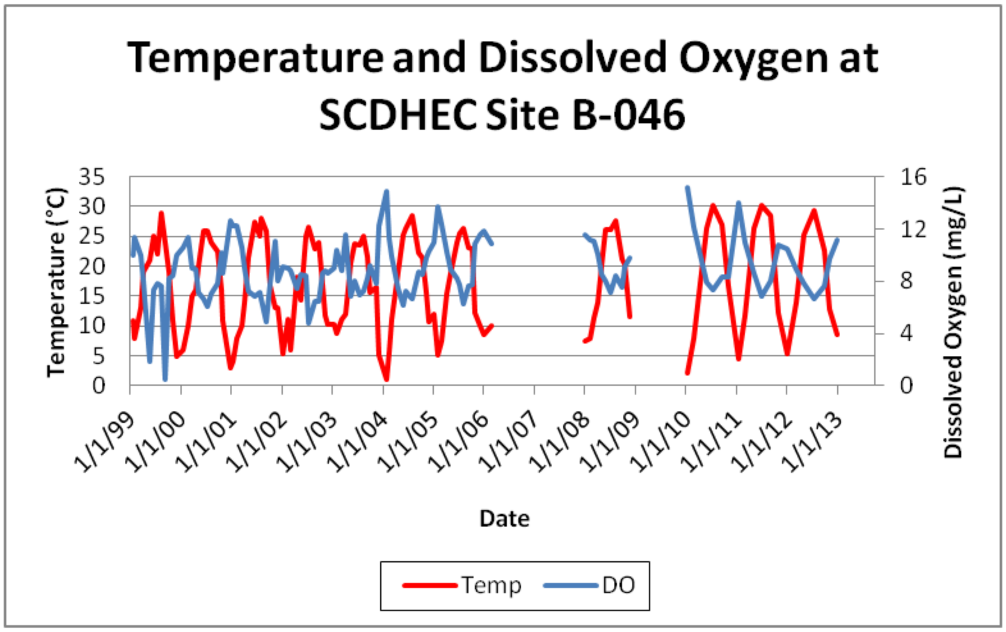
3.3.2 SCDHEC DATA

3.3.2.1 MONITORING STATION B-046

While samples collected from SCDHEC monitoring station B-046, Broad River at SC 72/215/121 bridge 3 miles E of Carlisle, have been above the allowed limits for some of the parameters discussed below in the past, this site is currently without impairment and is not listed on the 2012 303(d) list.

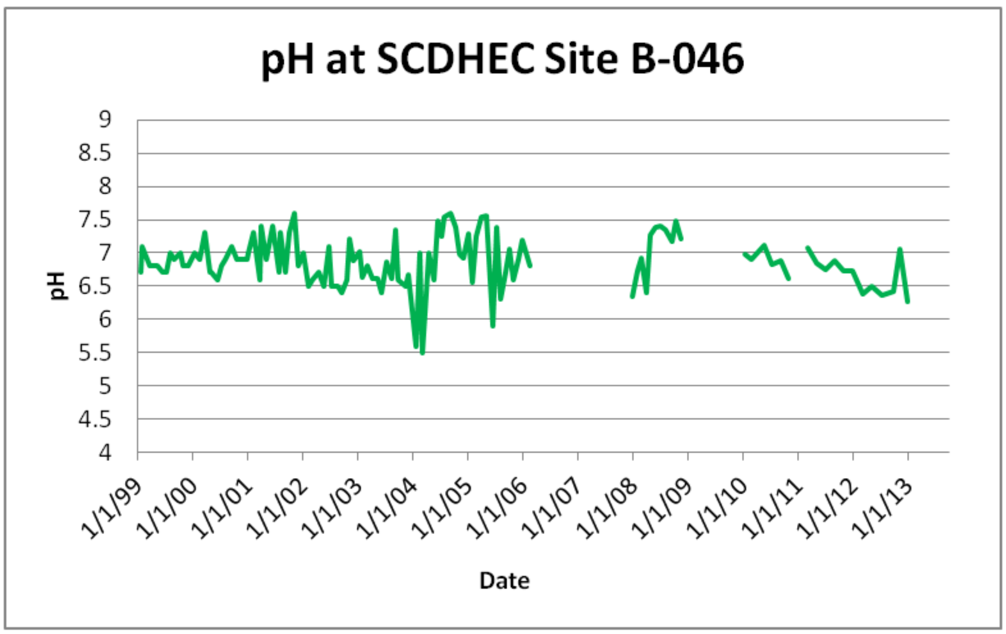
Temperature, DO, pH, and Turbidity

The following data was collected from 1999 through 2013 at the SCDHEC monitoring station B-046, located upstream of the Parr Reservoir. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



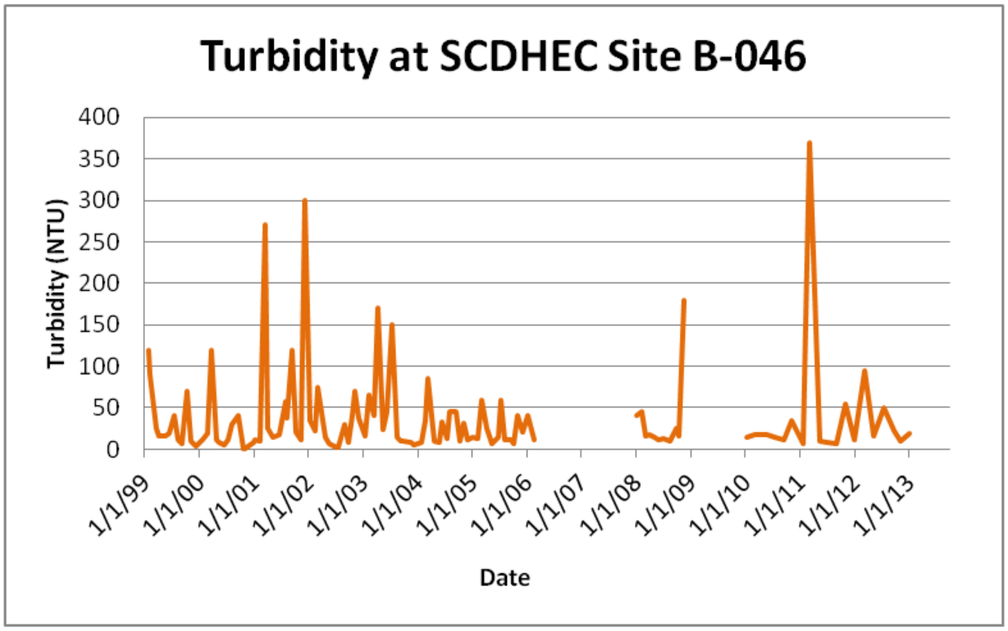
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-157 WATER TEMPERATURE AND DISSOLVED OXYGEN AT SCDHEC MONITORING STATION B-046[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-158 PH AT SCDHEC MONITORING STATION B-046[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-159 TURBIDITY AT SCDHEC MONITORING STATION B-046[A]

Metals

Metals data was collected on a quarterly basis from 1999 through 2012 at SCDHEC monitoring site B-046 and is presented in the table below. As shown in Table 3-25, the SCDHEC core indicator metals (Table 2-3) have been consistently measured as Present Below Quantification Limit (PBQL) at site B-046, indicating the river supports aquatic life use.

TABLE 3-25 METALS PRESENT AT SCDHEC MONITORING STATION B-046[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
3/23/99	PBQL	PBQL	PBQL	0.99	PBQL	-	0.04	PBQL	PBQL	PBQL
6/17/99	PBQL	PBQL	PBQL	1.1	PBQL	-	0.07	PBQL	PBQL	0.02
9/7/99	PBQL	PBQL	PBQL	0.4	PBQL	-	0.09	PBQL	PBQL	PBQL
3/23/00	0.01	PBQL	PBQL	9.1	PBQL	-	0.29	PBQL	PBQL	0.03
6/15/00	PBQL	PBQL	PBQL	0.34	PBQL	-	0.1	PBQL	PBQL	PBQL
9/20/00	PBQL	PBQL	PBQL	2.3	PBQL	-	0.12	PBQL	PBQL	0.01
12/28/00	PBQL	PBQL	PBQL	1.4	PBQL	-	0.12	PBQL	PBQL	-
3/21/01	PBQL	PBQL	PBQL	11	PBQL	-	0.55	PBQL	PBQL	0.02
6/19/01	PBQL	PBQL	PBQL	1.8	PBQL	-	0.15	PBQL	PBQL	0.012
9/10/01	PBQL	PBQL	PBQL	7	PBQL	-	0.36	PBQL	PBQL	0.017
12/4/01	PBQL	PBQL	PBQL	5.2	PBQL	-	0.3	PBQL	PBQL	PBQL
3/5/02	PBQL	PBQL	PBQL	1.3	PBQL	3.1	0.13	PBQL	PBQL	PBQL
6/24/02	PBQL	PBQL	PBQL	0.39	PBQL	-	0.17	PBQL	PBQL	PBQL
9/23/02	PBQL	PBQL	0.018	0.58	PBQL	-	0.18	PBQL	PBQL	PBQL
12/3/02	PBQL	PBQL	PBQL	1	PBQL	-	0.048	PBQL	PBQL	0.046
3/11/03	PBQL	PBQL	PBQL	3.1	PBQL	3	0.082	PBQL	PBQL	0.011
6/9/03	PBQL	PBQL	PBQL	3.1	PBQL	-	0.053	PBQL	PBQL	0.011
9/15/03	PBQL	PBQL	PBQL	0.76	PBQL	-	0.14	PBQL	PBQL	0.013
12/2/03	PBQL	PBQL	PBQL	0.68	PBQL	-	0.084	PBQL	PBQL	PBQL
3/10/04	PBQL	PBQL	PBQL	2.4	PBQL	2.4	0.11	PBQL	PBQL	PBQL
6/15/04	PBQL	PBQL	0.03	1.8	PBQL	-	0.066	PBQL	PBQL	0.067
9/15/04	PBQL	PBQL	PBQL	1.6	PBQL	-	0.06	PBQL	PBQL	0.042
12/1/04	PBQL	PBQL	PBQL	0.62	PBQL	-	0.026	PBQL	PBQL	0.022
3/3/05	PBQL	PBQL	PBQL	2.7	PBQL	-	0.047	PBQL	PBQL	0.037
6/20/05	PBQL	PBQL	PBQL	0.6	PBQL	-	0.038	PBQL	PBQL	0.032
9/13/05	PBQL	PBQL	PBQL	0.64	PBQL	-	0.036	PBQL	PBQL	PBQL
12/5/05	PBQL	PBQL	PBQL	2.6	PBQL	-	0.11	PBQL	PBQL	0.018
3/3/08	PBQL	PBQL	PBQL	0.88	PBQL	1.6	0.047	PBQL	PBQL	0.014
6/2/08	PBQL	PBQL	PBQL	0.45	PBQL	1.7	0.049	PBQL	PBQL	0.012
9/24/08	PBQL	PBQL	PBQL	0.6	PBQL	-	0.1	PBQL	PBQL	0.012
3/3/10	0.0013	PBQL	PBQL	0.76	PBQL	-	0.032	PBQL	PBQL	0.032
5/27/10	0.0073	PBQL	PBQL	0.69	PBQL	-	0.037	PBQL	PBQL	PBQL
7/15/10	PBQL	PBQL	PBQL	0.58	PBQL	-	0.055	PBQL	PBQL	0.017
9/16/10	PBQL	PBQL	PBQL	0.56	PBQL	-	0.035	PBQL	PBQL	0.016
11/2/10	0.0001	PBQL	PBQL	1	PBQL	-	0.042	PBQL	PBQL	PBQL
3/7/11	0.00035	0.0099	PBQL	9.4	PBQL	-	0.58	PBQL	PBQL	0.034
5/12/11	PBQL	PBQL	PBQL	0.49	PBQL	-	0.025	PBQL	PBQL	PBQL
9/1/11	PBQL	PBQL	PBQL	0.34	PBQL	-	0.036	PBQL	PBQL	PBQL
11/2/11	PBQL	PBQL	PBQL	2.5	PBQL	-	0.099	PBQL	PBQL	0.015
3/5/12	0.00026	PBQL	PBQL	4.3	PBQL	-	0.061	PBQL	PBQL	0.01
5/7/12	PBQL	PBQL	PBQL	0.7	PBQL	-	0.057	PBQL	PBQL	PBQL
9/25/12	PBQL	PBQL	PBQL	0.48	PBQL	-	0.064	PBQL	PBQL	0.011
11/7/12	PBQL	PBQL	PBQL	0.41	PBQL	-	0.033	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients and chlorophyll-a data was collected at SCDHEC monitoring station B-046 on a monthly basis from 1999 through 2012 and is presented in the table below. Site B-046 is located in the Broad River; the SCDHEC nutrient and chlorophyll-a standards only apply to reservoirs and therefore do not apply to this site. There are no nutrient and chlorophyll-a standards established for rivers.

TABLE 3-26 NUTRIENTS AT SCDHEC MONITORING STATION B-046[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
1/26/99	0.88	-	1/29/04	-	0.033
2/3/99	0.93	-	2/19/04	0.62	0.052
3/23/99	0.71	-	3/10/04	-	0.042
4/6/99	0.63	-	4/21/04	0.622	0.045
5/19/99	0.59	-	5/25/04	1.03	0.058
6/17/99	0.82	-	6/15/04	1.27	0.13
7/14/99	0.64	-	7/12/04	0.89	0.088
8/10/99	0.62	-	8/2/04	0.76	0.14
9/7/99	2.52	-	9/15/04	1.05	0.099
10/13/99	0.45	-	10/11/04	0.78	0.063
11/3/99	0.34	-	11/8/04	0.63	0.064
1/20/00	PBQL	-	12/1/04	PBQL	-
2/24/00	0.99	-	1/4/05	0.69	0.042
3/23/00	0.88	-	2/3/05	0.88	0.04
4/24/00	0.52	-	3/3/05	0.77	0.063
5/9/00	0.66	-	4/5/05	0.79	0.084
6/15/00	0.67	-	5/9/05	0.57	0.051
7/13/00	0.78	-	6/20/05	0.83	0.037
8/7/00	0.73	-	7/12/05	1.04	0.059
9/20/00	0.87	-	8/8/05	0.57	0.1
10/25/00	PBQL	-	9/13/05	0.64	0.07
11/2/00	PBQL	-	10/6/05	0.92	0.057
12/28/00	0.52	-	11/1/05	0.77	0.25
1/9/01	0.63	-	12/5/05	0.82	0.09
3/21/01	1.18	-	1/4/06	0.88	0.13
5/7/01	0.89	-	1/2/08	0.63	0.089
6/19/01	-	0.18	2/22/06	-	0.045
7/30/01	0.93	0.16	1/2/08	0.63	0.31
8/8/01	-	0.14	2/4/08	0.64	0.14
9/10/01	1.74	0.25	3/3/08	0.56	0.69
10/8/01	-	0.087	4/1/08	1.01	0.11
11/13/01	PBQL	0.11	5/1/08	0.67	0.18
12/4/01	-	0.71	6/2/08	1.2	0.13
1/9/02	0.67	0.12	7/2/08	0.9	0.24
2/13/02	2.384	1.1	8/11/08	-	0.29
3/5/02	-	0.14	9/24/08	0.86	0.09
4/24/02	1.38	0.19	10/16/08	0.75	0.15
5/21/02	-	0.035	11/18/08	0.55	0.18
6/24/02	1.26	0.18	1/13/10	0.67	0.056
7/17/02	-	PBQL	3/3/10	PBQL	0.1
8/28/02	2.36	0.07	5/27/10	0.94	0.16
9/23/02	-	0.043	7/15/10	1.58	0.34
10/21/02	1.25	0.088	9/16/10	1.3	0.46
11/7/02	-	0.12	11/2/10	1.13	0.16
12/3/02	0.78	0.045	1/18/11	PBQL	0.12
1/15/03	-	0.036	3/7/11	0.93	0.5
2/5/03	1.03	0.079	5/12/11	-	0.32
3/11/03	-	0.078	7/6/11	0.54	0.31
4/8/03	1.2	0.2	9/1/11	1.25	0.28
5/12/03	-	0.04	11/2/11	1.17	0.37
6/9/03	0.98	0.068	1/3/12	0.71	0.29
7/14/03	-	0.098	3/5/12	0.99	0.28
8/19/03	0.91	0.041	5/7/12	0.96	0.12
9/15/03	-	0.04	7/17/12	0.79	0.41
10/2/03	0.87	0.044	9/25/12	0.57	0.12
11/19/03	-	0.072	11/7/12	0.8	0.24
12/2/03	1.28	0.037	1/2/13	PBQL	0.092

[A] PBQL is Present Below Quantification Limit.

3.3.3 TURBIDITY DATA CONTRIBUTED BY SCDNR

The turbidity data displayed below was collected by SCDNR near USGS gage 02156500 as part of an ongoing four-year study entitled “Developing sediment management guidelines to enhance habitat and aquatic resources in the Broad River Basin, South Carolina.”

TABLE 3-27 TURBIDITY OF BROAD RIVER AT USGS GAGE 02156500

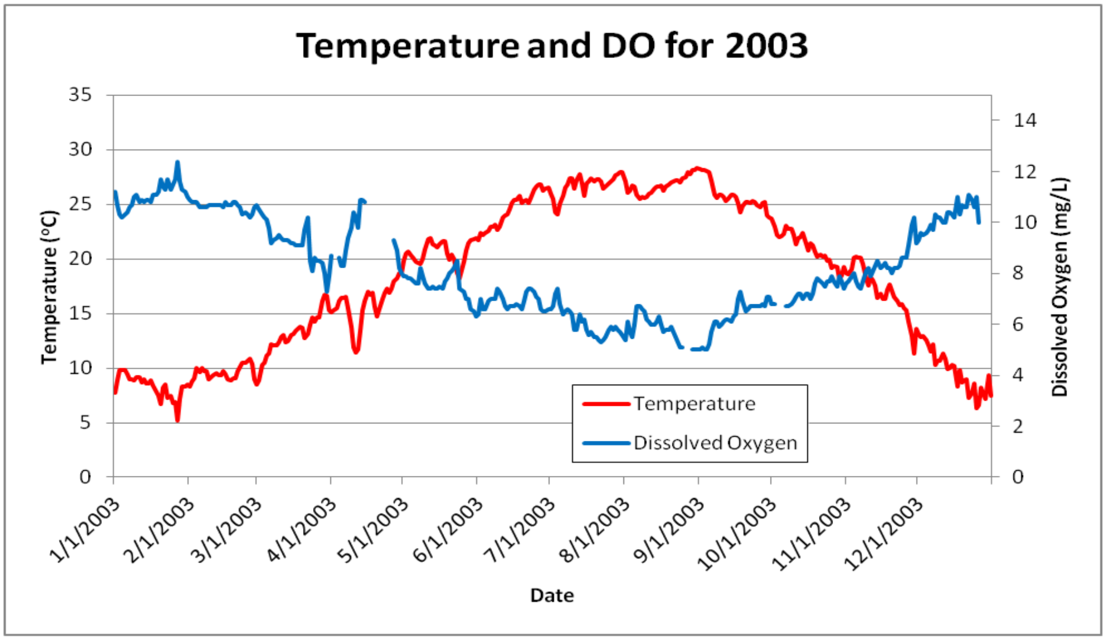
Date	Turbidity (NTU)
6/6/2012	[redacted]
6/20/2012	1.54
7/6/2012	6.93
7/12/2012	21.38
7/27/2012	6.32
8/7/2012	10.34
8/14/2012	26.30
8/20/2012	15.80
8/28/2012	14.80
9/7/2012	16.25
9/21/2012	17.85
10/10/2012	13.58
10/23/2012	7.24
11/14/2012	5.24
12/18/2012	8.17
1/24/2013	[redacted]
2/1/2013	115.00
2/8/2013	12.68
2/19/2013	10.53
2/27/2013	102.70
3/5/2013	10.82
3/13/2013	28.85
3/25/2013	26.31
4/4/2013	7.11
4/19/2013	5.65
4/29/2013	109.30
5/1/2013	58.81
5/6/2013	119.25
5/8/2013	94.13
5/24/2013	46.58
6/4/2013	11.79
6/11/2013	53.34
6/19/2013	20.00
7/5/2013	130.00
7/9/2013	62.03
7/16/2013	83.83
7/24/2013	78.53
8/1/2013	30.11
8/7/2013	49.90
8/8/2013	27.48
8/20/2013	13.88
8/29/2013	9.19

3.4 Broad River Downstream of Parr Shoals Dam

3.4.1 USGS Site 02160991

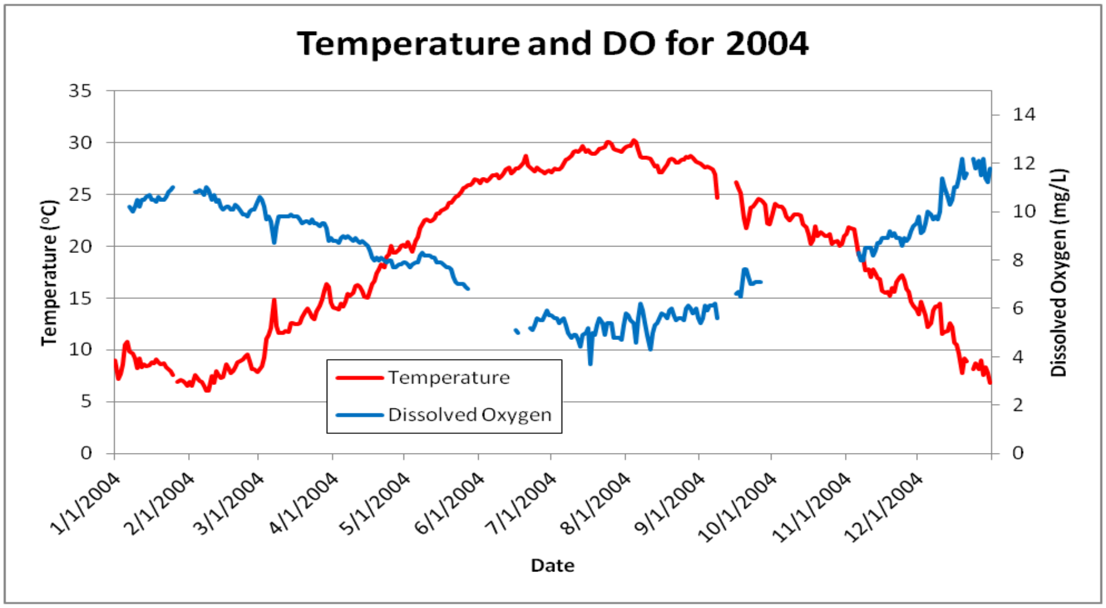
3.4.1.1 Temperature and Dissolved Oxygen

Water temperature at the USGS Site 02160991 ranges from approximately 5°C during the winter months to approximately 31°C during the summer. During the summer months, DO levels typically drop between the 5-6 mg/L range with very few instances of a DO level of 4 mg/L.



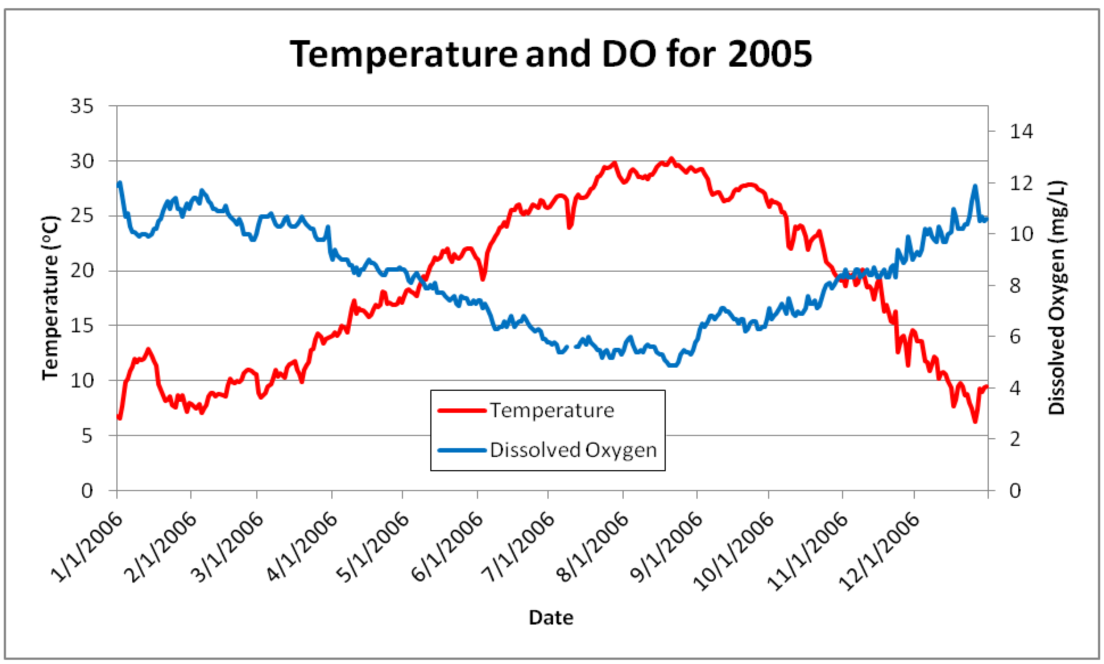
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

Figure 3-160 Temperature and Dissolved Oxygen for 2003 : Downstream of Parr Reservoir[A]



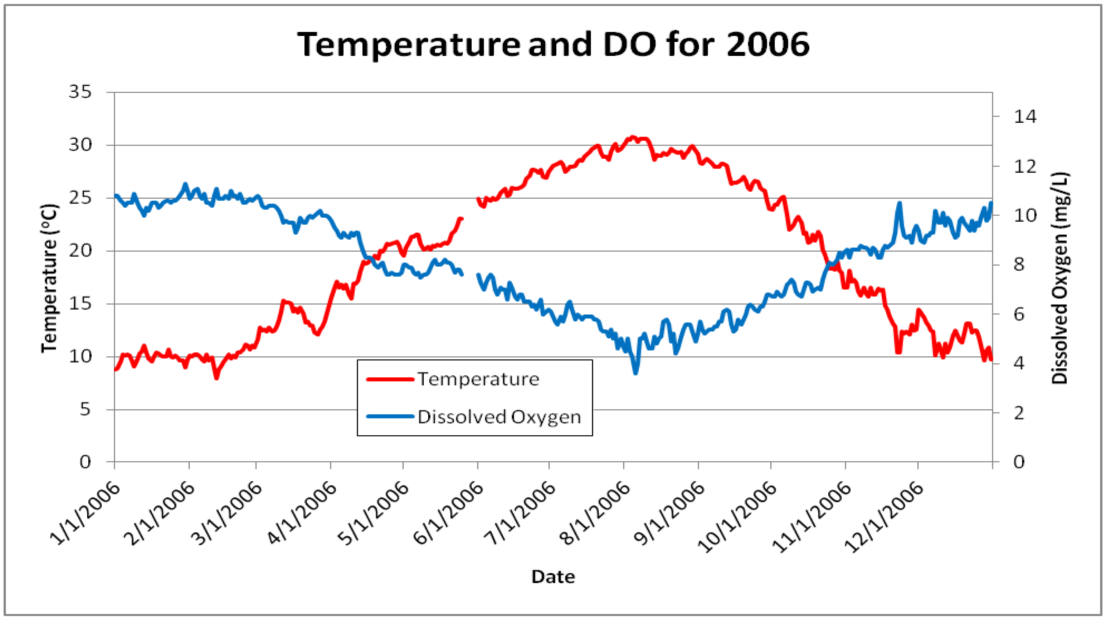
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-161 TEMPERATURE AND DISSOLVED OXYGEN FOR 2004: DOWNSTREAM OF PARR RESERVOIR[A]



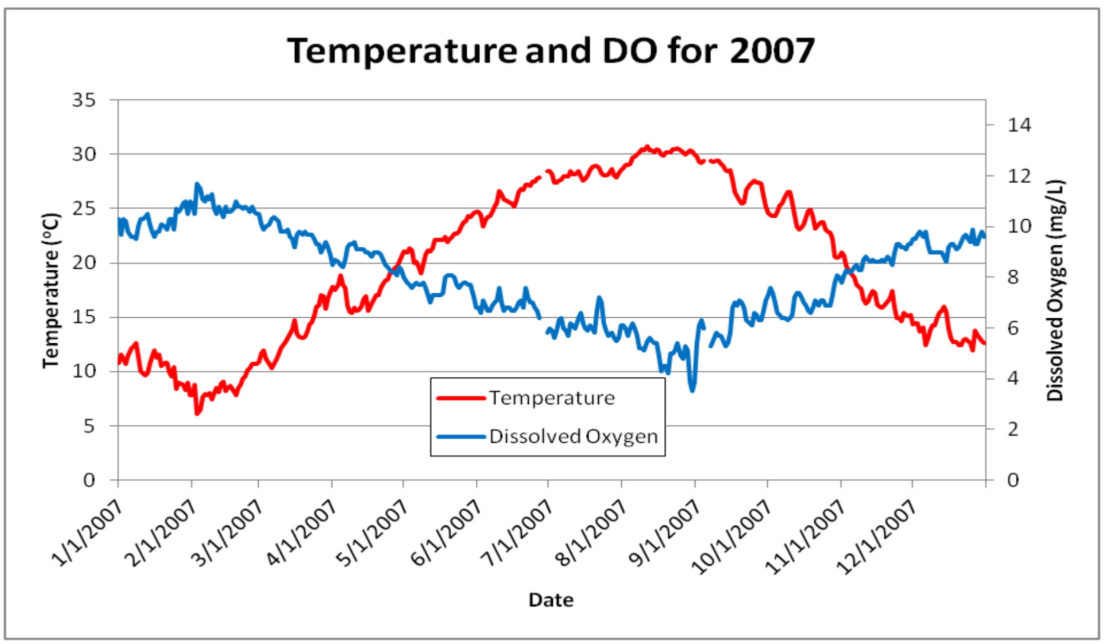
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-162 TEMPERATURE AND DISSOLVED OXYGEN FOR 2005: DOWNSTREAM OF PARR RESERVOIR[A]



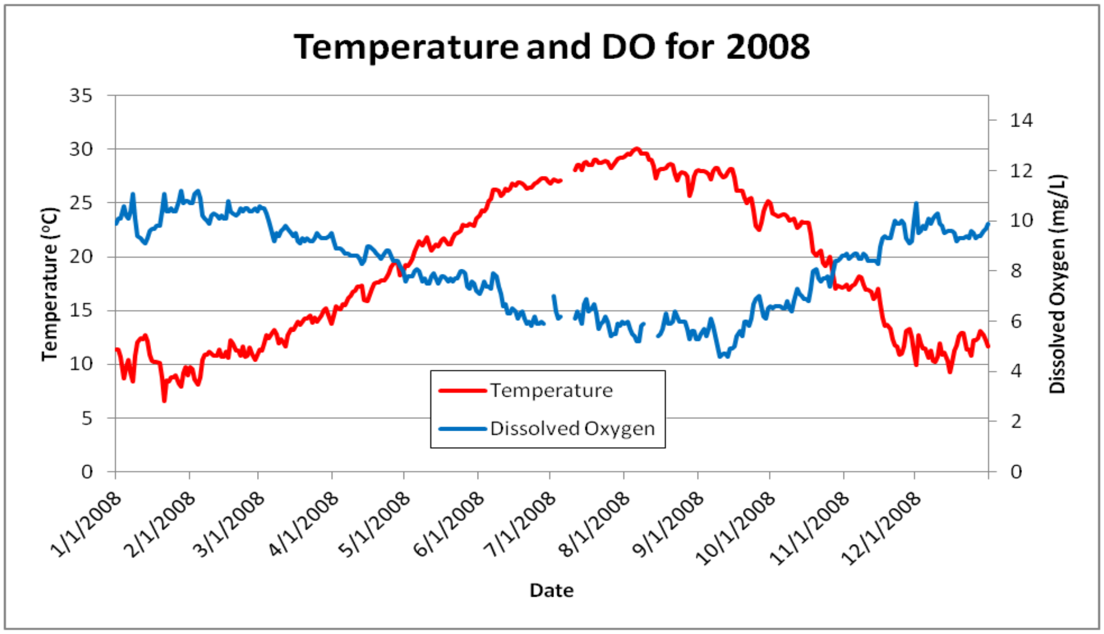
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-163 TEMPERATURE AND DISSOLVED OXYGEN FOR 2006: DOWNSTREAM OF PARR RESERVOIR[A]



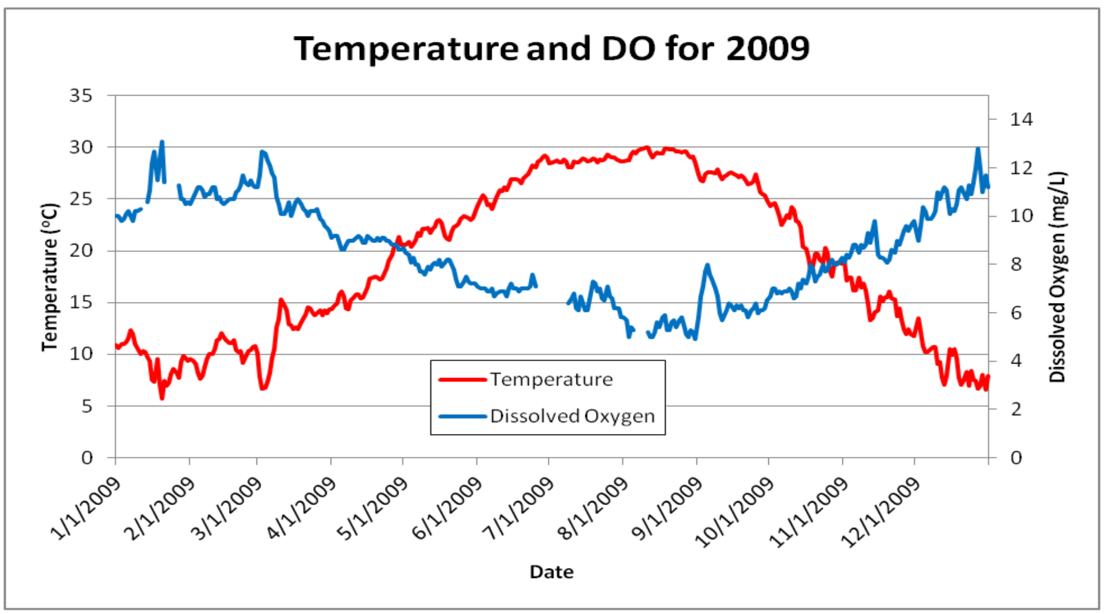
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-164 TEMPERATURE AND DISSOLVED OXYGEN FOR 2007: DOWNSTREAM OF PARR RESERVOIR[A]



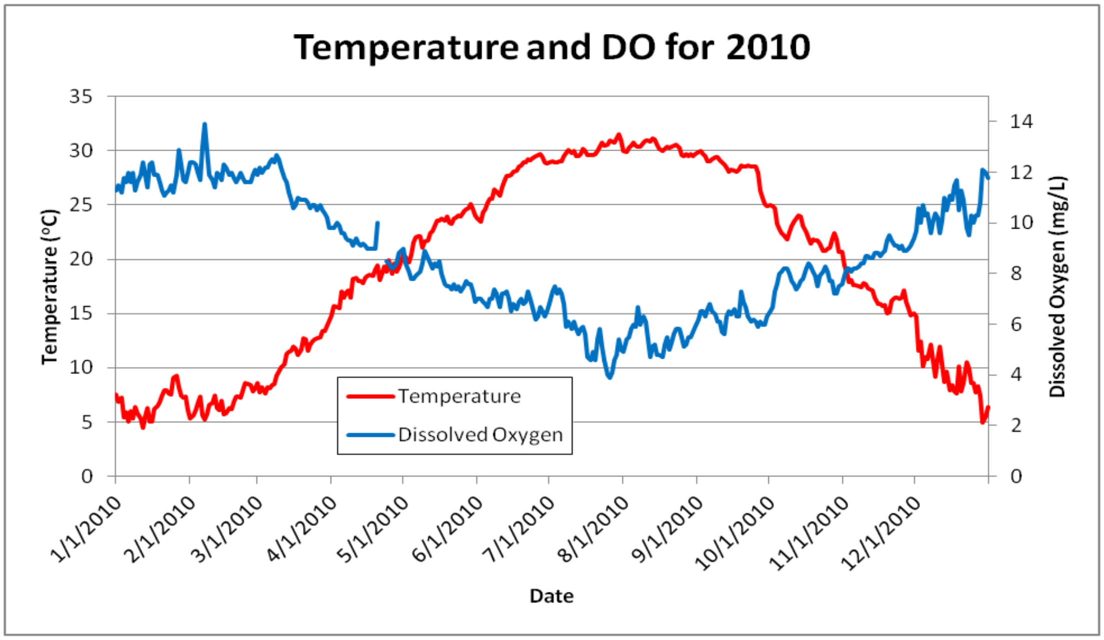
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-165 TEMPERATURE AND DISSOLVED OXYGEN FOR 2008: DOWNSTREAM OF PARR RESERVOIR[A]



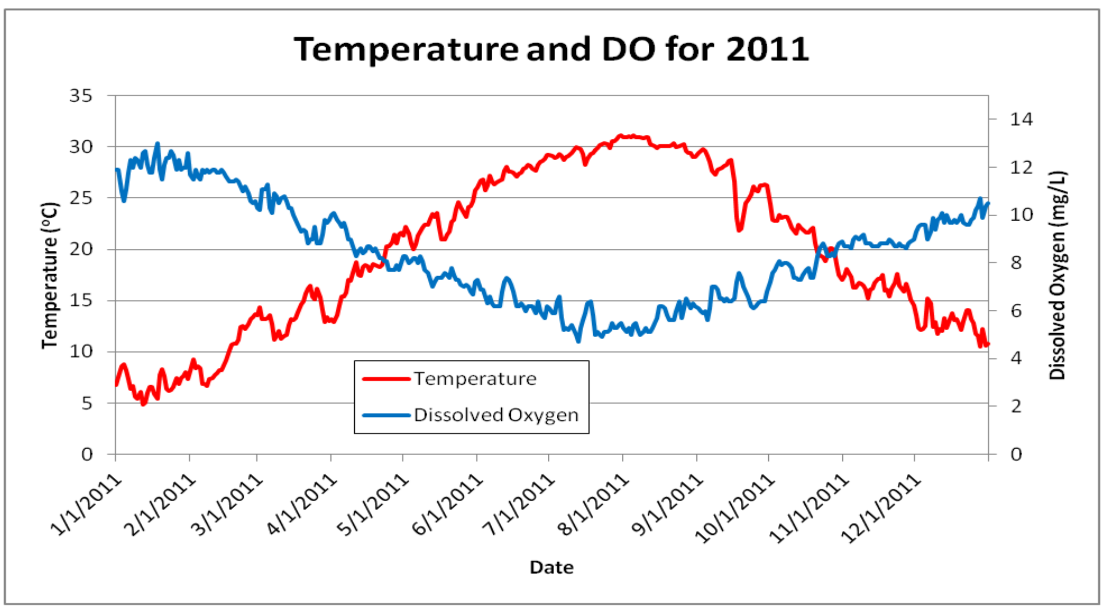
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-166 TEMPERATURE AND DISSOLVED OXYGEN FOR 2009: DOWNSTREAM OF PARR RESERVOIR[A]



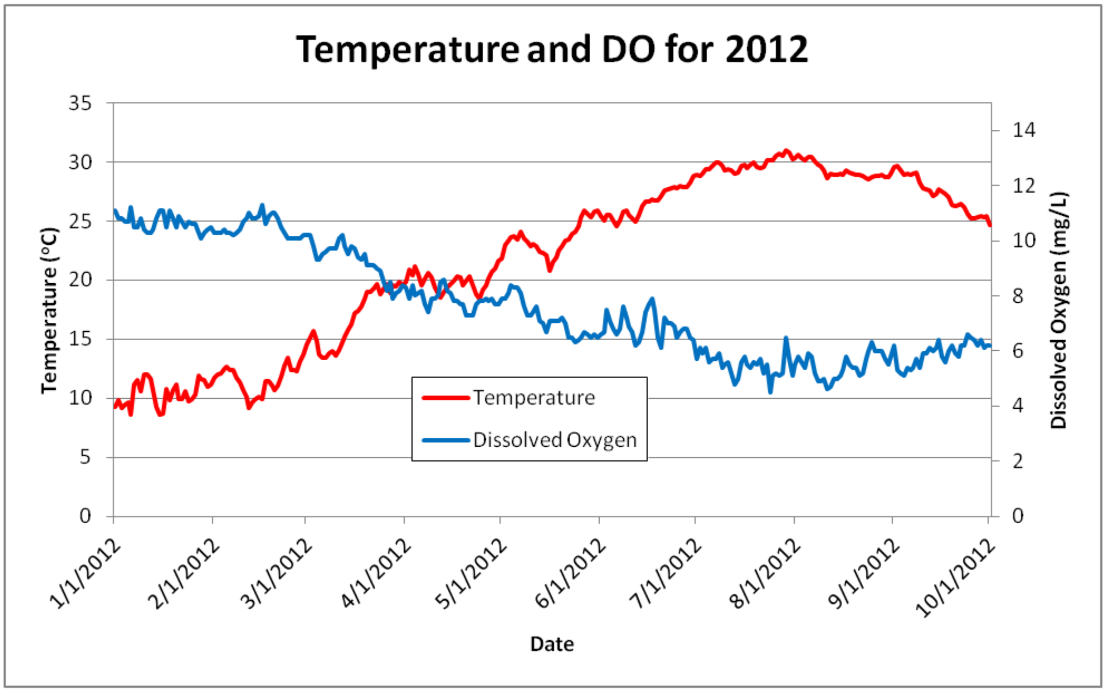
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-167 TEMPERATURE AND DISSOLVED OXYGEN FOR 2010: DOWNSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-168 TEMPERATURE AND DISSOLVED OXYGEN FOR 2011: DOWNSTREAM OF PARR RESERVOIR[A]

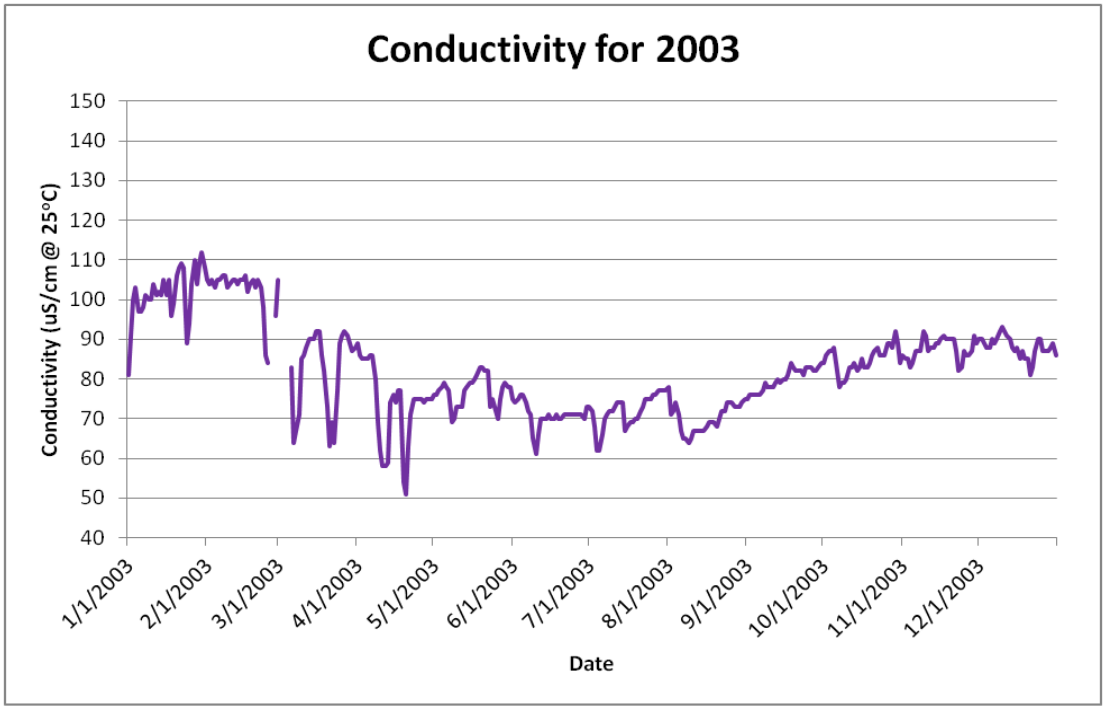


[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-169 TEMPERATURE AND DISSOLVED OXYGEN FOR 2012: DOWNSTREAM OF PARR RESERVOIR[A]

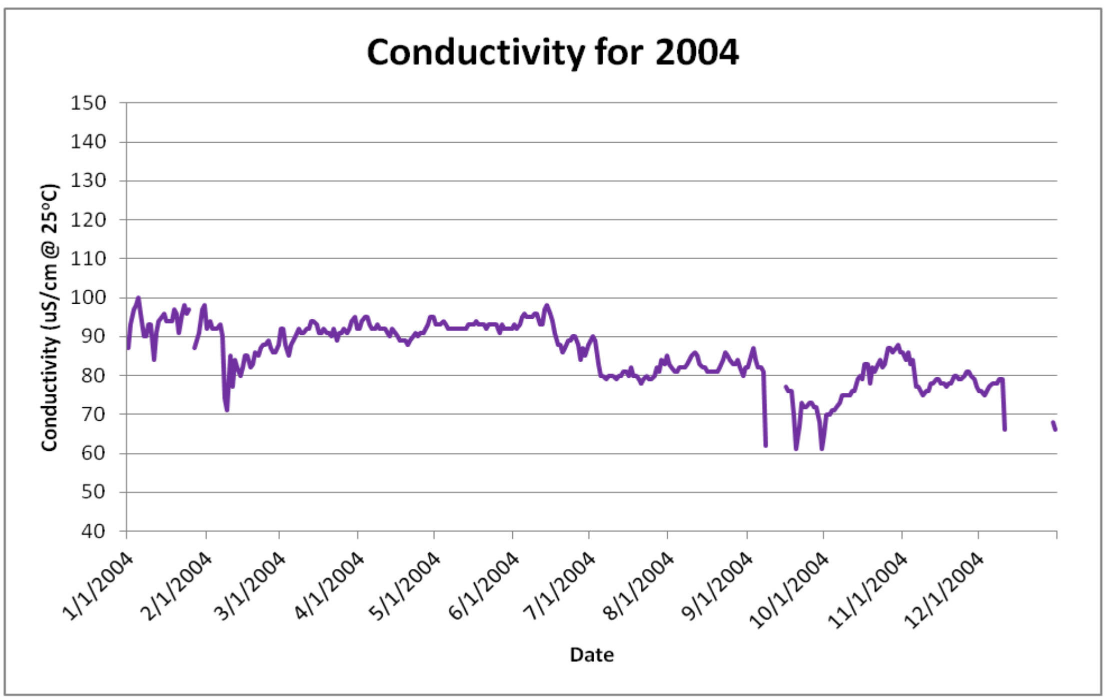
3.4.1.2 CONDUCTIVITY

The conductivity measured at the USGS site 02160991 ranged from approximately 45 µS/cm to 145 µS/cm over the last ten years. Daily readings for conductivity from January of 2003 through September of 2012 at the USGS site located immediately below the Parr Shoals Dam in the Broad River are shown in the figures below.



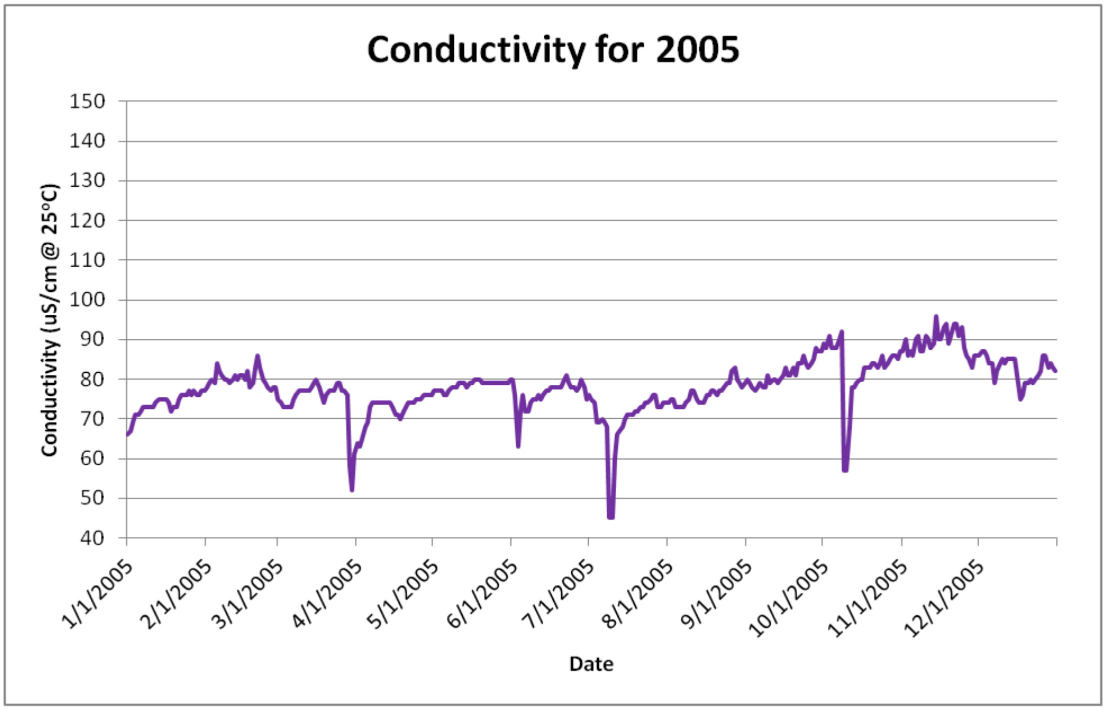
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-170 CONDUCTIVITY FOR 2003: DOWNSTREAM OF PARR RESERVOIR[A]



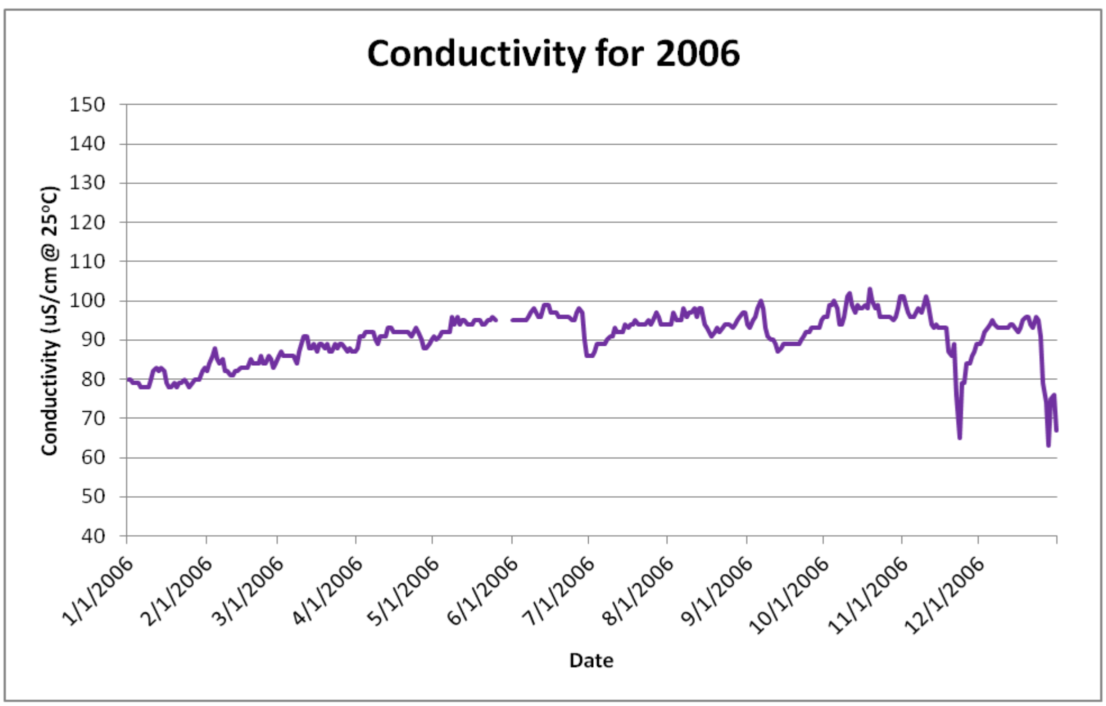
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-171 CONDUCTIVITY FOR 2004: DOWNSTREAM OF PARR RESERVOIR[A]



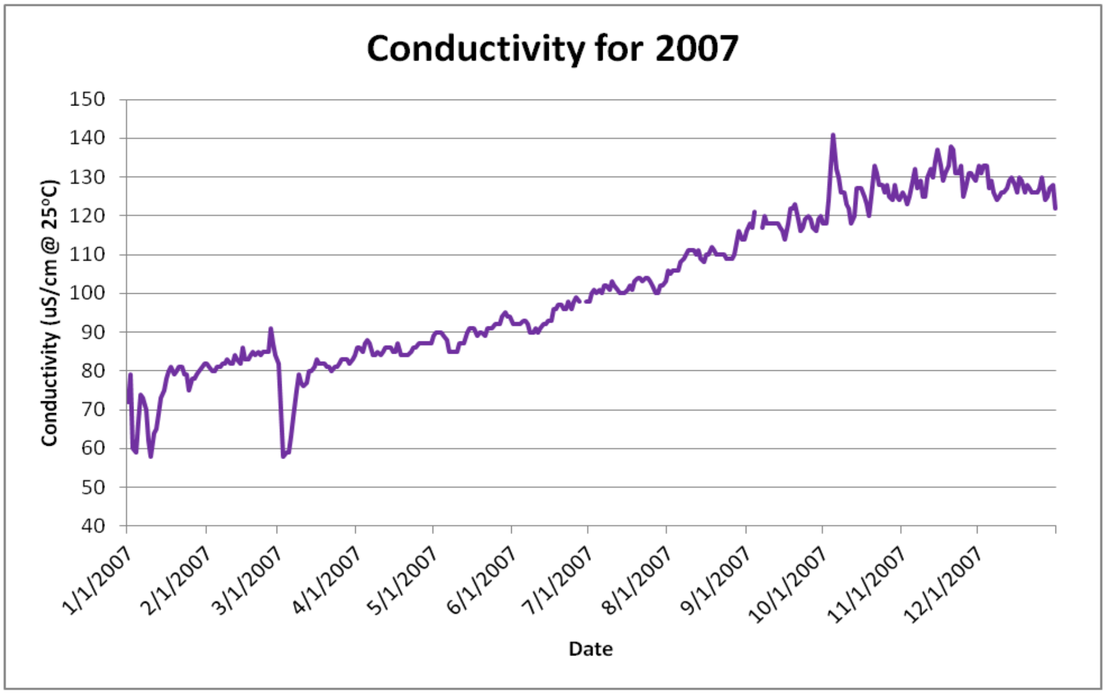
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-172 CONDUCTIVITY FOR 2005: DOWNSTREAM OF PARR RESERVOIR[A]



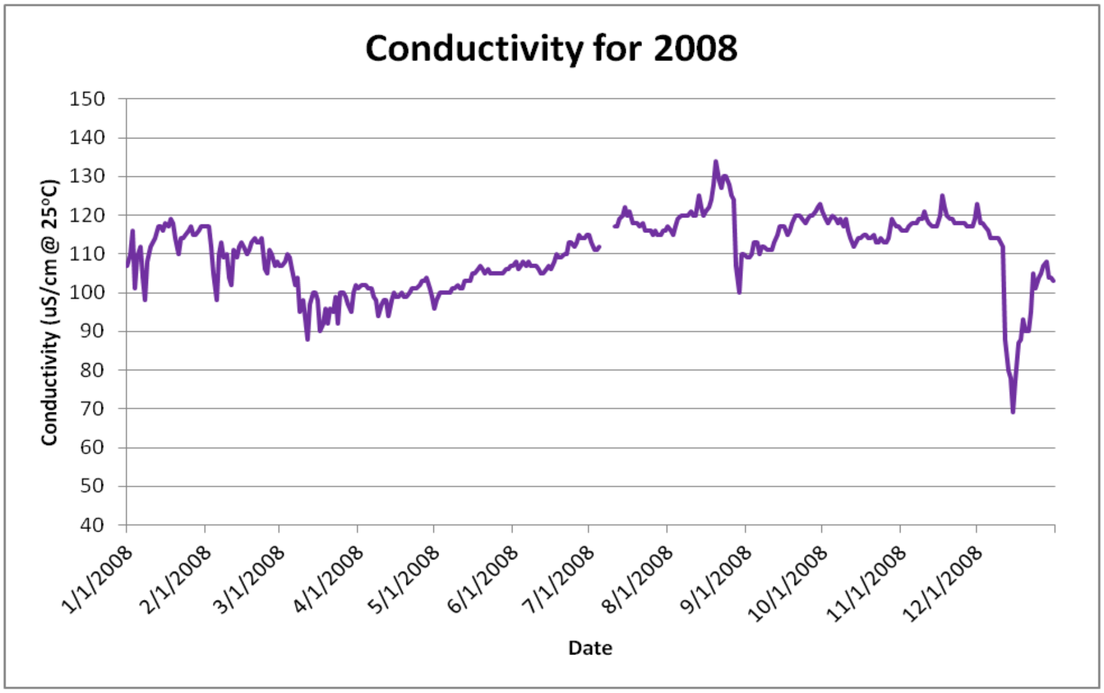
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-173 CONDUCTIVITY FOR 2006: DOWNSTREAM OF PARR RESERVOIR[A]



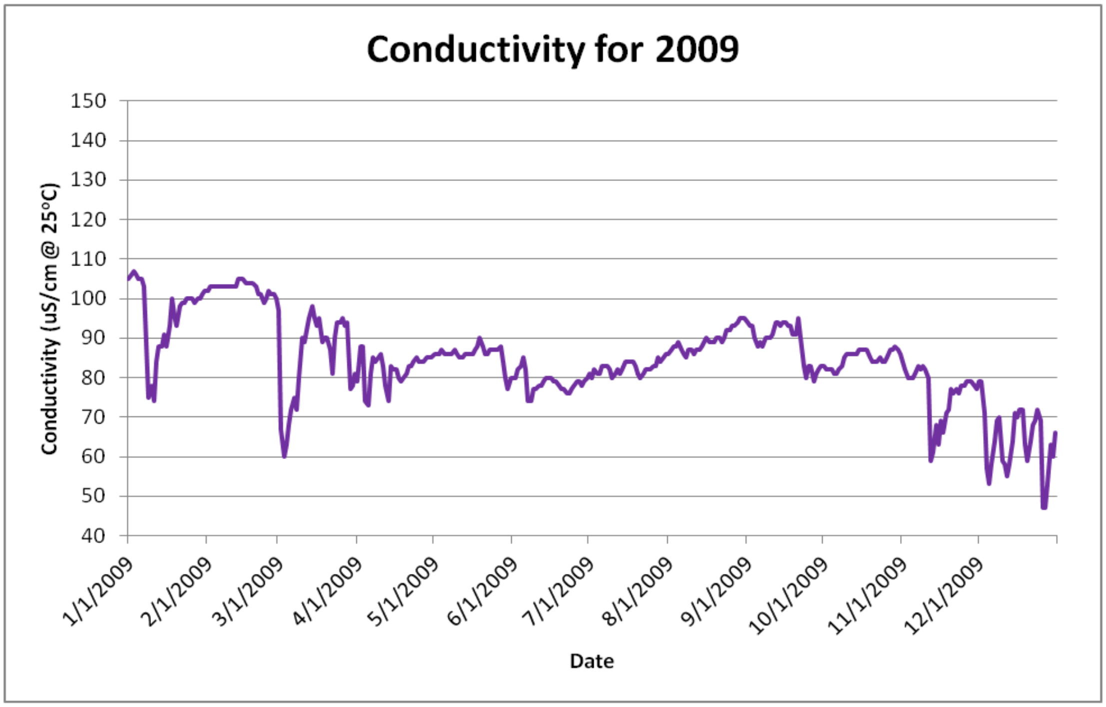
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-174 CONDUCTIVITY FOR 2007: DOWNSTREAM OF PARR RESERVOIR[A]



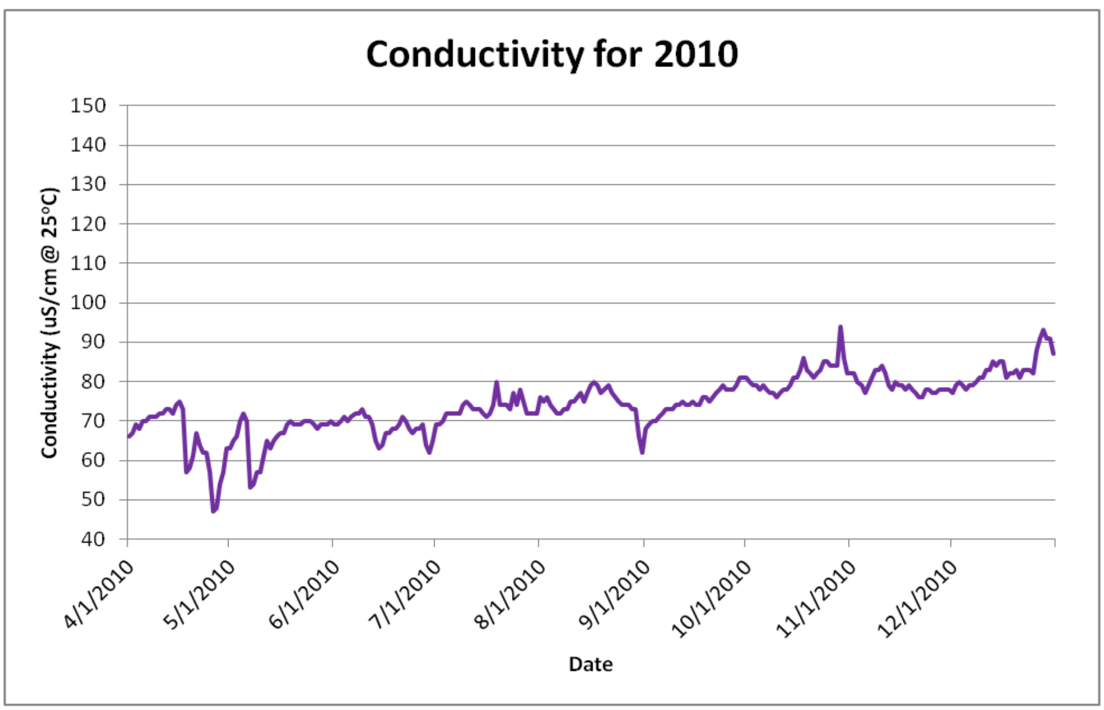
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-175 CONDUCTIVITY FOR 2008: DOWNSTREAM OF PARR RESERVOIR[A]



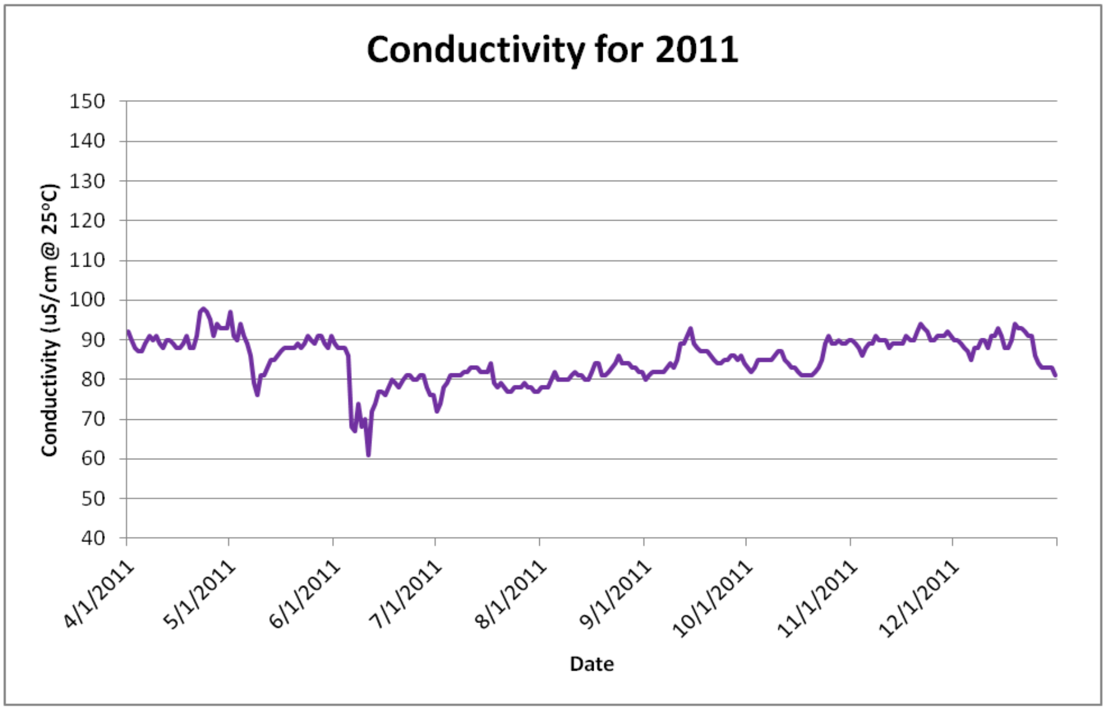
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-176 CONDUCTIVITY FOR 2009: DOWNSTREAM OF PARR RESERVOIR[A]



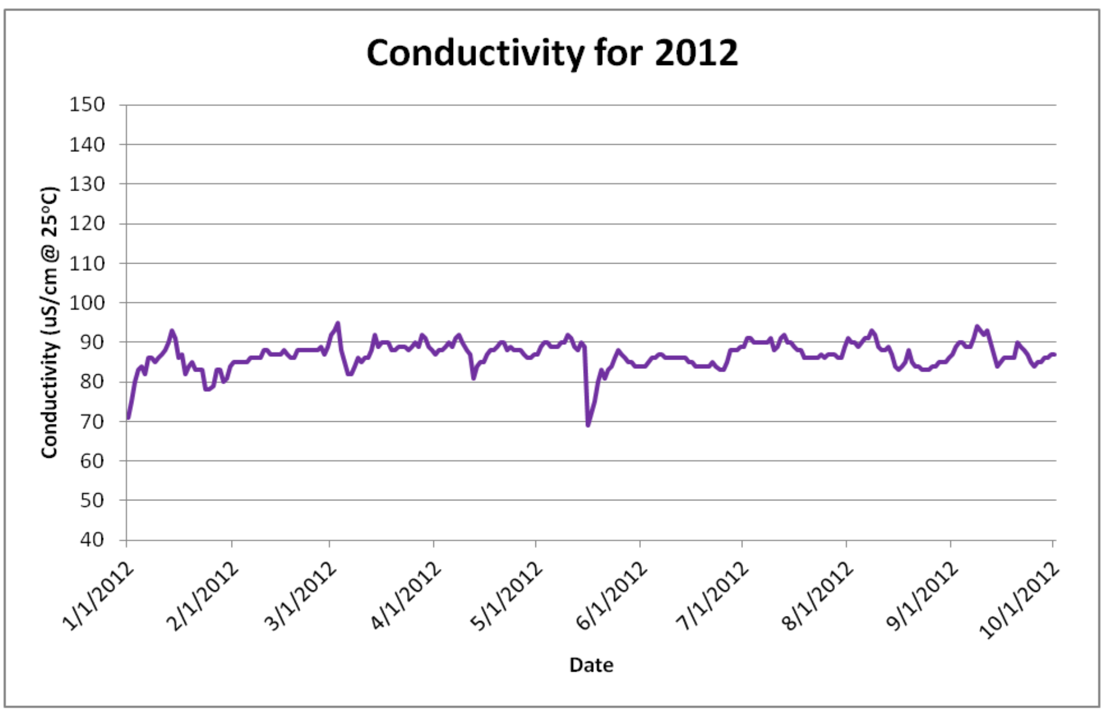
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-177 CONDUCTIVITY FOR 2010: DOWNSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-178 CONDUCTIVITY FOR 2011: DOWNSTREAM OF PARR RESERVOIR[A]

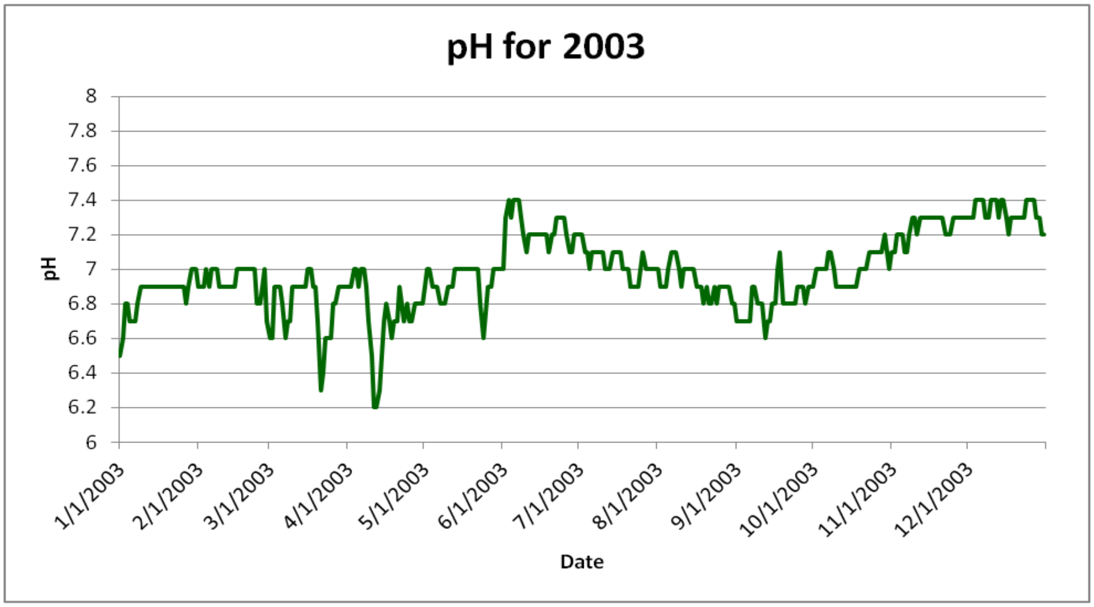


[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-179 CONDUCTIVITY FOR 2012: DOWNSTREAM OF PARR RESERVOIR[A]

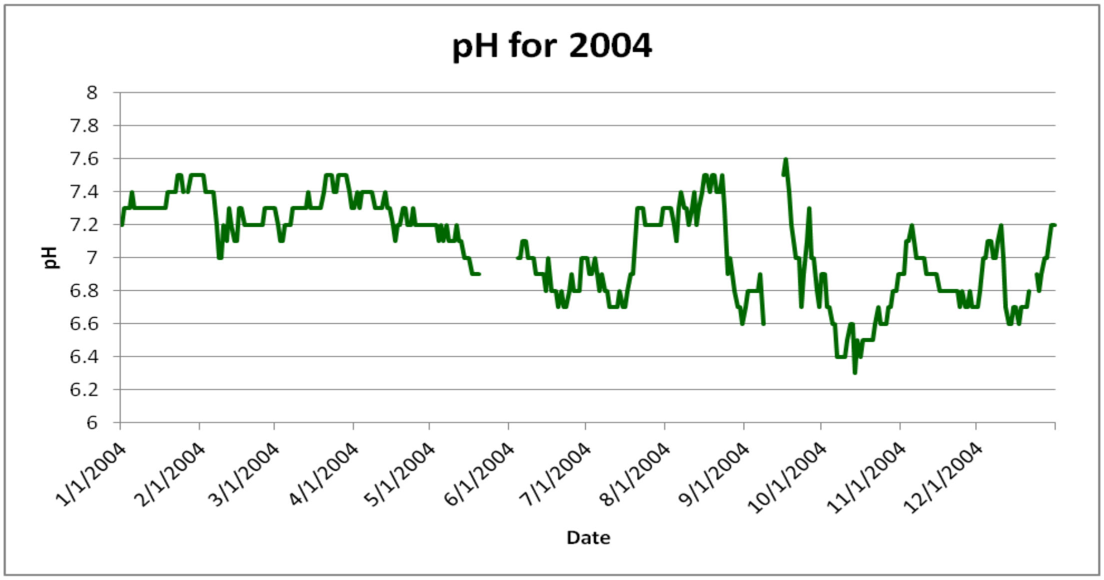
3.4.1.3 PH

Overall, the pH at the USGS monitoring site 02160991 is within the State Standards of 6.5 to 8.0, with few instances of a daily pH reading of below 6.5 in 2003, 2004 and 2007.



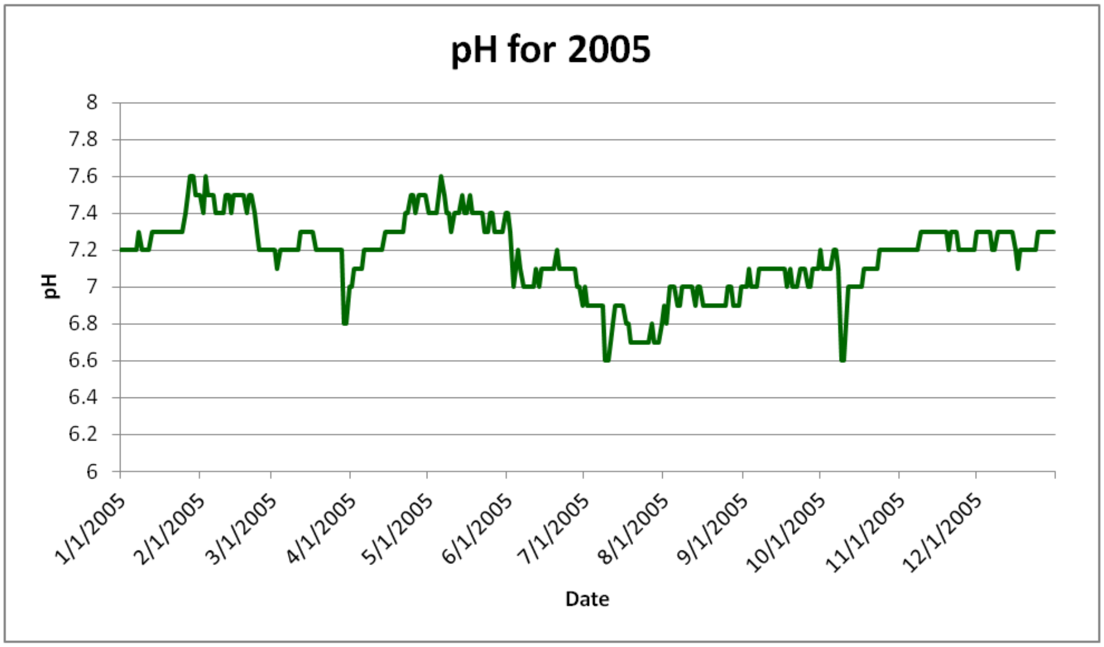
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-180 PH FOR 2003: DOWNSTREAM OF PARR RESERVOIR[A]



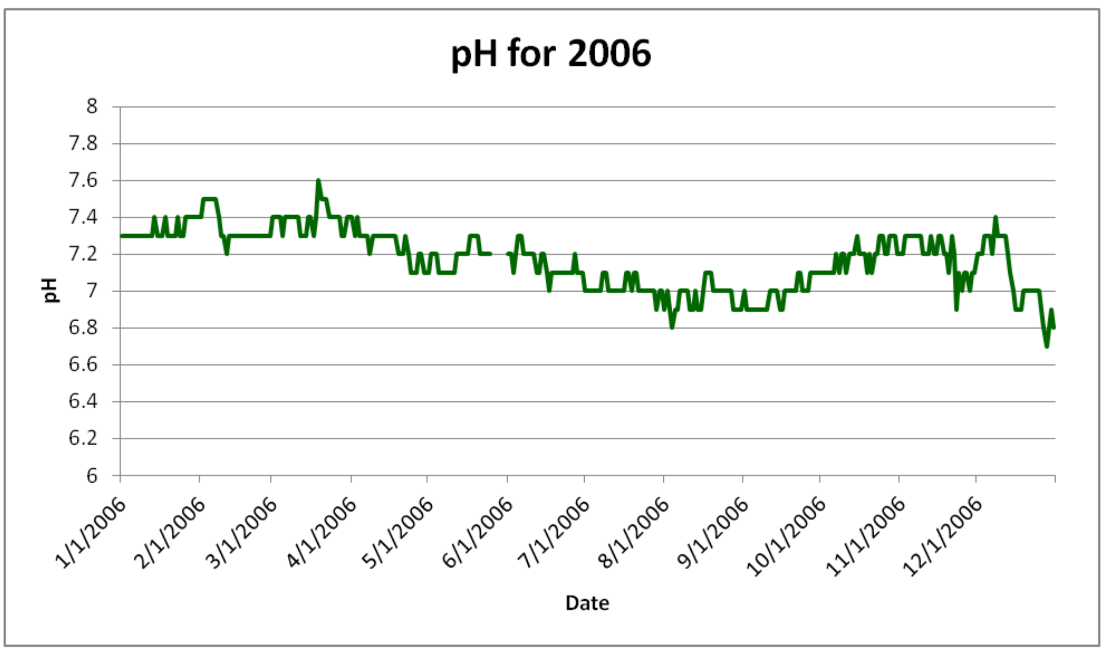
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-181 PH FOR 2004: DOWNSTREAM OF PARR RESERVOIR[A]



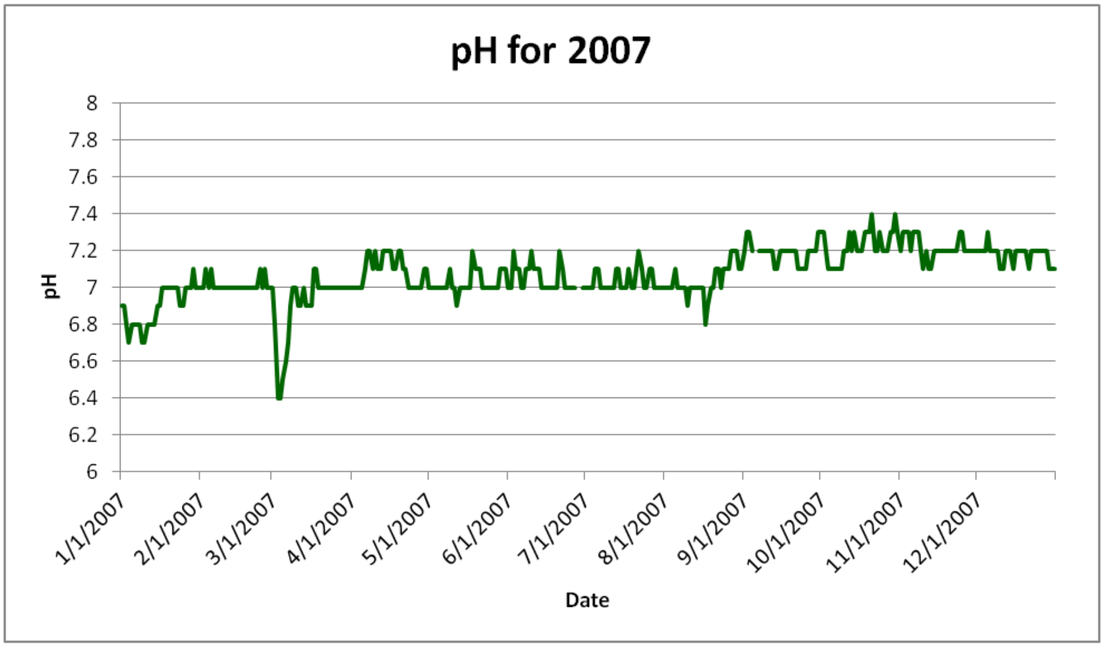
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-182 PH FOR 2005: DOWNSTREAM OF PARR RESERVOIR[A]



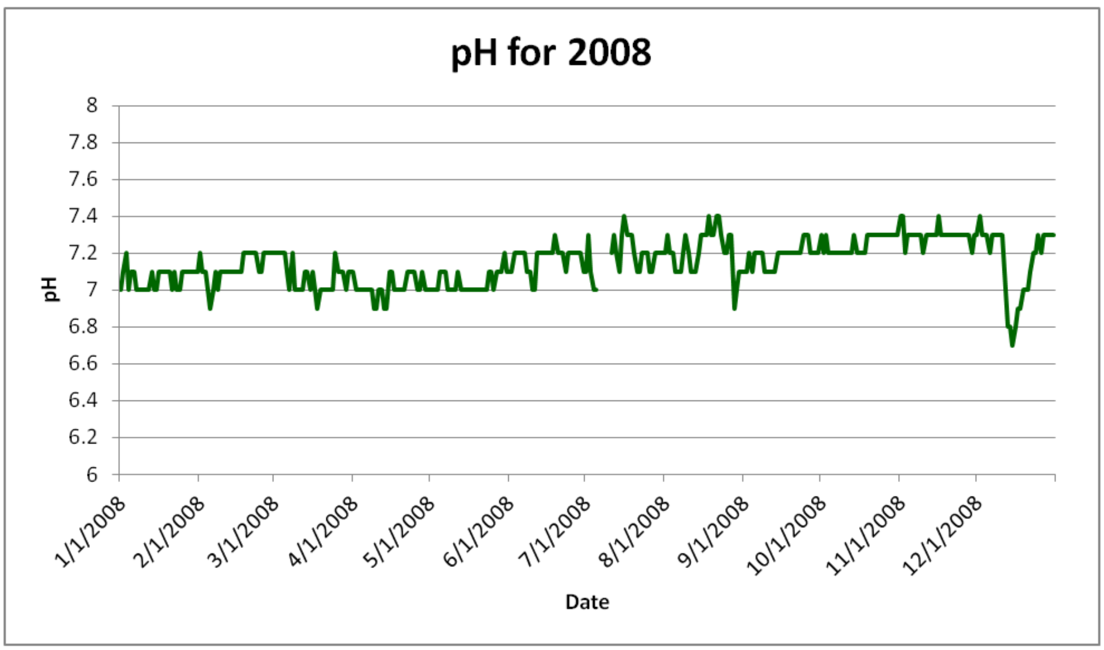
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-183 PH FOR 2006: DOWNSTREAM OF PARR RESERVOIR[A]



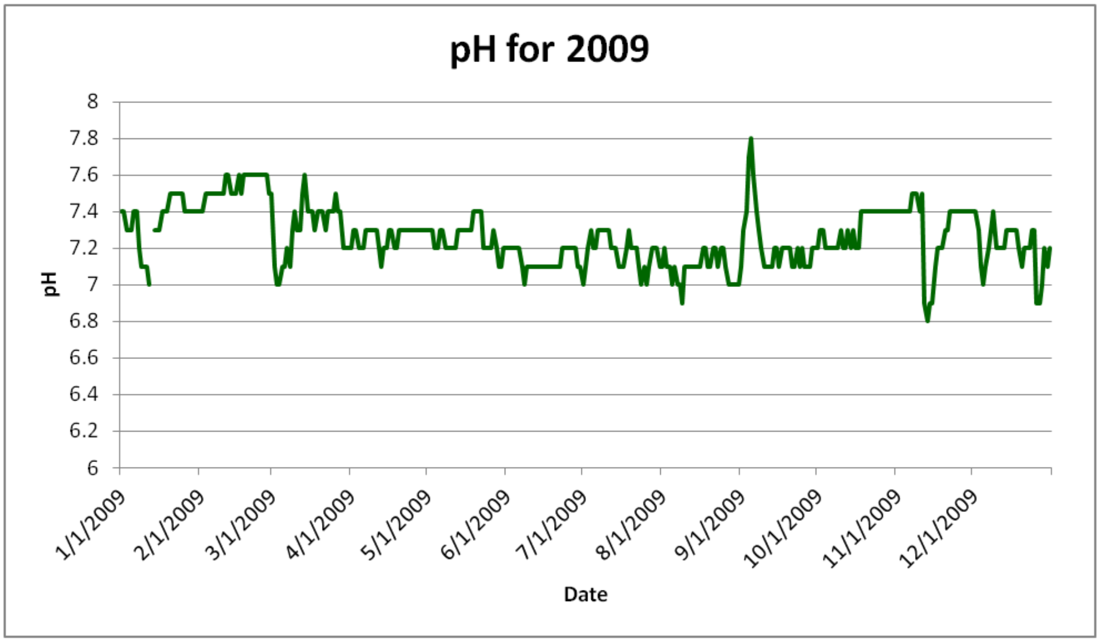
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-184 PH FOR 2007: DOWNSTREAM OF PARR RESERVOIR[A]



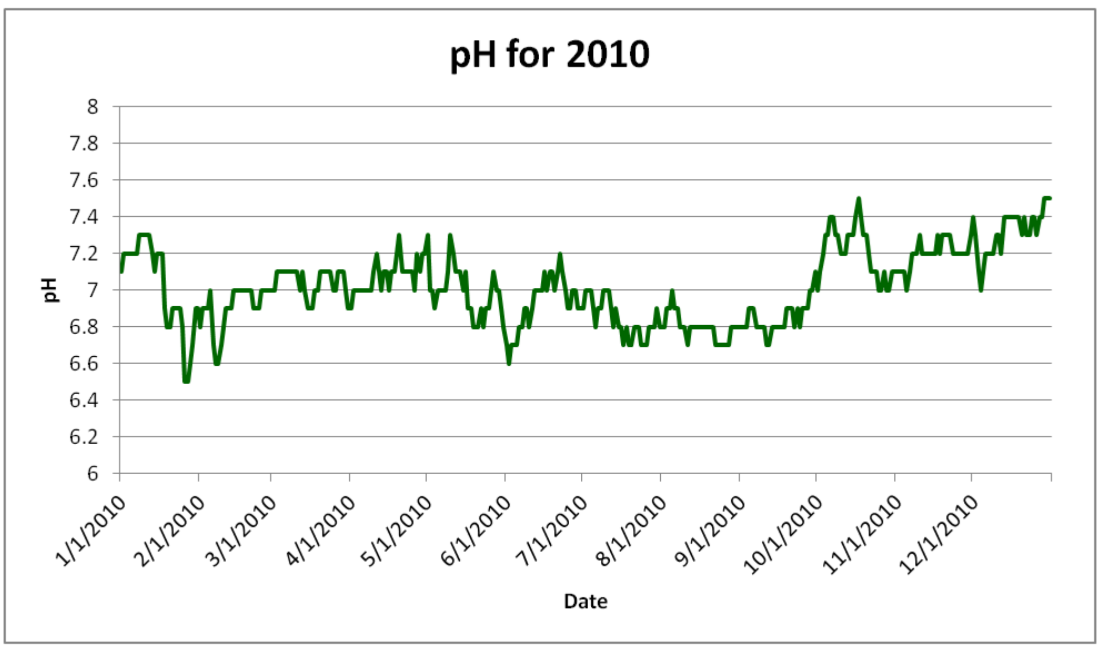
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-185 PH FOR 2008: DOWNSTREAM OF PARR RESERVOIR[A]



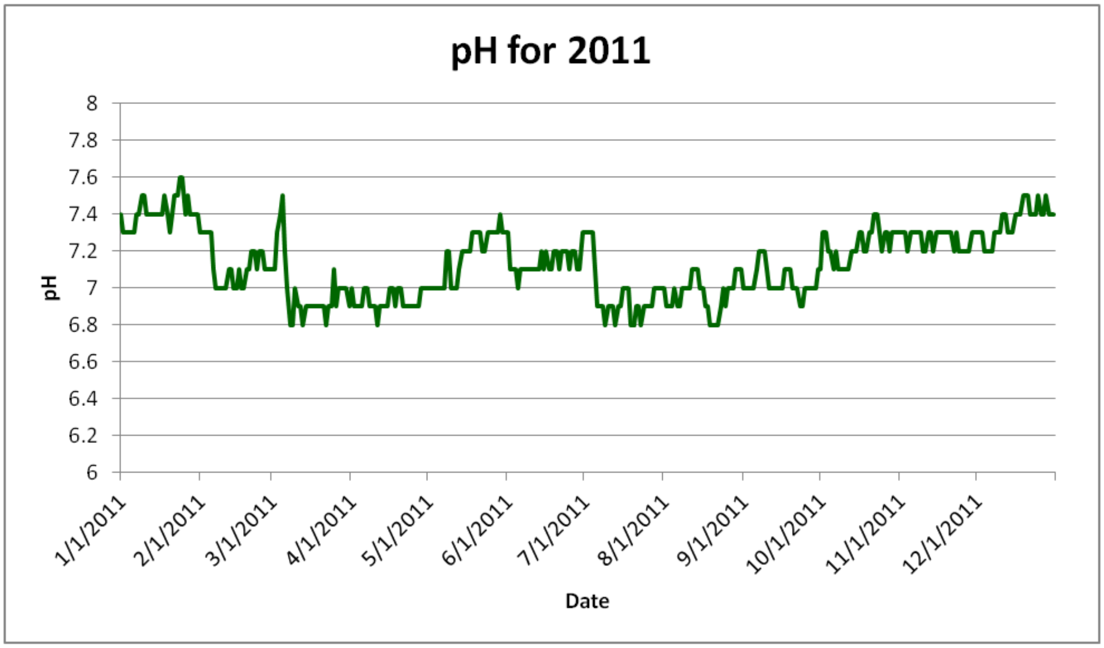
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-186 PH FOR 2009: DOWNSTREAM OF PARR RESERVOIR[A]



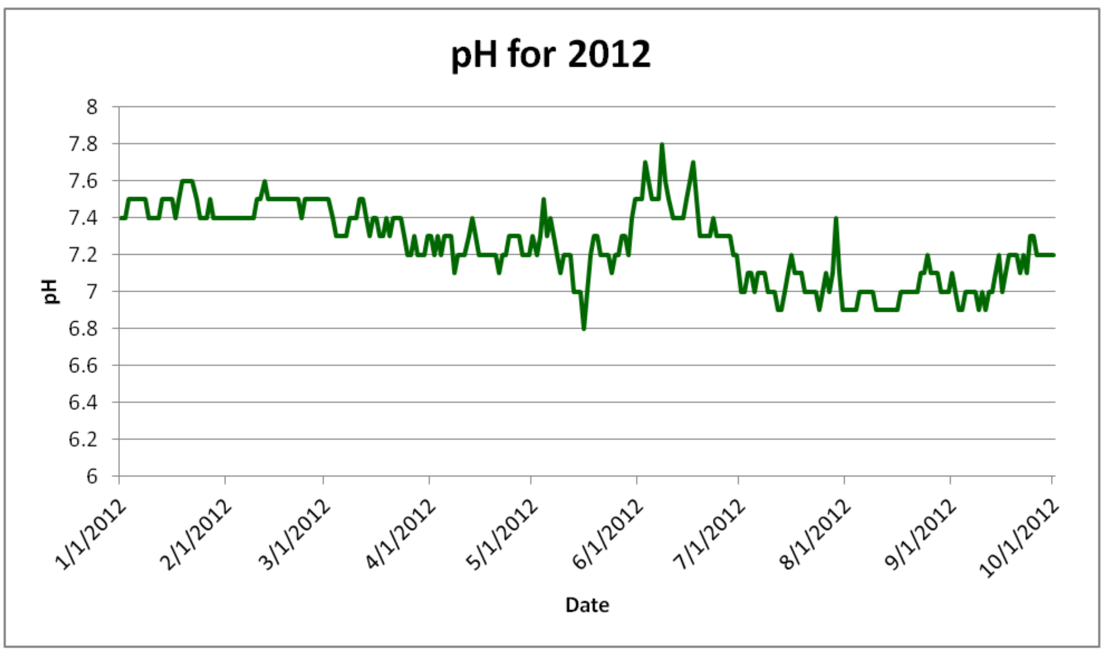
[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-187 PH FOR 2010: DOWNSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-188 PH FOR 2011: DOWNSTREAM OF PARR RESERVOIR[A]



[a] Graph depicts only data that were available on the USGS website. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-189 PH FOR 2012: DOWNSTREAM OF PARR RESERVOIR[A]

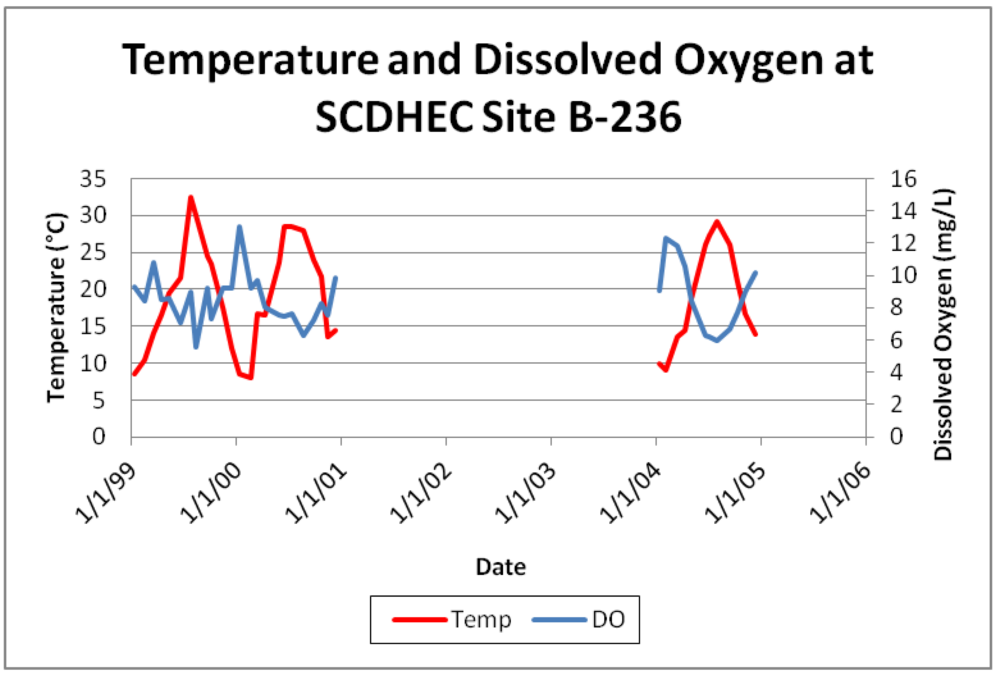
3.4.2 SCDHEC Data

3.4.2.1 Monitoring Station B-236

SCDHEC monitoring station B-236, Broad River at the Southern Railroad trestle, approximately 0.5 miles downstream of SC 213, was monitored on a monthly basis during 1999, 2000 and 2004. This site was added to the 303(d) list for a copper excursion in 2004. All other data is within SCDHEC's acceptable limits.

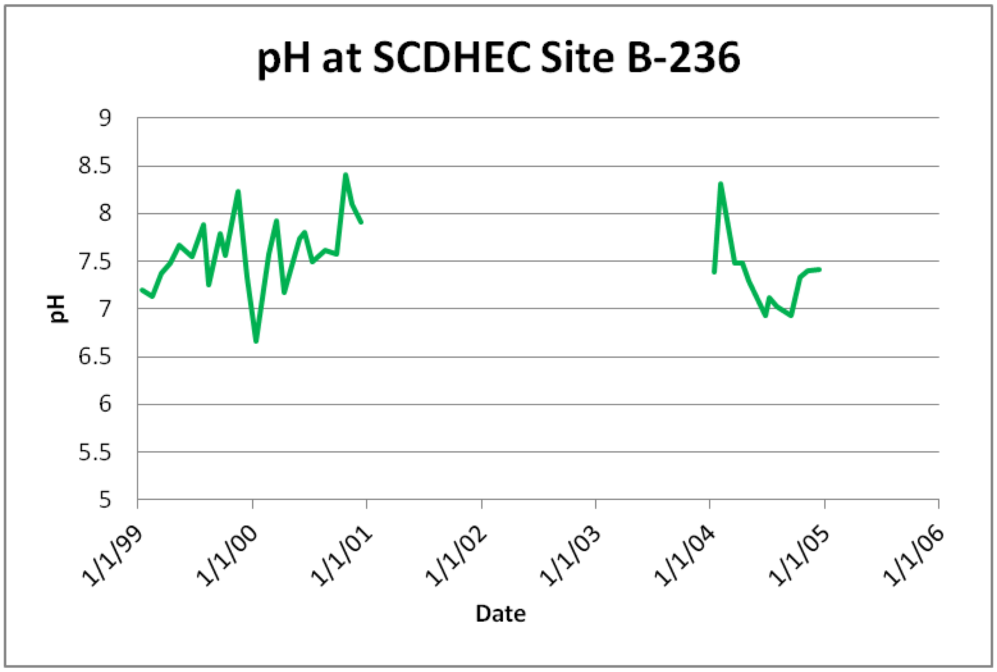
Temperature, DO, pH, and Turbidity

The following data was collected in 1999, 2000 and 2004 at the SCDHEC monitoring station B-236 located below Parr Shoals Dam. See Table 2-1 for the SCDHEC water quality standards for temperature, DO, pH, and turbidity.



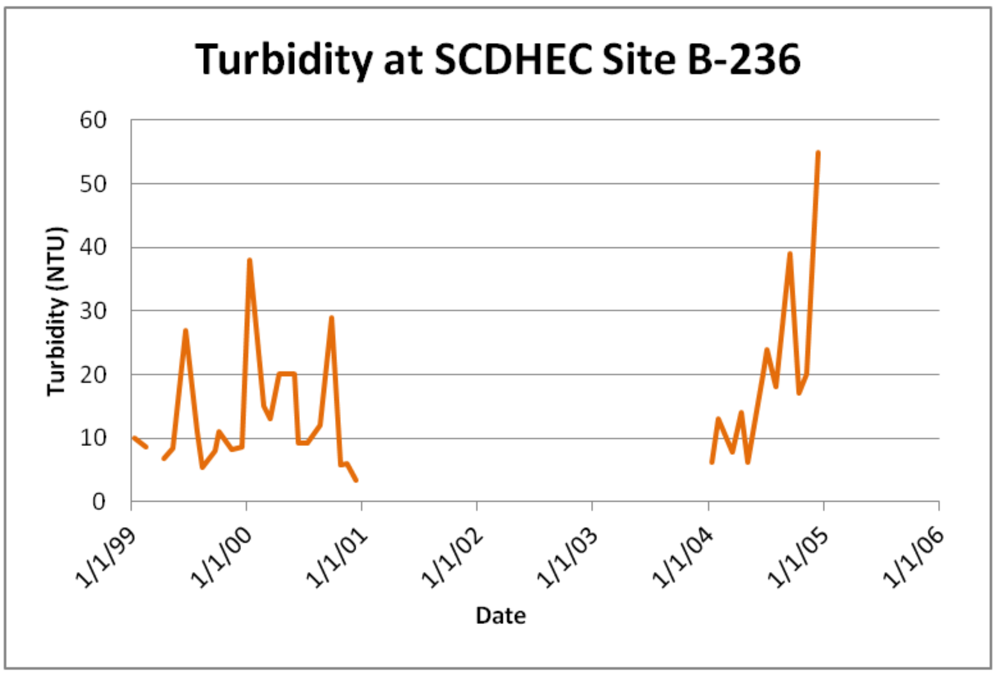
[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

Figure 3-190 Water Temperature and Dissolved Oxygen at SCDHEC Monitoring Station B-236[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-191 PH AT SCDHEC MONITORING STATION B-236[A]



[a] Graph depicts only data that were available on STORET. Any gaps reflect times when data were not collected, or not available.

FIGURE 3-192 TURBIDITY AT SCDHEC MONITORING STATION B-236[A]

Metals

Water samples collected at SCDHEC monitoring station B-236 were analyzed for a variety of metals. In 2004, this site was listed on the 303(d) list for a copper excursion. As shown in Table 3-28, most of the SCDHEC core indicator metals (Table 2-3) were regularly measured as Present Below Quantification Limit (PBQL) at site B-236, indicating the river supports aquatic life use.

TABLE 3-28 METALS PRESENT AT SCDHEC MONITORING STATION B-236[A]

DATE	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Zinc (mg/L)
2/17/99	PBQL	PBQL	PBQL	0.7	PBQL	-	0.036	PBQL	PBQL	PBQL
5/11/99	PBQL	PBQL	PBQL	0.8	PBQL	-	0.04	PBQL	PBQL	0.02
8/16/99	PBQL	PBQL	PBQL	0.27	PBQL	-	0.07	PBQL	PBQL	0.01
11/16/99	PBQL	PBQL	PBQL	0.31	PBQL	-	0.02	PBQL	PBQL	0.04
2/23/00	PBQL	PBQL	PBQL	0.94	PBQL	-	0.04	PBQL	PBQL	0.01
5/31/00	PBQL	PBQL	PBQL	0.8	PBQL	-	0.06	PBQL	PBQL	0.03
8/22/00	PBQL	PBQL	PBQL	0.54	PBQL	-	0.05	PBQL	PBQL	PBQL
11/16/00	PBQL	PBQL	PBQL	0.49	PBQL	-	0.03	PBQL	PBQL	0.04
2/4/04	0.018	0.017	0.018	0.62	PBQL	1.8	0.047	PBQL	PBQL	0.014
5/4/04	PBQL	PBQL	PBQL	0.3	PBQL	-	0.029	PBQL	PBQL	0.031
8/2/04	PBQL	0.33	0.039	1.3	PBQL	-	0.079	PBQL	0.15	0.014
11/9/04	PBQL	PBQL	PBQL	0.91	PBQL	-	0.035	PBQL	PBQL	PBQL

[A] PBQL is Present Below Quantification Limit.

Nutrients

Nutrients data was collected at SCDHEC monitoring station B-236 in 1999, 2000, and 2004 and is included in the table below. Site B-236 is located in the Broad River; the SCDHEC nutrient and chlorophyll-a standards only apply to reservoirs and therefore do not apply to this site. There are no nutrient and chlorophyll-a standards established for rivers.

TABLE 3-29 NUTRIENTS AND CHLOROPHYLL A AT SCDHEC MONITORING STATION B-236[A]

Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
1/13/99	1.12	-
2/17/99	PBQL	-
3/18/99	0.7	-
4/15/99	1.25	-
5/11/99	0.68	-
6/22/99	0.96	-
7/29/99	0.71	-
8/16/99	0.64	-
9/22/99	0.38	-
10/5/99	PBQL	-
11/16/99	0.48	-
12/16/99	0.51	-
1/12/00	0.75	-
2/23/00	0.56	-
3/16/00	0.59	-
4/13/00	0.72	-
5/31/00	0.71	-
6/15/00	0.73	-
7/12/00	0.65	-
8/22/00	0.5	-
9/28/00	0.69	-
10/26/00	0.52	-
11/16/00	0.57	-
12/12/00	0.57	0.03
1/13/04	1.31	0.026
3/18/04	0.78	0.022
4/14/04	0.58	0.041
5/4/04	0.88	0.038
6/24/04	1.01	0.069
7/7/04	0.71	0.07
8/2/04	0.7	0.046
9/16/04	0.7	0.055
10/14/04	1.15	0.046
11/9/04	0.82	0.059
12/13/04	0.82	0.08

[A] PBQL is Present Below Quantification Limit.

3.4.3 DATA CONTRIBUTED BY SCDNR

The data included below were collected and submitted by SCDNR. It should be noted that this data is unpublished.

Data collection sites include three different reaches of the Broad River, downstream of the Parr Shoals Dam. The data coincides with that collected at the USGS gage 02160991, and appears to be typical for this area of the Broad River.

TABLE 3-30 WATER QUALITY DATA FROM REACH 1 OF THE BROAD RIVER

Date	Discharge cfs	Temperature (°C)	DO (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)	Salinity (ppt)
8/25/2009	788	27.9	4.47	90.8	7.16	2.57	0
10/22/2009	1812	18.6	6.8	79	7.5	5.77	0
5/12/2010	2535	21.9	8.29	71.6	6.28	8.85	0
8/12/2010	838	32.4	4.64	61.8	7.97	4.44	0
11/2/2010	1507	18.1	5.81	88.3	7.3	18.2	0
4/21/2011	4650	17.9	7.1	78.1	na	8.53	0
8/10/2011	548	29.6	6.33	83	7.44	4.18	0
11/22/2011	2120	17.3	7.02	95.8	na	14.9	0
4/3/2012	2460	20.3	5.3	84.5	6.2	NA	0
8/27/2012	1150	26.5	3.4	89.7	7.38	4.36	0
4/18/2013	3920	20.8	5.04	75.5	-	17.9	0

TABLE 3-31 WATER QUALITY DATA FROM REACH 2A OF THE BROAD RIVER

Date	Discharge cfs	Temperature (°C)	DO (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)	Salinity (ppt)
8/20/2009	807	32	4.89	92.2	7.27	7.87	0
10/23/2009	1510	18.6	6.8	79	7.5	5.77	0
5/13/2010	2992	22.3	6.9	72	6.07	7.89	0
11/3/2010	1610	18	5.95	90.5	7.4	21.3	0
5/9/2011	3520	21.8	7.22	79.7	7.63	-	0
8/4/2011	670	32.3	9.9	80.8	7.86	3.48	0
10/26/2011	850	19.8	7.05	93.7	NA	21.9	0
4/27/2012	1720	20	6.55	79.7	7.37	NA	3
7/5/2012	813	33.5	5.26	83.8	7.8	4.09	0
11/29/2012	1020	12.9	8.02	95.1	6.73	5.97	0
4/23/2013	3430	18.8	6.17	83.1	6.98	7.92	0

TABLE 3-32 WATER QUALITY DATA FROM REACH 2B OF THE BROAD RIVER

Date	Discharge cfs	Temperature (°C)	DO (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)	Salinity (ppt)
8/12/2009	791	29.7	5.91	88.1	7.07	-	0
10/9/2009	1551	23.1	6.25	86.3	7.19	14.8	0
4/26/2010	4605	20.4	10.9	76.2	7.3	5.64	0
8/10/2010	825	30.6	5.9	76	7.26	14.7	0
8/27/2010	860	30.3	6.08	75.2	7.83	10.91	0
11/1/2010	1635	18.8	7.16	91	7.77	4.42	0
5/6/2011	3480	19.3	7.92	78.4	7.13	8.65	0
7/14/2011	788	29.5	6.72	81.3	6.67	3.88	0
10/20/2011	863	18.1	NA	94.1	7.93	7.22	0
4/4/2012	2910	20.9	6.98	96.5	6.62	NA	0
7/30/2012	830	31.1	9.02	85.6	7.01	3.67	0
10/9/2012	1570	20.1	7.88	85.1	6.78	3.37	0
4/25/2013	4440	19.4	5.95	80.7	7.07	10.24	0

3.5 COMPARING UPSTREAM AND DOWNSTREAM OF PARR RESERVOIR

Monthly temperature, DO, and pH data was collected in 2004 by SCDHEC at four monitoring stations located above, within, and below the Project. This data is displayed below. Site B-046 is located upstream of Parr Reservoir, downstream of Neal Shoals Dam. Site B-345 is located in Parr Reservoir, upstream of Parr Shoals Dam. Site B-327 is located within Monticello Reservoir. Site B-236 is located downstream of Parr Shoals Dam. While temperatures at all four sites are very similar, generally temperatures at site B-046 and B-236 are slightly lower during the summer months than at the other sites. This is trend is not unexpected as these sites are located in flowing sections the Broad River versus sites B-235 and B-327, which are located in reservoirs. As with temperature, the DO values at all four sites are very similar. The site located just upstream of the Parr Shoals Dam, B-345, dipped to a low point of approximately 4.5 mg/L in July, but rebounded in August. The pH values at the four sites varies slightly over the course of the year, with site B-327 reaching a high of approximately 8.7 in May. Overall all four sites follow the same general trends for the three parameters examined.

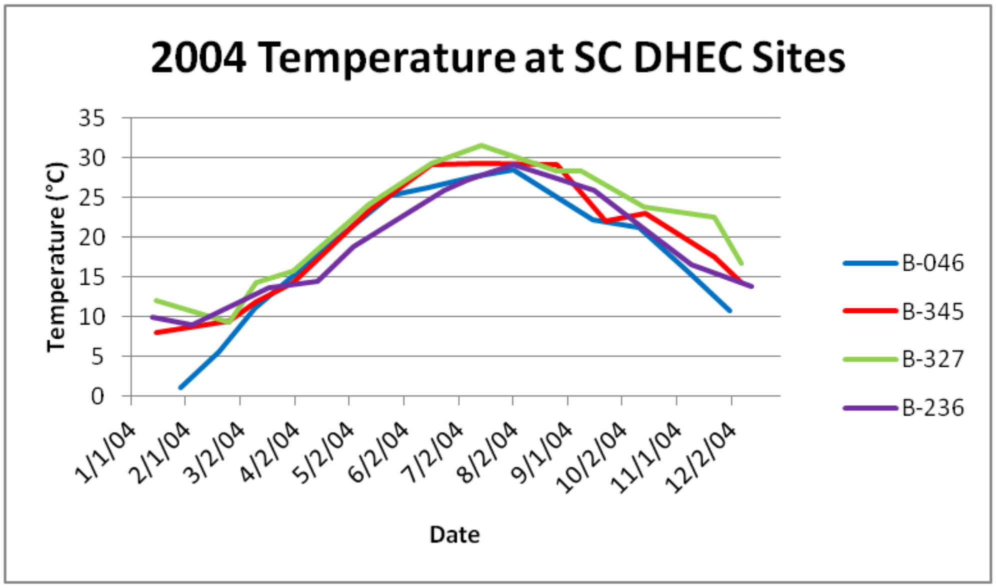


FIGURE 3-193 **2004 WATER TEMPERATURE DATA AT SCDHEC MONITORING STATIONS B-046, B-345, B-327 AND B-236**

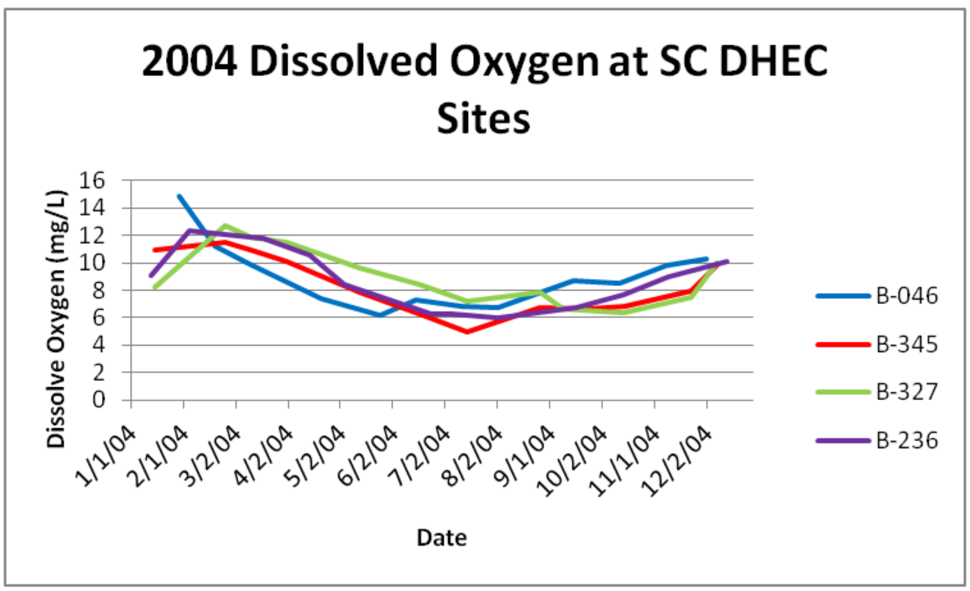


FIGURE 3-194 **2004 DISSOLVED OXYGEN DATA AT SCDHEC MONITORING STATIONS B-046, B-345, B-327 AND B-236**

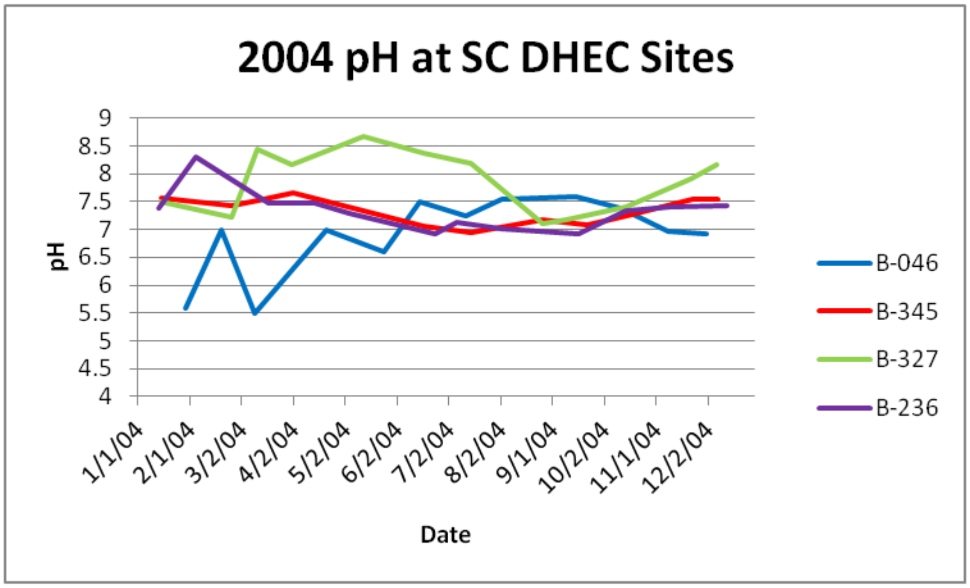


FIGURE 3-195 2004 PH DATA AT SCDHEC MONITORING STATIONS B-046, B-345, B-327, AND B-236

4.0 DISCUSSION AND CONCLUSIONS

Overall, there is a vast amount of data that have been or is currently being collected in the vicinity of the Parr Fairfield Hydroelectric Project. Due to ongoing monitoring efforts by SCANA, SCDHEC, SCDNR and USGS, Parr Reservoir, Monticello Reservoir and the Broad River upstream and downstream of Parr Shoals Dam are constantly being examined for potential water quality issues. Daily, monthly and quarterly readings and analyses provide continual insight into the health of the Project waters. The water quality parameters included in this report are commonly used indicators of the overall health of a body of water.

Data summarized in this report shows that localized water temperature increases do occur in the vicinity of the V.C. Summer Nuclear Station. This phenomenon is explained further in the Thermal Mixing Zone Evaluation at VCSNS, included in Appendix B. Also, SCDHEC monitoring stations B-346, B-236, RL-04370, RL-04374, and RL-11031 are included on the 2012 303(d) list, for excursions in total phosphorus, copper and/or pH.

After examing the results of the water quality analyses summarized in this report, a few general conclusions on the condition of Project waters, as well as upstream and downstream waters associated with the Project, can be made. Water temperature, DO, pH and specific conductivity appear to fluctuate naturally with the time of year and depth of the reservoirs. The Parr Fairfield Project operations contribute a few small, localized effects on water quality, but do not appear to affect the overall quality of the Parr Reservoir, Monticello Reservoir and the Broad River downstream of Parr Shoals Dam.

The data presented here depicts an overall healthy water system, providing suitable habitat for a variety of aquatic species. The clean waters of Monticello Reservoir, Parr Reservoir and the Broad River are also able to provide the public with safe recreation opportunities.

5.0 REFERENCES

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APPENDIX A

2012 PARR SEDIMENT INVESTIGATION REPORT

SCANA Services Inc.

Parr Reservoir Sediment Investigation Report 2012

Milton Quattlebaum

March 2013

Table of Contents

List of Figures

Appendix

Introduction

Parr Reservoir is located in Fairfield County, South Carolina. Parr Reservoir (4,400 acre) is formed by the impounding of the Broad River by the South Carolina Electric and Gas (SCE&G) Parr Shoals Dam (Parr). Daily operation of the SCE&G's Fairfield Pump Storage (FFPS) facility located on Parr Reservoir has two distinct effects on Parr Reservoir. The first being daily fluctuations in water level, and the second being the potential reversal of current flow in Parr Reservoir depending on the Broad River flows.

In accordance with provisions of the Clean Water Act Section 401 Water Quality Certification issued to SCE&G by the South Carolina Department of Health and Environmental Control, SCANA Corporate Environmental Services began annual collections of sediment samples from two locations in Parr Reservoir for analysis of the following metals (total): aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, strontium, thallium, and zinc. Total phosphorus was also measured.

The data from the 2012 collections will begin to provide background information for determining what impact, if any, the discharge from the operation of VCSNS 2 & VCSNS 3 will have on various constituents of the sediment in the vicinity of the discharge

Methods

Sediment samples were collected from two transects located within Parr Reservoir. The first transect (Transect 2) was located approximately 200 yards downstream of the cooling water discharge location. The second transect (Transect 1) was located just north of the Heller's Creek confluence approximately 4 mile upstream of the discharge location. Sampling at each transect consisted of collection of one grab sample from each of five sample points along each transect. One sample was collected from each end of the transect (eastern shore and western shore). The third sample point was located at the mid-point of each transect. The remaining two sample points were located at equal distance from the mid-point sample location and each end of each transect. All sample points are constantly inundated at the reservoir's low pool elevation (256 ft msl; NGVD 29). The five grab samples were composited and thoroughly homogenized to form one discrete sample from each transect. Basic water quality parameters (dissolved oxygen, pH, specific conductivity, and temperature) were collected using a YSI 650 MDS Water Quality Logger equipped with a YSI 600XL Sonde or instrumentation of equivalent capabilities and accuracy at each transect **(Figure 1)**.

Results

Results for the samples collected at the two transects are presented in Appendix 1. A copy of the laboratory report is presented in Appendix 2. For comparing transects, the metals were divided into groups based on detection results for Transect 2. Beryllium, Mercury, Silver, and Thallium were not detected at either transect during this sampling event. Cadmium was the only metal with a higher detection value at Transect 1 (0.4 mg/kg) than transect 2 (0.3 mg/kg).

Four metals (Antimony, Arsenic, Lead and Nickel) were measured at <10 mg/kg. Antimony (1.7 mg/kg) and Arsenic (3.8 mg/kg) were detected at Transect 2 compared to non-detect at Transect 1. Lead and Nickel concentrations at Transect 2 ranged from 6.0X – 6.6X higher than Transect 1.

Copper, Chromium, Zinc, and Barium results at Transect 2 ranged in values from 15 mg/kg – 97 mg/kg. In comparison Transect 1 values ranged from 2.1 mg/kg -24 mg/kg. Copper concentrations at Transect 2 (15 mg/kg) were measured 7X higher than Transect 1 (2.1 mg/kg) results.

The results at Transect 2 for Manganese and Calcium ranged between 580 mg/kg to 790 mg/kg. Calcium was measured at 790 mg/kg at Transect 2 compared to non-detect at Transect 1 for this sampling event. Manganese concentrations at Transect 2 (580 mg/kg) were 2X higher than Transect 1 (290 mg/kg).

Potassium, Magnesium, Aluminum, and Iron results ranged from 1,600 mg/kg, to 21,000 mg/kg at Transect 2, compared to 500 mg/kg to 5,500 mg/kg at Transect 1. Aluminum concentrations at Transects 2 were 6.5X higher than Transect 1. Potassium, Magnesium, and Iron concentrations at Transect 2 ranged from 3.2X to 3.8X higher than Transect 1.

The phosphorous results were higher at Transect 2 with a value of 350 mg/kg compared to a value of 150 mg/kg at Transect 1.

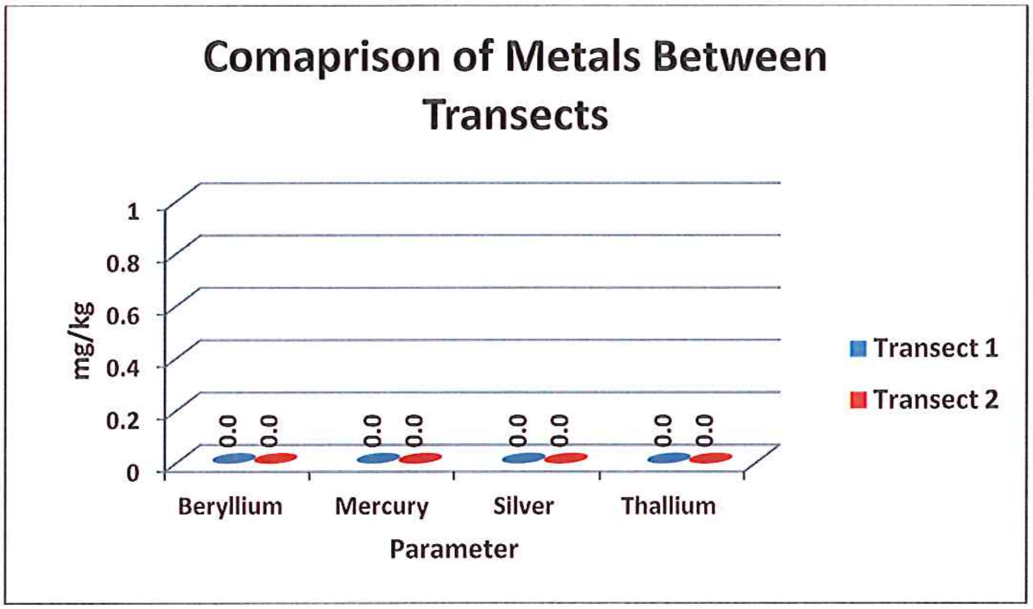
Summary

This data will be used along with subsequent yearly sampling of Transects 1 & 2 to provide background information to help determine what impacts, if any, the discharge from the future operation of VCSNS 2 & VCSNS 3 will have on the aquatic environment of Parr Reservoir as well as the Broad River immediately downstream of Parr Reservoir.

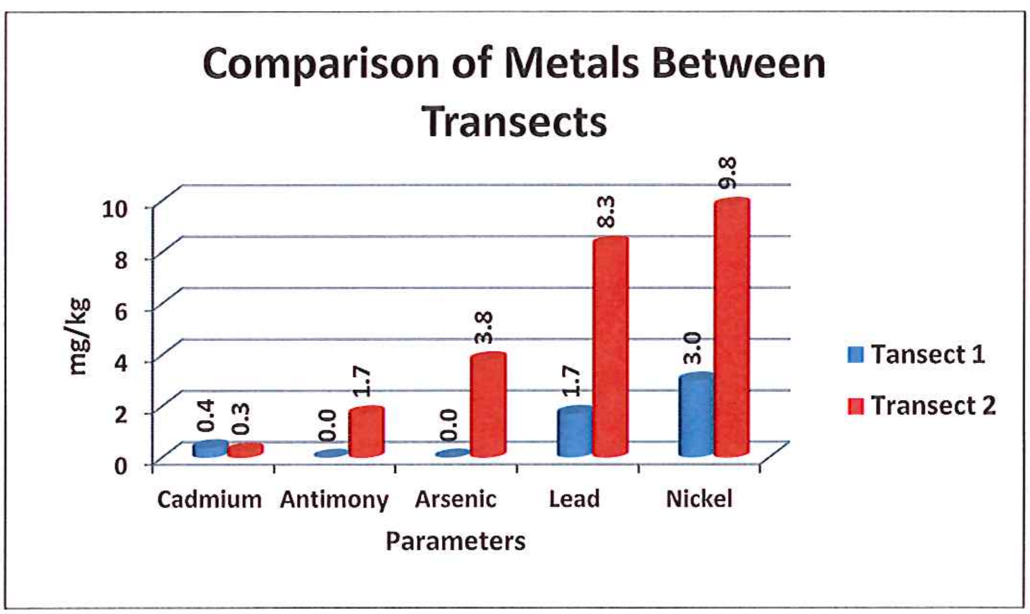
Figure 1. Parr Reservoir Sediment Transect Locations.

Appendix 1

Transect 1 Metals Results versus Transect 2 Metals Results

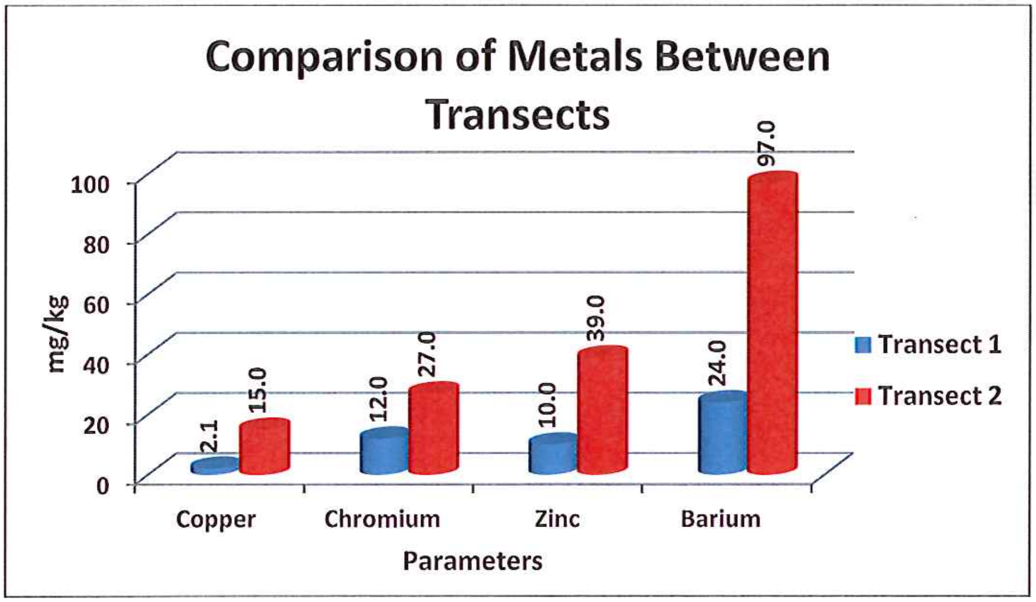


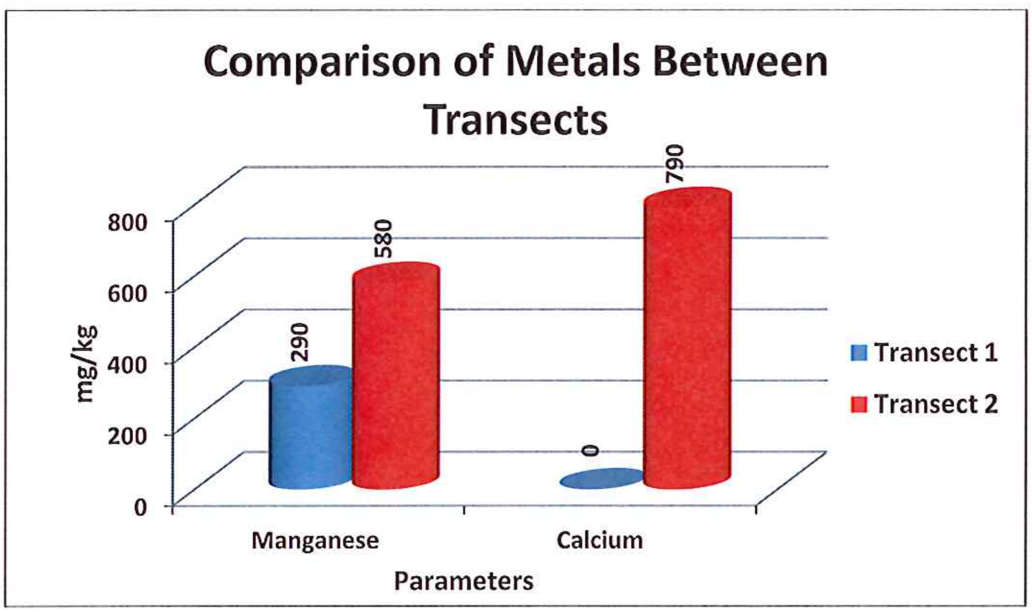
Note: 0.0 = Non- detect



Note: 0.0 = Non- detect

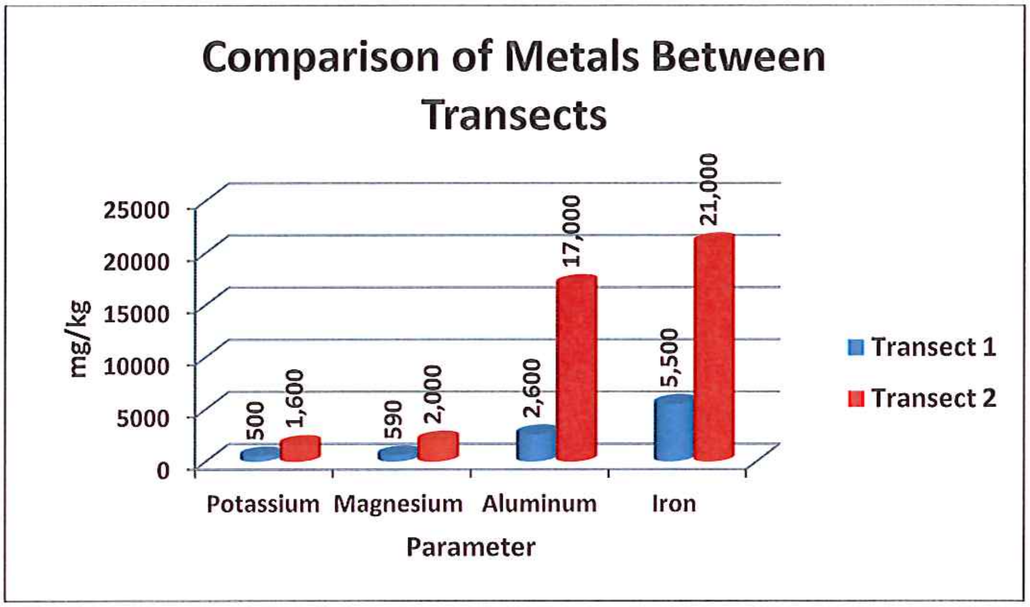
Transect 1 Metals Results versus Transect 2 Metals Results continued:



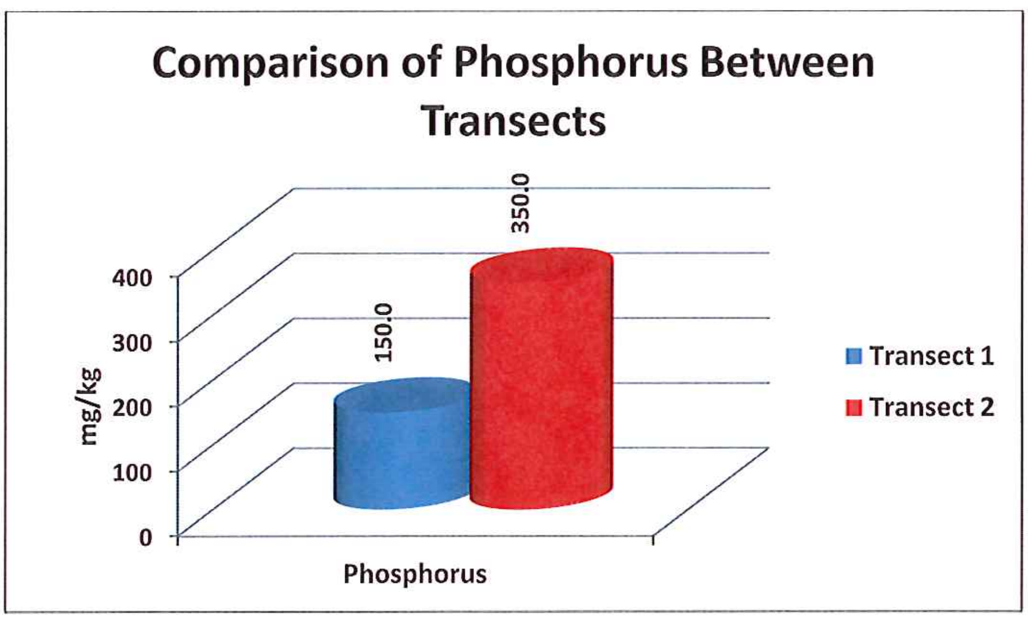


Note: 0.0 = Non- detect

Transect 1 Metals Results versus Transect 2 Metals Results continued:



Transect 1 Total Phosphorus versus Transect 2 Total Phosphorus:



Appendix 2

Laboratory Results.

SHEALY ENVIRONMENTAL SERVICES, INC.

Report of Analysis

SC Electric and Gas Company
220 Operations Way, C221
Cayce, SC 29033--3701
Attention: Milton Quattlebaum

Project Name: **NND**

Lot Number: **NI28059**
Date Completed: **10/08/2012**

Grant N Wilton

Grant Wilton
Project Manager

The following non-paginated documents are considered part of this report: Chain of Custody Record and Sample Receipt Checklist.

Case Narrative
SC Electric and Gas Company
Lot Number: NI28059

This Report of Analysis contains the analytical result(s) for the sample(s) listed on the Sample Summary following this Case Narrative. The sample receiving date is documented in the header information associated with each sample.

All results listed in this report relate only to the samples that are contained within this report.

Sample receipt, sample analysis, and data review have been performed in accordance with the most current approved NELAC standards, the Shealy Environmental Services, Inc. ("Shealy") Quality Assurance Management Plan (QAMP), standard operating procedures (SOPs), and Shealy policies. Any exceptions to the NELAC standards, the QAMP, SOPs or policies are qualified on the results page or discussed below.

If you have any questions regarding this report please contact the Shealy Project Manager listed on the cover page.

SHEALY ENVIRONMENTAL SERVICES, INC.

Sample Summary

SC Electric and Gas Company

Lot Number: NI28059

Sample Number	Sample ID	Matrix	Date Sampled	Date Received
001	Sediment Sta Control	Solid	09/27/2012 1129	09/28/2012
002	Sediment Sta 2 Downstream	Solid	09/27/2012 1228	09/28/2012

(2 samples)

SHEALY ENVIRONMENTAL SERVICES, INC.

Executive Summary
SC Electric and Gas Company
Lot Number: NI28059

Sample	Sample ID	Matrix	Parameter	Method	Result	Q	Units	Page
001	Sediment Sta Control	Solid	Phosphorus	365.1	150		mg/kg	5
001	Sediment Sta Control	Solid	Aluminum	6010C	2600		mg/kg	6
001	Sediment Sta Control	Solid	Barium	6010C	24		mg/kg	6
001	Sediment Sta Control	Solid	Cadmium	6010C	0.38		mg/kg	6
001	Sediment Sta Control	Solid	Chromium	6010C	12		mg/kg	6
001	Sediment Sta Control	Solid	Copper	6010C	2.1		mg/kg	6
001	Sediment Sta Control	Solid	Iron	6010C	5500	S	mg/kg	6
001	Sediment Sta Control	Solid	Lead	6010C	1.7		mg/kg	6
001	Sediment Sta Control	Solid	Magnesium	6010C	590		mg/kg	6
001	Sediment Sta Control	Solid	Manganese	6010C	290	S	mg/kg	6
001	Sediment Sta Control	Solid	Nickel	6010C	3.0		mg/kg	6
001	Sediment Sta Control	Solid	Potassium	6010C	500		mg/kg	6
001	Sediment Sta Control	Solid	Zinc	6010C	10		mg/kg	6
002	Sediment Sta 2 Downstream	Solid	Phosphorus	365.1	350		mg/kg	7
002	Sediment Sta 2 Downstream	Solid	Aluminum	6010C	17000	S	mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Antimony	6010C	1.7		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Arsenic	6010C	3.8		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Barium	6010C	97		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Cadmium	6010C	0.26		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Calcium	6010C	790		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Chromium	6010C	27		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Copper	6010C	15		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Iron	6010C	21000		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Lead	6010C	8.3		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Magnesium	6010C	2000		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Manganese	6010C	580		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Nickel	6010C	9.8		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Potassium	6010C	1600		mg/kg	8
002	Sediment Sta 2 Downstream	Solid	Zinc	6010C	39		mg/kg	8

(29 detections)

Inorganic non-metals

Client: **SC Electric and Gas Company**
Description: **Sediment Sta Control**
Date Sampled: **09/27/2012 1129**
Date Received: **09/28/2012**

Laboratory ID: **NI28059-001**
Matrix: **Solid**
% Solids: **77.2** **09/29/2012 0121**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1		(Phosphorus) 365.1	5	10/05/2012 0843	WKH	10/02/2012 0930	94447

Parameter	CAS Number	Analytical Method	Result	Q	PQL	Units	Run
Phosphorus	**7723-14-0**	**365.1**	**150**		**6.5**	**mg/kg**	**1**

PQL = Practical quantitation limit | B = Detected in the method blank | E = Quantitation of compound exceeded the calibration range | H = Out of holding time | Q = Surrogate failure
ND = Not detected at or above the PQL | J = Estimated result < PQL and ≥ MDL | P = The RPD between two GC columns exceeds 40% | N = Recovery is out of criteria | L = LCS/LCSD failure
Where applicable, all soil sample analysis are reported on a dry weight basis unless flagged with a "W" | * = Reportable result (only when report all runs) | S = MS/MSD failure

TAL Metals

Client: **SC Electric and Gas Company**	Laboratory ID: **NI28059-001**
Description: **Sediment Sta Control**	Matrix: **Solid**
Date Sampled: **09/27/2012 1129**	% Solids: **77.2 09/29/2012 0121**
Date Received: **09/28/2012**	

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	7471B	7471B	1	10/04/2012 1230	COH	10/04/2012 0922	94469
1	3050B	6010C	1	10/03/2012 2319	BNW	10/03/2012 0919	94528
2	3050B	6010C	1	10/05/2012 0216	BNW	10/03/2012 0919	94528

Parameter	CAS Number	Analytical Method	Result	Q	PQL	Units	Run
Aluminum	**7429-90-5**	**6010C**	**2600**		**12**	**mg/kg**	**1**
Antimony	7440-36-0	6010C	ND		0.59	mg/kg	1
Arsenic	7440-38-2	6010C	ND		0.59	mg/kg	2
Barium	**7440-39-3**	**6010C**	**24**		**1.5**	**mg/kg**	**1**
Beryllium	7440-41-7	6010C	ND		0.24	mg/kg	1
Cadmium	**7440-43-9**	**6010C**	**0.38**		**0.12**	**mg/kg**	**1**
Calcium	7440-70-2	6010C	ND		290	mg/kg	2
Chromium	**7440-47-3**	**6010C**	**12**		**0.29**	**mg/kg**	**1**
Copper	**7440-50-8**	**6010C**	**2.1**		**0.29**	**mg/kg**	**1**
Iron	**7439-89-6**	**6010C**	**5500**	**S**	**5.9**	**mg/kg**	**1**
Lead	**7439-92-1**	**6010C**	**1.7**		**0.59**	**mg/kg**	**1**
Magnesium	**7439-95-4**	**6010C**	**590**		**290**	**mg/kg**	**1**
Manganese	**7439-96-5**	**6010C**	**290**	**S**	**0.88**	**mg/kg**	**1**
Mercury	7439-97-6	7471B	ND		0.094	mg/kg	1
Nickel	**7440-02-0**	**6010C**	**3.0**		**2.4**	**mg/kg**	**1**
Potassium	**7440-09-7**	**6010C**	**500**		**290**	**mg/kg**	**1**
Silver	7440-22-4	6010C	ND		0.29	mg/kg	1
Thallium	7440-28-0	6010C	ND		2.9	mg/kg	1
Zinc	**7440-66-6**	**6010C**	**10**		**2.9**	**mg/kg**	**1**

PQL = Practical quantitation limit B = Detected in the method blank E = Quantitation of compound exceeded the calibration range H = Out of holding time Q = Surrogate failure
ND = Not detected at or above the PQL J = Estimated result < PQL and ≥ MDL P = The RPD between two GC columns exceeds 40% N = Recovery is out of criteria L = LCS/LCSD failure
Where applicable, all soil sample analysis are reported on a dry weight basis unless flagged with a "W" * = Reportable result (only when report all runs) S = MS/MSD failure

Inorganic non-metals

Client: **SC Electric and Gas Company**	Laboratory ID: **NI28059-002**
Description: **Sediment Sta 2 Downstream**	Matrix: **Solid**
Date Sampled: **09/27/2012 1228**	% Solids: **52.5** **09/29/2012 0121**
Date Received: **09/28/2012**	

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1		(Phosphorus) 365.1	10	10/05/2012 0927	WKH	10/02/2012 0930	94447

Parameter	CAS Number	Analytical Method	Result	Q	PQL	Units	Run
Phosphorus	**7723-14-0**	**365.1**	**350**		**19**	**mg/kg**	**1**

PQL = Practical quantitation limit B = Detected in the method blank E = Quantitation of compound exceeded the calibration range H = Out of holding time Q = Surrogate failure
ND = Not detected at or above the PQL J = Estimated result < PQL and ≥ MDL P = The RPD between two GC columns exceeds 40% N = Recovery is out of criteria L = LCS/LCSD failure
Where applicable, all soil sample analysis are reported on a dry weight basis unless flagged with a "W" * = Reportable result (only when report all runs) S = MS/MSD failure

TAL Metals

Client: **SC Electric and Gas Company**
Description: **Sediment Sta 2 Downstream**
Date Sampled: **09/27/2012 1228**
Date Received: **09/28/2012**

Laboratory ID: **NI28059-002**
Matrix: **Solid**
% Solids: **52.5 09/29/2012 0121**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	7471B	7471B	1	10/04/2012 1232	COH	10/04/2012 0922	94469
1	3050B	6010C	1	10/03/2012 2334	BNW	10/03/2012 0919	94528
2	3050B	6010C	1	10/05/2012 0231	BNW	10/03/2012 0919	94528

Parameter	CAS Number	Analytical Method	Result	Q	PQL	Units	Run
Aluminum	**7429-90-5**	**6010C**	**17000**	**S**	**18**	**mg/kg**	**1**
Antimony	**7440-36-0**	**6010C**	**1.7**		**0.90**	**mg/kg**	**1**
Arsenic	**7440-38-2**	**6010C**	**3.8**		**0.90**	**mg/kg**	**1**
Barium	**7440-39-3**	**6010C**	**97**		**2.3**	**mg/kg**	**1**
Beryllium	7440-41-7	6010C	ND		0.36	mg/kg	1
Cadmium	**7440-43-9**	**6010C**	**0.26**		**0.18**	**mg/kg**	**1**
Calcium	**7440-70-2**	**6010C**	**790**		**450**	**mg/kg**	**2**
Chromium	**7440-47-3**	**6010C**	**27**		**0.45**	**mg/kg**	**1**
Copper	**7440-50-8**	**6010C**	**15**		**0.45**	**mg/kg**	**1**
Iron	**7439-89-6**	**6010C**	**21000**		**9.0**	**mg/kg**	**1**
Lead	**7439-92-1**	**6010C**	**8.3**		**0.90**	**mg/kg**	**1**
Magnesium	**7439-95-4**	**6010C**	**2000**		**450**	**mg/kg**	**1**
Manganese	**7439-96-5**	**6010C**	**580**		**1.4**	**mg/kg**	**1**
Mercury	7439-97-6	7471B	ND		0.16	mg/kg	1
Nickel	**7440-02-0**	**6010C**	**9.8**		**3.6**	**mg/kg**	**1**
Potassium	**7440-09-7**	**6010C**	**1600**		**450**	**mg/kg**	**1**
Silver	7440-22-4	6010C	ND		0.45	mg/kg	1
Thallium	7440-28-0	6010C	ND		4.5	mg/kg	1
Zinc	**7440-66-6**	**6010C**	**39**		**4.5**	**mg/kg**	**1**

PQL = Practical quantitation limit B = Detected in the method blank E = Quantitation of compound exceeded the calibration range H = Out of holding time Q = Surrogate failure
ND = Not detected at or above the PQL J = Estimated result < PQL and ≥ MDL P = The RPD between two GC columns exceeds 40% N = Recovery is out of criteria L = LCS/LCSD failure
Where applicable, all soil sample analysis are reported on a dry weight basis unless flagged with a "W" * = Reportable result (only when report all runs) S = MS/MSD failure

Chain of Custody Record

Shealy Environmental Services, Inc.
106 Vantage Point Drive
West Columbia, South Carolina 29172
Telephone No. (803) 791-9700 Fax No. (803) 791-9111
www.shealylab.com

Number 30300

Client	SCE&G
Address	2112 North Lake Dr.
City / State / Zip Code	Columbia / SC / 29212
Project Name	NND
Project Number	
P.O Number	
Report to Contact	Milton Quattlebaum
Telephone No. / Fax No. / Email	(803) 217-8125 mquattlebaum@scana.com
Sampler (Printed Name)	Milton Quattlebaum
Waybill No.	
Quote No.	
Page	1 of 1

Preservative: 1. Unpres. 2. NaOH/ZnA 3. H2SO4 4. HNO3 5. HCL 6. Na Thio. 7. NaOH

Analysis	Metals	Total Phosphorus	
Number of Containers	1	1	
Bottle (See Instructions on back)	L	L	
Preservative	1	1	
Lot No.			NI2859

Sample ID / Description (Containers for each sample may be combined on one line)	Date 2012	Time	G=Grab C=Composite	GW	DW	WW	S	Other	Metals	Total Phosphorus	Remarks / Cooler ID
Sediment Stal Control	27Sept	1129	G				K		1	1	Metals: Arsenic,
Sediment Sta 2 Downstrm	27Sept	1228	G				K		1	1	Barium, Beryllium,
											Cadmium, Calcium
											Chromium, Copper Iron, Lead,
MMQ 28 Sept 2012											Magnesium, Manganese,
											Mercury, Nickel,
											Potassium, Silver,
											Strontium, Thallium & Zinc
											Aluminum, Antimony

Turn Around Time Required (Prior lab approval required for expedited TAT): ☐ Standard ☐ Rush (Please Specify)

Sample Disposal: ☐ Return to Client ☐ Disposal by Lab

QC Requirements (Specify)

Possible Hazard Identification: ☐Non-Hazard ☐Flammable ☐Skin Irritant ☐Poison ☐Unknown

	Date	Time		Date	Time
1. Relinquished by / Sampler: [signature]	28Sept2012	0905	1. Received by		
2. Relinquished by			2. Received by		
3. Relinquished by			3. Received by		
4. Relinquished by			4. Laboratory Received by: [signature]	9-28-12	0905

Note: All samples are retained for six weeks from receipt unless other arrangements are made.

LAB USE ONLY: Received on Ice (Check) ☑ Yes ☐ No ☐ Ice Pack; Receipt Temp. 5.5 °C; Temp. Blank ☐ Y ☑ N

SHEALY ENVIRONMENTAL SERVICES, INC.

Shealy Environmental Services, Inc.
Document Number: F-AD-016
Revision Number: 9

Page 1 of 1
Replaces Date: 03/06/11
Effective Date: 10/11/11

Sample Receipt Checklist (SRC)

Client: SCE + G   Cooler Inspected by/date: EV 9/24/12   Lot #: NL28859

Means of receipt: ☐ SESI ☑ Client ☐ UPS ☐ FedEx ☐ Airborne Exp ☐ Other

Yes ☐	No ☑		1. Were custody seals present on the cooler?
Yes ☐	No ☐		2. If custody seals were present, were they intact and unbroken?

Cooler ID/temperature upon receipt 5.5 °C / °C / °C / °C
Method: ☐ Temperature Blank ☑ Against Bottles
Method of coolant: ☑ Wet Ice ☐ Blue ice ☐ Dry Ice ☐ None

If response is No (or Yes for 14, 15, 16), an explanation/resolution must be provided.

Yes ☐	No ☐	NA ☑	3. If temperature of any cooler exceeded 6.0°C, was Project Manager notified? PM notified by SRC, phone, note (circle one), other: ______. (For coolers received via commercial courier, PMs are to be notified immediately.
Yes ☐	No ☐	NA ☑	4. Is the commercial courier's packing slip attached to this form?
Yes ☑	No ☐		5. Were proper custody procedures (relinquished/received) followed?
Yes ☐	No ☐	NA ☑	5a Were samples relinquished by client to commercial courier?
Yes ☑	No ☐		6. Were sample IDs listed?
Yes ☑	No ☐		7. Was collection date & time listed?
Yes ☑	No ☐		8. Were tests to be performed listed on the COC?
Yes ☑	No ☐		9. Did all samples arrive in the proper containers for each test?
Yes ☑	No ☐		10. Did all container label information (ID, date, time) agree with COC?
Yes ☑	No ☐		11. Did all containers arrive in good condition (unbroken, lids on, etc.)?
Yes ☑	No ☐		12. Was adequate sample volume available?
Yes ☑	No ☐		13. Were all samples received within ½ the holding time or 48 hours, whichever comes first?
Yes ☐	No ☑		14. Were any samples containers missing?
Yes ☐	No ☑		15. Were there any excess samples not listed on COC?
Yes ☐	No ☐	NA ☑	16. Were bubbles present >"pea size" (¼"or 6mm in diameter) in any VOA vials?
Yes ☐	No ☐	NA ☑	17. Were all metals/O&G/HEM/nutrient samples received at a pH of <2?
Yes ☐	No ☐	NA ☑	18. Were all cyanide and/or sulfide samples received at a pH >12?
Yes ☐	No ☐	NA ☑	19. Were all applicable NH3/TKN/cyanide/phenol/BNA/pest/PCB/herb (<0.2mg/L) samples free of residual chlorine?
Yes ☐	No ☐	NA ☑	20. Were collection temperatures documented on the COC for NC samples?
Yes ☐	No ☐	NA ☑	21. Were client remarks/requests (i.e. requested dilutions, MS/MSD designations, etc...) correctly transcribed from the COC into the comment section in LIMS?

Sample Preservation (Must be completed for any sample(s) incorrectly preserved or with headspace.)

Sample(s) ______ were received incorrectly preserved and were adjusted accordingly in sample receiving with ______ (H_2SO_4,HNO_3,HCl,NaOH) with the SR # (number) ______

Sample(s) ______ were received with bubbles >6 mm in diameter.

Sample(s) ______ were received with TRC >0.2 mg/L for NH3/TKN/cyanide/BNA/pest/PCB/herb.

Corrective Action taken, if necessary:

Was client notified: Yes ☐ No ☐   Did client respond: Yes ☐ No ☐

SESI employee: ______   Date of response: ______

Comments: ______

APPENDIX B

THERMAL MIXING ZONE EVALUATION

VIRGIL C. SUMMER NUCLEAR STATION

NPDES PERMIT

Prepared for

SCANA – South Carolina Electric and Gas
100 SCANA Parkway
Cayce, SC 29033

THERMAL MIXING ZONE EVALUATION
VIRGIL C. SUMMER NUCLEAR STATION
NPDES PERMIT
FAIRFIELD COUNTY, SOUTH CAROLINA

Prepared by

Geosyntec consultants

engineers | scientists | innovators

&

MMI

engineers • scientists • innovators

Project Number GR4796

January 9, 2012

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MMI
engineers • scientists • innovators

Geosyntec
consultants

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1. INTRODUCTION

South Carolina Electric and Gas (SCE&G, a subsidiary of SCANA Corporation) is making an application to the South Carolina Department of Health and Environmental Control (DHEC) for a renewal of its National Pollutant Discharge Elimination System (NPDES) permit for Unit 1 of the Virgil C. Summer Nuclear Generating Station (V. C. Summer Station) located in Fairfield County near Jenkinsville, South Carolina.

This document presents background and technical information supporting formal requests to DHEC for the thermal mixing zone for the V. C. Summer Station cooling water effluent discharge to the Monticello Reservoir pursuant to Rule 61-68 (Water Classifications and Standards) Section C.10.

Facility Description

Summer Station is a single-unit, 974-megawatt (MW) nuclear-fueled electric power generating facility that operates as a base-load facility. It uses a once-through cooling water system that withdraws cooling water from Monticello Reservoir via a single shoreline-positioned cooling water intake structure (CWIS) located at the south end of the reservoir. After the cooling water leaves the condensers, the heated water is conveyed to a "discharge bay" and then through a 1,000 foot (ft) discharge canal leading into Monticello Reservoir.

Monticello Reservoir is a 6,800-acre (ac) freshwater impoundment that was built in the Frees Creek valley in 1978 to serve both as the cooling water source for Summer Station and the upper pool for the Fairfield Pumped Storage Facility (FPSF). The Federal Energy Regulatory Commission (FERC) regulates water levels in Monticello Reservoir through the hydropower license for SCE&G's Parr Shoals (Broad River) Hydroelectric Project (FERC License No. 1894), of which FPSF is a part. The FERC license for Parr Shoals establishes water surface elevation guidelines for Monticello Reservoir between 425.0 feet (ft) above mean sea level (msl) (high water level) and 420.5 ft msl (low water level). Reservoir levels may fluctuate daily within this 4.5-ft operating band as a result of FPSF operation.

The operation of the FPSF will vary depending on the season and system power needs. In summer, the facility generally pumps water from Parr Reservoir to Monticello Reservoir between the hours of 11:00 pm and 8:00 am and generates power by releasing water between the hours of 10:00 am and 11:00 pm. In winter, FPSF generally pumps water daily from Parr Reservoir to Monticello Reservoir between 11:00 pm and 6:00 am and generates between the hours of 6:00 am and 1:00 pm. Pumping to Monticello Reservoir is normally done at maximum capacity during off-peak periods. The power output for FPSF varies from one generator up to the maximum output from eight generators, depending on demand. Consistent with its operation as a peaking facility, maximum output of FPSF may not be necessary on all days.

Permitting History

The NPDES permitting history for the Summer Station discharge extends from the mid-1970s when the facility was first permitted. Operating as a once-through cooling water system, thermal addition to Monticello Reservoir is substantial with discharge flow rates up to 532,000 gallons per minute (768 million gallons per day). To comply with South Carolina Department of Health and Environmental Control (DHEC) water quality standards for temperature in lakes, SCE&G conducted studies to successfully support alternate thermal effluent limitations under Clean Water Act Section 316(a) per South Carolina Regulation 61-68 – Water Classifications and Standards: Section E.12.c.)[1]. The following numeric effluent limitations for temperature were established for Summer Station Outfall 001 in the initial permit:

- a daily maximum temperature of 113°F to be measured "in pipe" prior to discharge;
- a monthly average temperature of 90°F measured at the FPSF intake structure (considered the mixing zone boundary);
- a maximum thermal plume size of 6,700 acres; and

[1] The weekly average water temperature of all Freshwaters which are **lakes** shall not be increased more than 5°F (2.8°C) above natural conditions and shall not exceed 90°F (32.2°C) as a result of the discharge of heated liquids unless a different site-specific temperature standard as provided for in C.12. has been established, a mixing zone as provided in C.10. has been established, or a Section 316(a) determination under the Federal Clean Water Act has been completed (South Carolina Regulation 61-68 – Water Classifications and Standards: Section E.12.c.).

- a monthly average temperature rise (ΔT) within the plume of 3°F measured between the FPSF intake structure and a point at the northern end of the reservoir.

Based on several years of monitoring, DHEC ultimately eliminated the plume size and ΔT limitations leaving in place the 113°F daily maximum limit and 90°F monthly average limit in subsequent permits.

Thermal discharges and repeated continuation of alternate thermal limits (variances) in NPDES permits that are based on historical 316(a) demonstration study data have come under increased scrutiny by the U.S. Environmental Protection Agency (USEPA) who oversees the DHEC NPDES program. Recently, DHEC and SCE&G have had discussions relative to renewal of the current NPDES permit for V. C. Summer Station concerning the level of information needed to support the continued discharge temperature limits for the facility. There have been no substantive changes[2] to V. C. Summer Station operations since issuance of the initial NPDES permit in the mid-1970s. As such, SCE&G believes that reevaluation of the thermal mixing zone characteristics and boundaries via updated hydrodynamic modeling (in complement to the earlier 316(a) demonstration study data) will provide the quantitative information needed by DHEC to support a decision maintaining the current temperature limits for Summer Station that is consistent with South Carolina Regulation 61-68, Section E.12.

Related Modeling Work

The primary modeling study related to the thermal plume characteristics of the cooling water discharge for the V. C. Summer Station was carried out by NUS Corporation in 1985 [1] and updated in 1989 [2]. A mathematical model of the lake was created which accounted for discharge and atmospheric parameters and calculated the thermal plume based on assumed vertical temperature profiles. The conclusions of the study showed that the VC Summer Station would not violate any of the three quantitative temperature limits in the NPDES permit at the time, even under extreme meteorological conditions.

[2] Licensed power output of the V.C. Summer Station Unit 1 has been increased, but due to some cooling loads being handled by a small cooling tower, the heat loading to the reservoir has not changed significantly. Additionally, the discharge canal was dredged (canal is now deeper than it was originally) to alleviate fish kills in the discharge bay area.

While certainly an advanced and comprehensive analysis at the time, the NUS study did not consider several important features of the thermal discharge. In particular, the Unit 1 cooling water discharges into a small basin (approximately 600 ft x 600 ft surface dimension), which is connected to the reservoir through a channel approximately 900 ft in length and 200 ft wide. The dynamics in the basin and channel are complex; recirculating flows in the basin, and an unusual return flow of cold water flowing along the bottom of the channel from the reservoir to the basin. These features could not have been reasonably accounted for and calculated by the NUS study, and neither can they be calculated with more modern tools such as CORMIX [3], since in both these cases underlying assumptions are made regarding the temperature profiles.

In order to more definitively characterize the V. C. Summer Station Unit 1 thermal discharge into the hydrodynamically and spatially complex mixing environment in the basin, channel and reservoir, a more robust modeling approach was needed. As such, three-dimensional Computational Fluid Dynamics (CFD) modeling effort was conducted.

CFD modeling is based on the Navier-Stokes equations for fluid motion, which are simply an expression of Newton's laws of motion with additional viscous stress terms required to calculate fluid flow [4]. The equations express the laws of conservation of mass, momentum and energy and are hence a "fundamental" set of equations (i.e., no assumptions are made in forming the basic equation set).

CFD modeling has been used successfully for over 40 years in a variety of industrial and environmental applications. The Tennessee Valley Authority (TVA) used CFD modeling to evaluate the thermal discharge from its Browns Ferry Nuclear Power Plant to Wheeler Reservoir in north Alabama [5]. The CFD model allowed TVA to determine thermal plume mixing and temperature rise patterns as well as other hydrodynamic features of the discharge. Notably, TVA found close agreement between CFD model predicted water temperatures and direct temperature measurements at the operating diffusers.

More recently, Geosyntec Consultants and MMI Engineering employed CFD to model the complex thermal plume characteristics of the proposed William States Lee III Nuclear Generating Station, as part of the NPDES permit application for the site submitted by Duke Energy to DHEC. Similar to the current study, the thermal plume was affected by operations in the receiving water body that significantly affected the surface elevation.

Other examples of CFD environmental applications include the U.S. Department of Energy's Pacific Northwest National Laboratory use of CFD in the hydrodynamic evaluation of the North Fork Dam forebay on the Clackamas River in Oregon and to model the three-dimensional velocity field below Bonneville Dam to enhance fish passage [6]. CFD has also been used to investigate the increased discharge associated with the re-powering of an existing power plant [7].

2. GENERATION OF THE COMPUTATIONAL MODEL

Geosyntec/MMI Engineering uses a variety of classical and computational analysis techniques to assess the performance of fluid systems and processes. For detailed CFD analysis, calculations are made with the general purpose, commercial CFD code ANSYS-CFX Version 12 [8]. This is the CFD model code selected for the current analysis. Full details of the computational model are given in Appendix A.

The extent (geometry) of the Monticello Reservoir and discharge bay and canal environment in the CFD models included:

- the Unit 1 discharge bay and canal;
- the Fairfield Pumped Storage Facility intakes;
- the backwater areas in the locality of the canal; and,
- a section of the Monticello Reservoir extended approximately 1.6 miles north of the discharge structure.

Total surface area of the modeled domain was approximately 1800 acres, or approximately 25% of the total surface area of the reservoir.

Bathymetry data in the discharge bay and canal, and in part of the Monticello Reservoir, was collected by Geosyntec in the form of point-depth measurements in a series of transects. These point data were interpolated to form part of the reservoir bed in the CFD models. For the areas of the model that were not covered by the bathymetry data, a contour map was provided to MMI/Geosyntec (a section of this map in shown in

Figure 3) and was digitized by MMI/Geosyntec to create approximately 10,000 additional data points (Figure 4) that were combined with the collected bathymetry data to form the entire model (see Figure 5 and Figure 6). A more detailed view of the model in the vicinity of the discharge, showing the bay and canal, is shown on Figure 7 and Figure 8.

Detailed drawings of the discharge structure were not available; however the shape of the structure and its dimensions and exact location can be calculated from aerial photographs. The discharge pipe diameter is 144" [9], and in the model this was represented as a square cross-section (rather than circular) of the same area as the circular pipe. This ensures the correct mass, energy and momentum input into the model and the highly turbulent flows near the discharge would quickly smooth out small differences in the shape of the discharge pipe.

Views of the computational mesh, which contained approximately 500,000 cells with 20 cells in the depth direction, are shown on Figure 9 and Figure 10.

3. SCENARIOS

The following modeling scenarios were run to capture the expected worst case results (thermally and spatially) for the Summer Station thermal discharge:

- **Scenario 1** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under <u>high water-slack</u> conditions (no flow through FPSF).
- **Scenario 2** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under <u>low water-slack</u> conditions (no flow through FPSF).
- **Scenario 3** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under <u>low water-rising</u> conditions (FPSF pump-back); and
- **Scenario 4** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under <u>high water-falling</u> conditions (FPSF generation).

Each scenario was modeled under critical conditions of summer when ambient reservoir and discharge temperatures are expected to be greatest and have the most potential for acute effects to aquatic life. This will allow evaluation of thermal plume mixing characteristics and spatial dimensions in the context of the DHEC 90°F temperature criterion. Based on data transmitted to MMI/Geosyntec [10], the ambient reservoir temperature was set to 86.4°F as this was the highest monthly-average temperature recorded at the Unit 1 intakes in 2010. The discharge temperature was set to 113.0°F which was measured during August 2011, and is approximately 1°F higher than the recorded highest monthly-average discharge temperature in 2010.

Additionally, each scenario was also modeled under winter conditions when differential between the plume temperature and ambient temperature (i.e., ΔT) are expected to be greatest. This will allow evaluation of thermal plume mixing characteristics and spatial dimensions in the context of the DHEC 5°F ΔT temperature criterion. Based on data transmitted to MMI/Geosyntec [10], the highest monthly-averaged ΔT for 2010 occurred in November, where the monthly-average reservoir temperature was recorded at 66.6°F and the monthly-average discharge temperature was 98.7°F, resulting in a ΔT of 32.1°F. These temperature values were used to represent winter conditions.

In all cases, the discharge flow rate was set to 532,000 gpm which is the flow rate through the Unit 1 intake with all three intake pumps fully operational. Based on data transmitted to MMI/Geosyntec [11], the flow rate for FPSF pump-back was set to 41,800 cfs and the flow rate for FPSF generation was set to 50,400 cfs.

4. VALIDATION OF THE COMPUTATIONAL MODEL

Geosyntec collected temperature and velocity profiles during a data survey conducted on the Monticello Reservoir in August 2011. The most useful "snapshot" of the temperature of the thermal plume was taken at around 2pm on August 3rd 2011in the form of five temperature profiles extending to a maximum depth of 25ft. These profiles are shown on Figure 11 (note that the temperature scale is in degrees Celsius). At the time of the measurements, the discharge temperature was 44.1°C (111.4 °F) and this is shown for reference on Figure 11 by the broken purple line on the right. The most striking feature of the measurements is the difference between the discharge temperature and the measured temperature in the discharge bay (i.e. almost immediately downstream of the discharge). This profile is shown in blue in the figure. If the water in the discharge bay were from the discharge alone, then a temperature near to 44.1°C would be expected as the only losses would be minor. However, the measurements show temperatures around 40°C in the discharge bay. An indication of the explanation for this can be deduced from the temperature profile taken at the confluence of the discharge bay and canal (shown in red). For depths below 15 ft, the temperature reduces rapidly to less than 34°C. The profile taken at the mouth of the discharge canal (green) has a similar dramatic reduction in temperature below 10 ft depth, to just above 30°C near the bottom, which is approximately the same as the recorded background temperature (light blue). It appears from the data that it is likely that these temperature profiles comprise discharge (hot) water in the upper layer and ambient (cold) water in the lower layer, which, since this pattern is repeated at in the discharge bay (red line) suggests that cold water is flowing from the reservoir into the bay along the bottom of the discharge canal, and hot water is flowing in the opposite direction near the surface. Indeed, this phenomenon of warm water flowing over cool water in the discharge canal was explained to MMI/Geosyntec staff by SCE&G staff prior to the measurements being taken. The field measurements confirmed this.

A somewhat less expected feature of the temperature profiles is the apparent inversion in the upper 5ft of the profiles, where the temperature reduces significantly, suggesting a cooler, more dense layer near the surface on top of a warmer and less dense layer below (in opposition to the natural tendency of buoyancy). The only physical explanation for this reduction in temperature is a very high rate of heat loss at the surface, much higher than one would expect by classical heat loss calculations alone. This may be linked to waves generated by the discharge or the wind, or churning aeration of the very upper layer.

To investigate the accuracy of the computational model, a simulation was run to approximate the thermal plume as closely as possible at the time the measurements were taken. The discharge temperature was set to 44.1°C (111.4 °F) and the flow rate was set to 532,000 gpm. The surface elevation of the reservoir was set to 423.5 ft msl which was calculated from level-loggers installed by Geosyntec. In addition, a surface shear stress was applied that was equivalent to a 10 ft/s north-easterly wind which was recorded on the day.

Figure 12 shows a contour plot of temperature on the surface of the reservoir resulting from the simulation. The blue coloration indicates the ambient temperature of the reservoir (set as 32.0°C) while the red coloration indicates a temperature equal to the discharge temperature. The plume can be seen to gradually reduce in temperature away from the discharge bay and canal. Interestingly, the oranges and yellows in the discharge bay as predicted in the CFD model indicate much lower temperatures than in the discharge pipe. To investigate this further, two contour plots were produced of temperature on the surface and at 18 ft depth – these are shown on Figure 13 (a) and (b) respectively. Figure 13 (a) shows a close view of the contour plot in Figure 12, and surface temperatures of approximately 41.0°C can be observed. However, Figure 13 (b) which is the temperature at 18 ft depth, shows much cooler (blue) temperatures near the bottom of the discharge canal, as was observed in the field measurements. A clear visualization of this phenomenon can be seen on Figure 14, where velocity vectors are shown on a vertical cut-plane in the center of the canal, and are colored by temperature rather than velocity. There is a clear flow of cold water from the reservoir to the discharge bay in the lower layers, and a flow of hot water in the reverse direction in the upper layers.

Qualitatively the model thus agrees with the anticipated flows, despite these flows being unusual. A quantitative comparison is shown on Figure 15 where the lines indicate results from the CFD model and the circles indicate measured data. The colors of the lines and circles match where the profiles were taken at the same locations. The CFD results in the discharge bay (blue line) shows that the temperature has decreased in the discharge bay by approximately the correct amount. This is due to the counter-flow of cold water into the bay from the reservoir, which is shown by the CFD model results at the confluence of the discharge bay and canal (red line). The sharp decrease in temperature mirrors the measured temperature gradient well. The major differences between the model and measured temperature profiles exist within the upper layer, where the inversion is not predicted by the CFD model. This is not unexpected since it is difficult to account for the inversion recorded by the data. However, it is important to note that the differences between the model and the data result in a higher surface temperature being predicted by the CFD model, showing that the model results will in general be conservative. At the mouth of the discharge canal (green line) the surface temperature is again over-predicted, but the sharp temperature gradient seen below 5 ft depth is captured, albeit at a slightly shallower depth in the model than was measured. Importantly, the model and data match well in the region halfway between the canal and exclusion buoys (orange), as the edges of the thermal plume are expected near this region. The last profile comparison (light blue line) is simply the background profile, which was set as constant in the CFD model but showed slight variation with depth in the measured data, probably due to naturally formed thermoclines rather than the thermal plume itself given the distance between the measurement and the discharge (approximately 2 miles).

The validation effort therefore shows that the CFD model qualitatively predicts the correct behavior, particularly with respect to the known unusual flows in the discharge canal. The agreement between the model and measured data is generally good, with the greatest discrepancies near the surface of the reservoir. Where these discrepancies occur, the CFD model over-predicts the measured data, so the model results are conservative with respect to surface temperature and therefore the size and magnitude of the thermal plumes.

5. MODEL RESULTS – T = 90°F PLUME

The four scenarios listed in §3 were run under summer conditions to evaluate the size of the 90°F thermal plume, as these conditions represent the worst-case scenarios for this plume. In all scenarios the discharge temperature was set to 113.0°F and the ambient reservoir temperature was 86.4°F. The scenarios for summer conditions are referred to as 1S, 2S, 3S and 4S in the text and figure captions, and the input parameters and results are summarized in §7 for reference.

The surface temperature for scenario 1S is shown on Figure 16. In this scenario, the reservoir surface elevation is high (425.0 ft msl) and the FPSF flow rate is zero (slack conditions). This figure provides a full view of the thermal plume in plan view, although it must be remembered that the analysis is three-dimensional so variations in temperature in the depth direction are captured. As anticipated, the hot plume spreads and cools as it mixes with the ambient water downstream of the discharge canal (the red areas in the figure represent temperatures about 112.0°F and the blue indicates less than 87.0°F). The 90°F plume is difficult to distinguish from the contour plot, so it is shown more clearly on Figure 17 where the purple area shows the 90.0°F. Note that the area shown on this figure does not necessarily extend vertically down to the bottom of the reservoir, as the temperature gradients highlighted in the validation study will also exist here. The dimensions of the thermal plume account for these variations as the computational model is three-dimensional. The volume of the 90.0°F plume for scenario 1S is 1,418 acre-ft and the surface area is 128 acres. The maximum length of the plume, which is taken from the end of the discharge pipe to the point in the plume furthest away from the pipe, is 4,332 ft, while the width of the plume (the maximum width in approximately an east-west direction) is 3,312 ft. Note that although the maximum depth of the plume is 40 ft, the average depth of the plume is only 6.4 ft, indicating that the majority of the plume is relatively shallow.

Scenario 2S is the same simulation as scenario 1S but at a low surface elevation (420.5 ft). As the volume of the ambient water is reduced in the reservoir, but the flow rate from the discharge remains the same, it might be expected that the plume would be slightly larger in volume than the previous scenario. This is indeed the case – the volume of the 90°F plume is 1,627 acre-ft and the surface area is 150 acres. The temperature contours and 90°F plume for this case are shown on Figure 19.

When the FPSF is pumping under low surface elevation, approximately 41,800 cfs is injected into the reservoir at the ambient reservoir temperature. This is the situation modeled in scenario 3S. The velocity vectors on the surface of the reservoir are shown on Figure 20 where the scale is from zero velocity (blue) to 3 ft/s (red). Although the jet from the FPSF is set almost directly from west to east in the model, the proximity and angle of the coast just to the south of the FPSF causes the jet to turn south, resulting in a large recirculation region bounded by the jetty and the island. Although the change to the flows in the western region of the lake are significantly changed, the raised jetty effectively shields the thermal plume, so that neither the temperature contours (Figure 21) or the 90°F plume (Figure 22) are changed from slack conditions (compare to scenario 2S). Indeed, the 90°F plume are very similar to those in scenario 2S: the plume volume is 1,626 acre-feet, the surface area is 150 acres and the maximum length and width are 4,699 ft and 3,830 ft respectively.

The final scenario under summer conditions is 4S, where the FPSF is generating, removing 50,400 cfs of flow from the reservoir. This generates a velocity field pointing towards the FPSF intakes, as shown by the velocity vectors on Figure 23 (the scale in this figure is from zero (blue) to 1 ft/s (red). Note that the influence of the FPSF is lesser when the flow is being withdrawn from the reservoir rather than injected, since the flow is withdrawn from all angles rather than the highly directional jet seen in Figure 20. The withdrawal of fluid from the reservoir does have the effect of “pulling” the plume and results in a stretched but shallower thermal plume – the maximum length and width of the plume are 4,775 ft and 3,705 ft respectively, but the average depth has reduced to 6.1 ft. Overall the 90°F plume is largest in this flow regime, with a volume of 1,790 acre-ft and a surface area of 163 acres. The reason why the generating rather than pumping regime increases the plume size is twofold: first, the “pulling” of the fluid is less turbulent and does not cause additional mixing; second, the flow does not sharply turn, as was shown by the vectors near the island for the previous scenario. The surface temperature contours and 90°F plume for this case are shown on Figure 24 and Figure 25 respectively.

A summary of these results is given by the table in §7.

6. MODEL RESULTS – ΔT = 5°F PLUME

The worst case for the ΔT = 5°F thermal plume is under winter conditions where the temperature difference between the background and discharge is greatest. As explained in §3, this occurs in November where the monthly-average ambient reservoir temperature is 66.6°F and the discharge temperature is 98.7°F, a ΔT of 32.1°F. These temperatures were set for all four winter scenarios, and are referred to as 1W, 2W, 3W and 4W in the text and figure captions, and the input parameters and results are summarized in §8 for reference.

The surface temperature for scenario 1W (high surface elevation, slack conditions) is shown on Figure 26. Similar to the figures for the summer conditions, the blue coloration indicates ambient temperatures and red indicates temperatures similar to the plume; however in winter the ambient temperature is now 66.6°F and the plume temperatures is 98.7°F. In this color scale the thermal plume appears to be similar in shape and size to the summer plumes, but it is the ΔT = 5°F rather than the 90°F plume that is of interest here. This is shown for scenario 1W by the green area in Figure 27. This plume is visibly smaller than the 90°F plumes in the previous section. The volume of the ΔT = 5°F for this scenario is 799 acre-feet and the surface area is 77 acres. The maximum length and width are 3,391 ft and 2,763 ft respectively, while the average depth is 6.5 ft.

The same simulation but for low surface elevation of 420.5 ft msl was run as scenario 2W. For the summer simulations, the reduced surface elevation resulted in a larger thermal plume, and this is also the case for the winter conditions, as the volume has increased to 1,005 acre-ft and the surface area has increased to 107 acres. Similarly, the maximum length and width have increased to 4,129 ft and 3,190 ft respectively, but the plume on average is shallower with an average depth of 5.5 ft. The temperature contours and plume can be seen on Figure 28 and Figure 29.

A large recirculation zone was observed in the summer simulation with the FPSF pumping, and this is also seen under winter conditions in Figure 30, which shows velocity vectors (blue is zero, red is 3 ft/s) for scenario 3W. The vectors are very similar to those for scenario 3S, which is expected as the FPSF pumping flow rate is the same in both cases. However, unlike the summer scenario where an almost identical plume resulted with the FPSF pumping, in this case the plume is slightly bigger. This is not noticeable on the temperature contours (Figure 31) or the plume visualization (Figure 32) but the statistics show a marginal increase in plume size, to 1,148 acre-ft volume and 120 acres surface area. The maximum length and width has also increased to 4,219 ft and 3,325 ft respectively, but the average depth remains the same as scenario 2W at 5.5 ft.

Scenario 4W is the final scenario under winter conditions, simulating FPSF generating flow (50,400 cfs removed from the reservoir). The velocity vectors for this scenario are shown on Figure 33, which show the effect of the flow being removed from the reservoir. Similar to the results for summer conditions, the generating condition for the FPSF results in an extended but shallower plume; the surface area is 110 acres and the average depth is 5.8 ft. The plume dimensions are 3,183 ft for maximum width and 3,901 ft for maximum length, and result in an increase in volume over scenario 1W to 1,043 acre-feet.

7. RESULTS SUMMARY – T = 90°F PLUME

	Scenario 1S	Scenario 2S	Scenario 3S	Scenario 4S
Description	*Summer, high water, slack*	*Summer, low water, slack*	*Summer, low water, pumping*	*Summer, high water, generating*
Reservoir Surface Elevation	425.0 ft msl	420.5 ft msl	420.5 ft msl	425.0 ft msl
Reservoir Temperature	86.4°F	86.4°F	86.4°F	86.4°F
Discharge Flow	532,000 gpm	532,000 gpm	532,000 gpm	532,000 gpm
Discharge Temperature	113.0°F	113.0°F	113.0°F	113.0°F
FPSF Operation	0 cfs	0 cfs	+ 41,800 cfs	- 50,400 cfs
Dimensions of the T = 90°F Thermal Plume				
- **Volume**	1,418 acre-ft	1,627 acre-ft	1,626 acre-ft	1,790 acre-ft
- **Surface area**	128 acre	150 acre	150 acre	163 acre
- **Average Depth/Thickness**	6.4 ft	6.0 ft	5.9 ft	6.1 ft
- **Maximum Depth/Thickness**	40 ft	36 ft	36 ft	40 ft
- **Maximum Width**	3,312 ft	3,840 ft	3,830 ft	3,705 ft
- **Maximum Length**[3]	4,332 ft	4,699 ft	4,699 ft	4,775 ft

[3] Calculated from the end of the discharge pipe.

8. RESULTS SUMMARY – ΔT = 5°F PLUME

	Scenario 1W	Scenario 2W	Scenario 3W	Scenario 4W
Description	*Winter, high water, slack*	*Winter, low water, slack*	*Winter, low water, pumping*	*Winter, high water, generating*
Reservoir Surface Elevation	425.0 ft msl	420.5 ft msl	420.5 ft msl	425.0 ft msl
Reservoir Temperature	66.6°F	66.6°F	66.6°F	66.6°F
Discharge Flow	532,000 gpm	532,000 gpm	532,000 gpm	532,000 gpm
Discharge Temperature	98.7°F	98.7°F	98.7°F	98.7°F
FPSF Operation	0 cfs	0 cfs	+ 41,800 cfs	- 50,400 cfs
Dimensions of the ΔT = 5°F Thermal Plume				
- **Volume**	799 acre-ft	1,005 acre-ft	1,148 acre-ft	1,043 acre-ft
- **Surface area**	77 acre	107 acre	120 acre	110 acre
- **Average Depth/Thickness**	6.5 ft	5.5 ft	5.5 ft	5.8 ft
- **Maximum Depth/Thickness**	40 ft	36 ft	36 ft	40 ft
- **Maximum Width**	2,763 ft	3,190 ft	3,325 ft	3,183 ft
- **Maximum Length**[4]	3,391 ft	4,129 ft	4,219 ft	3,901 ft

[4] Calculated from the end of the discharge pipe.

9. RELEVANCE TO THE THEMRAL MIXING ZONE RENEWAL

The results of the thermal modeling relative to the thermal mixing zone are as follows.

For the T = 90°F plume:

- The maximum plume dimensions occur in summer, when the reservoir is at high surface elevation (425.0 ft msl) and the FPSF is generating.
- The maximum volume is 1,790 acre-ft.
- The maximum surface area is 163 acres.
- The maximum length is 4,775 ft.
- The maximum width is 3,705 ft.

For the ΔT = 5°F plume:

- The maximum plume dimensions occur in winter, when the reservoir is at low surface elevation (420.5 ft msl) and the FPSF is pumping.
- The maximum volume is 1,148 acre-ft.
- The maximum surface area is 120 acres.
- The maximum length is 4,219 ft.
- The maximum width is 3,325 ft.

The above results indicate that the **T = 90°F plume has a larger impact** than the ΔT = 5°F plume.

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[8] ANSYS,Inc., Southpointe, 275 Technology Drive, Canonsburg, PA 15317. http://www.ansys.com/default.asp.

[9] *Piping Yard Plan – Non Nuclear*, SCE&G Drawing E-303-202.

[10] *Email correspondence*, from Summer, S. (SCE&G) to Heynes, O. (MMI) on 11/28/11 at 12:15 PM.

[11] *Email correspondence*, from Summer, S. (SCE&G) to Heynes, O. (MMI) on 11/28/11 at 12:07 PM.

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11. FIGURES

N

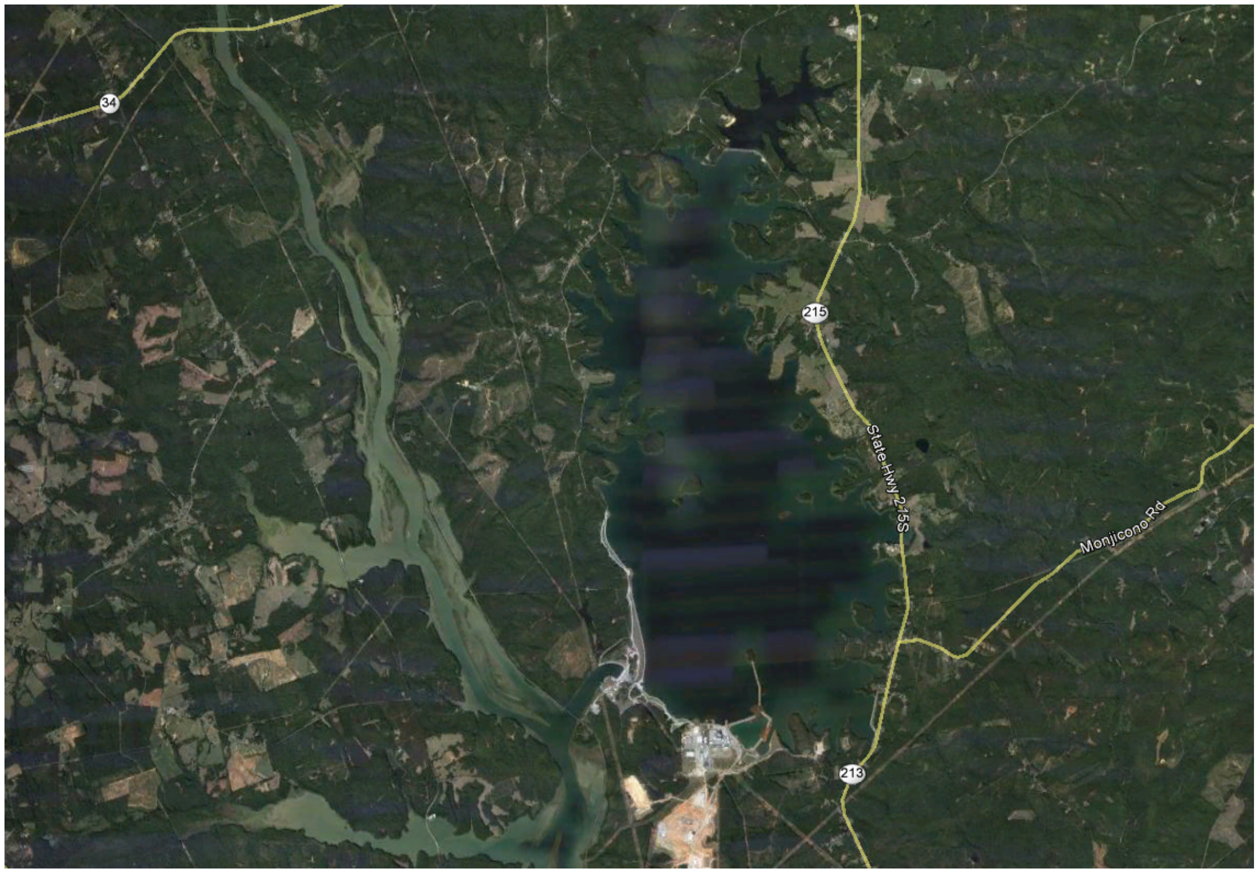

Figure 1 – Aerial photograph of the Monticello Reservoir and V. C. Summer Station

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Figure 2 – Close aerial photograph of the Monticello Reservoir and V. C. Summer Station

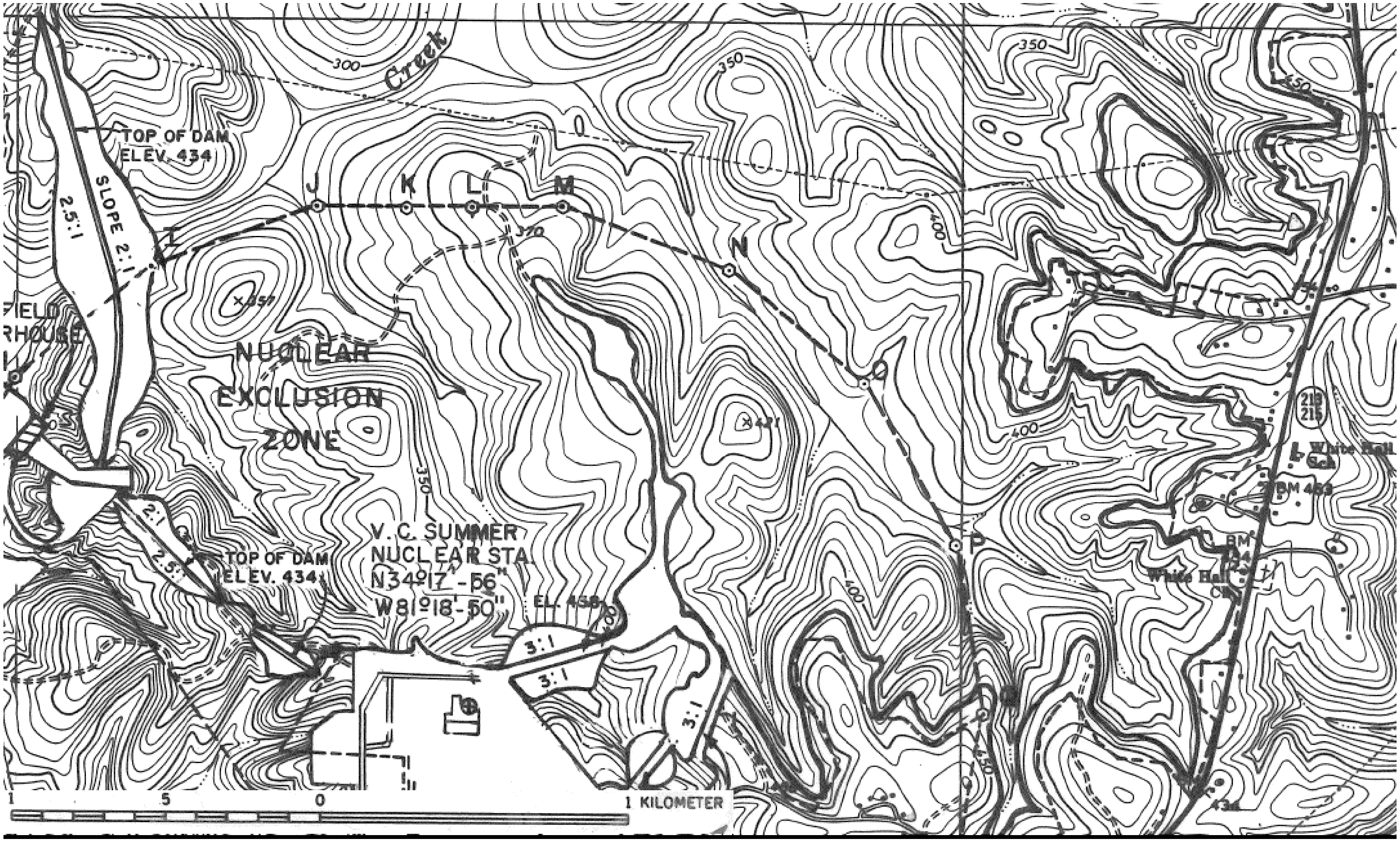

Figure 3 – Contour map of the Monticello Reservoir in the vicinity of the Unit 1 thermal discharge.

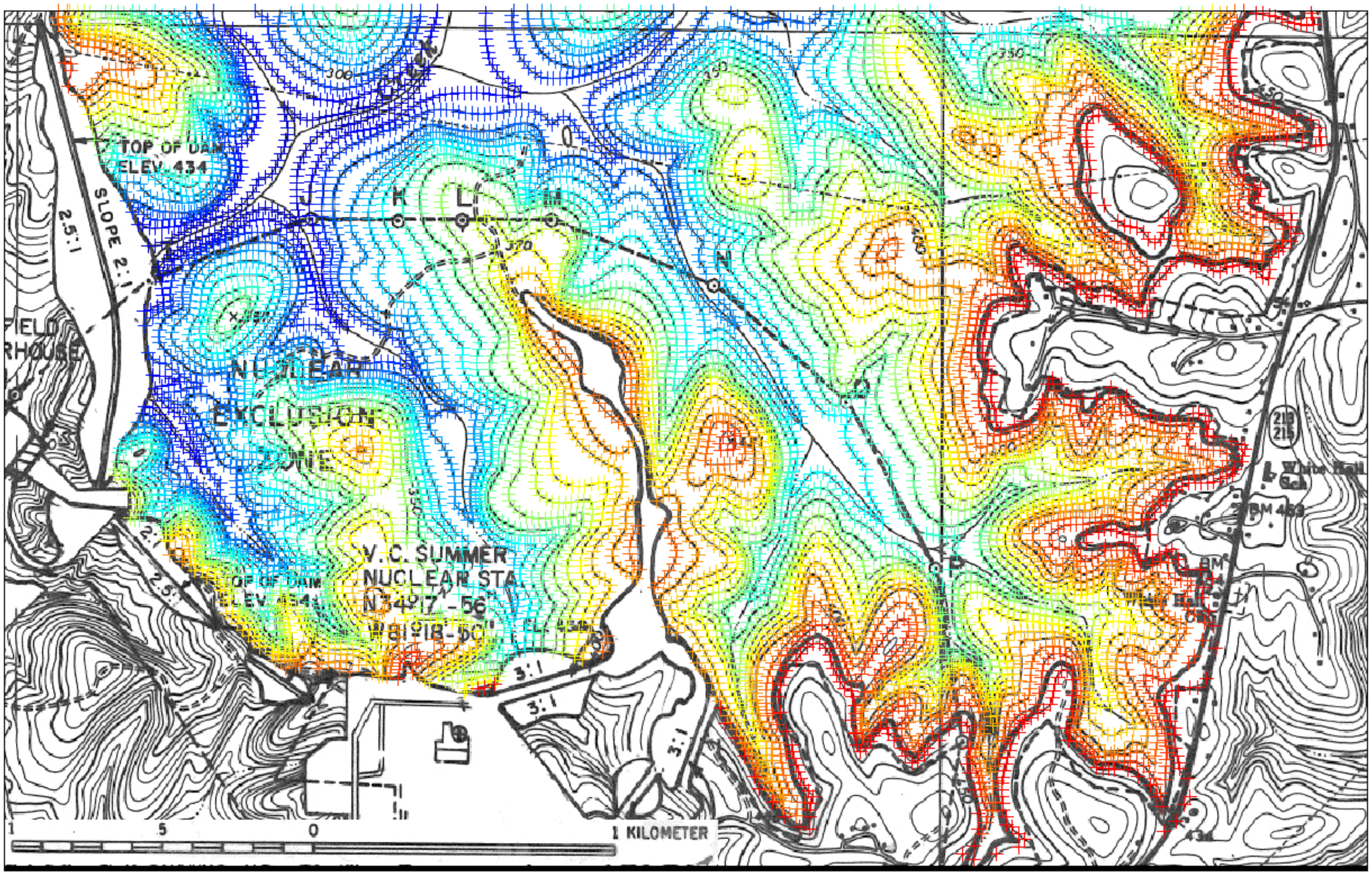

Figure 4 – Digitized points from the contour map, colored by elevation (red is 430 ft msl, blue is 270 ft msl).

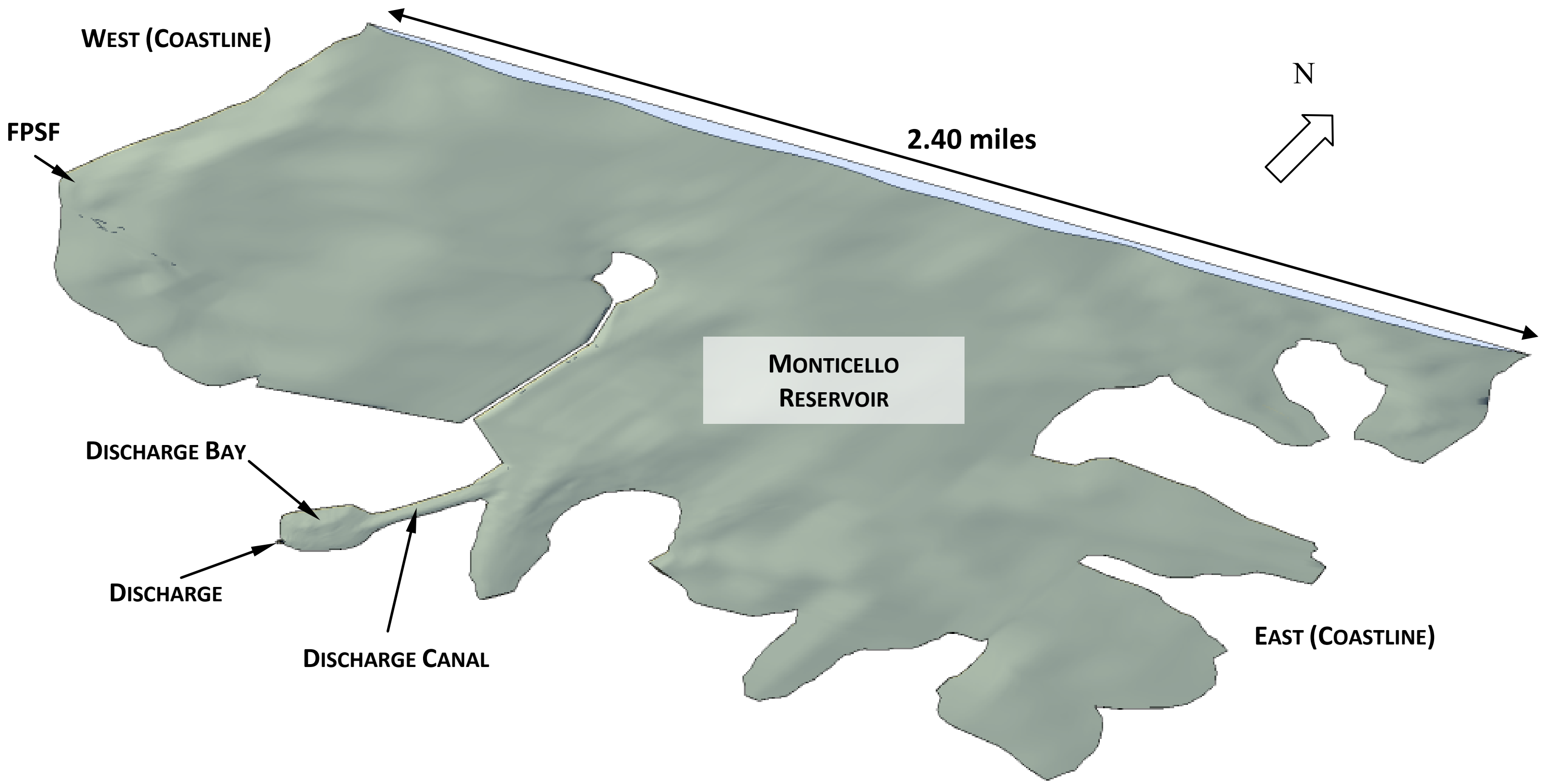

Figure 5 – Perspective view of the computational model.

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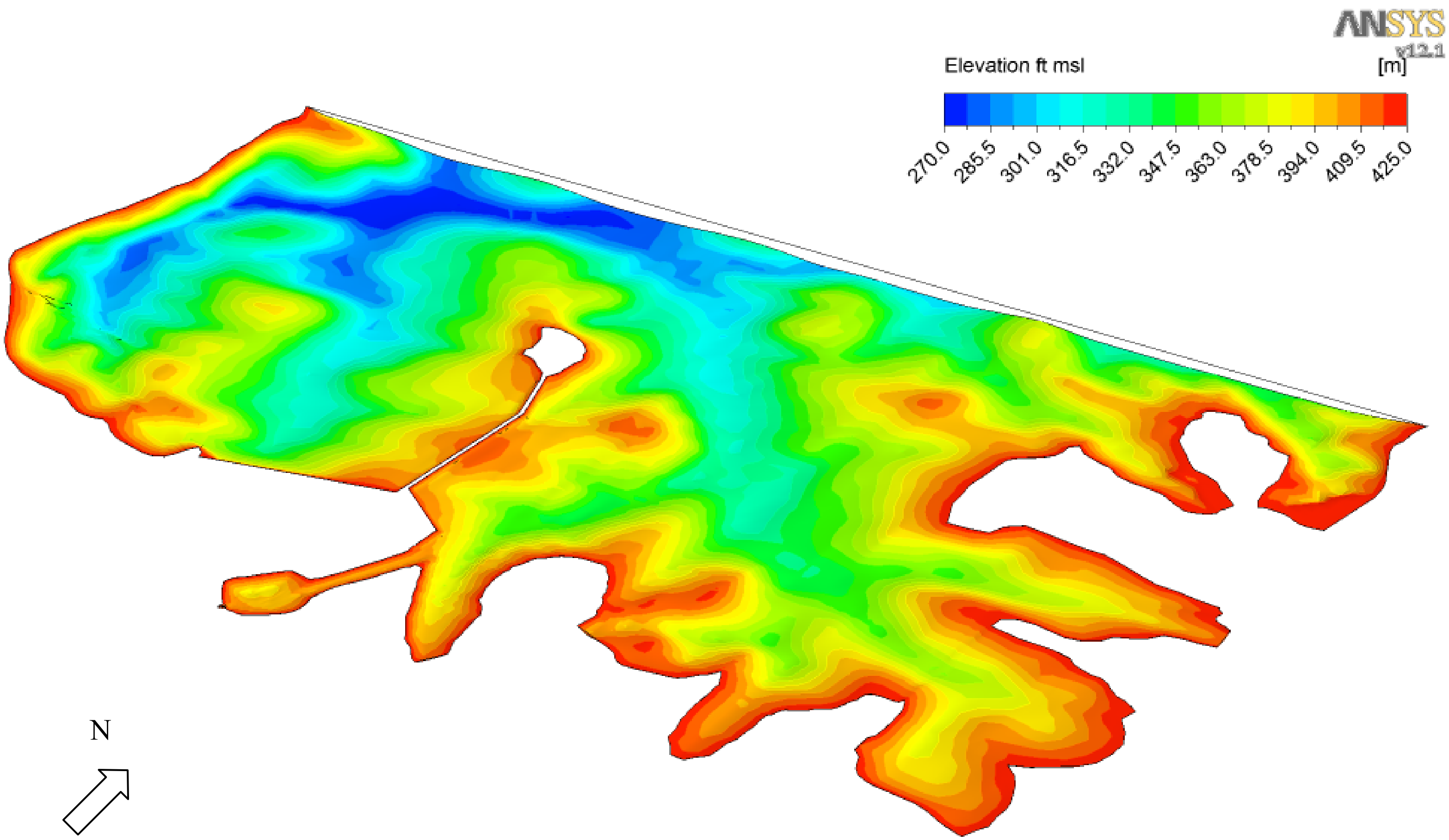

Figure 6 – Contour map showing surface elevation in the computational model.

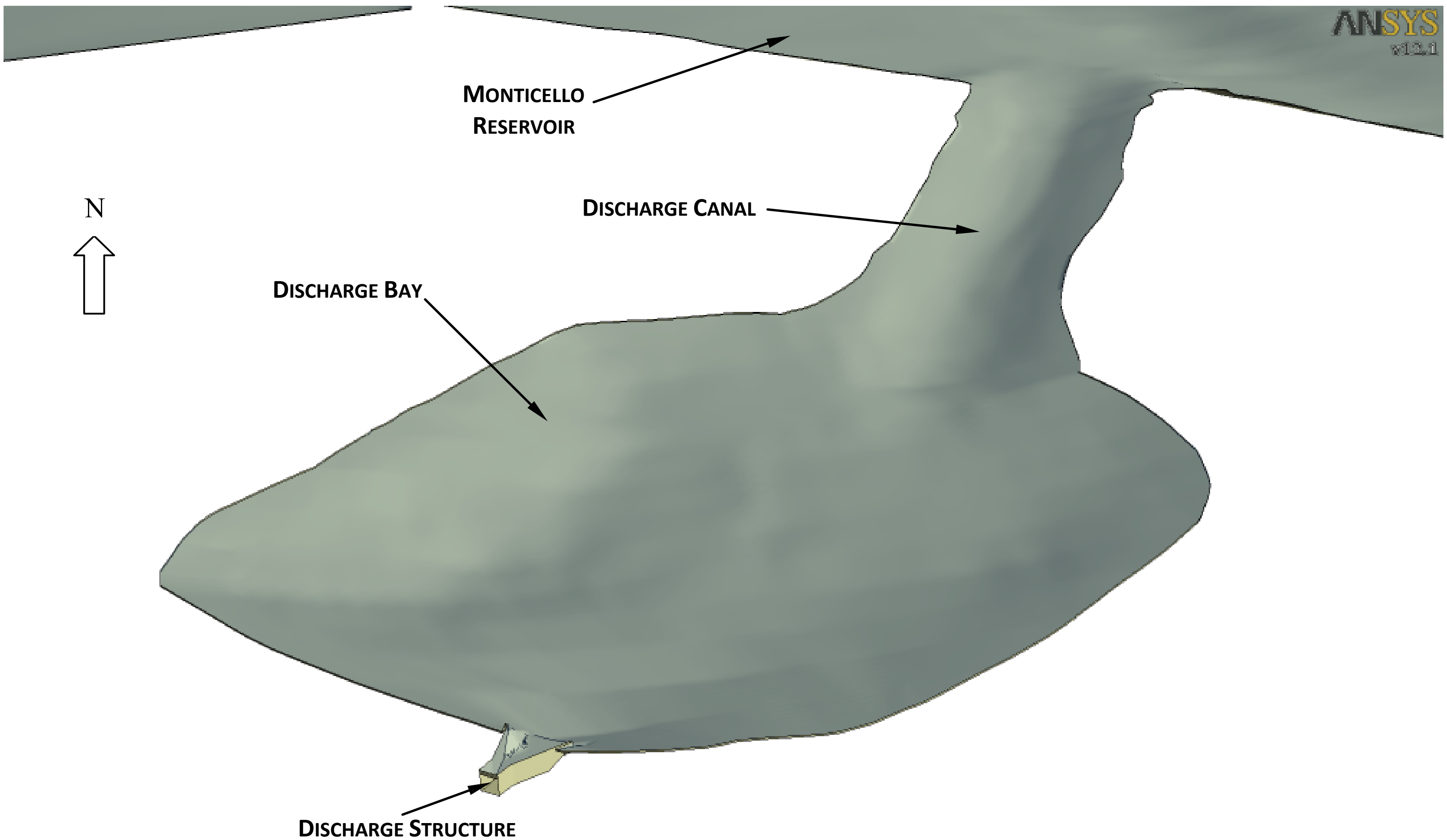

Figure 7 – View of the model near the discharge structure, bay and canal.

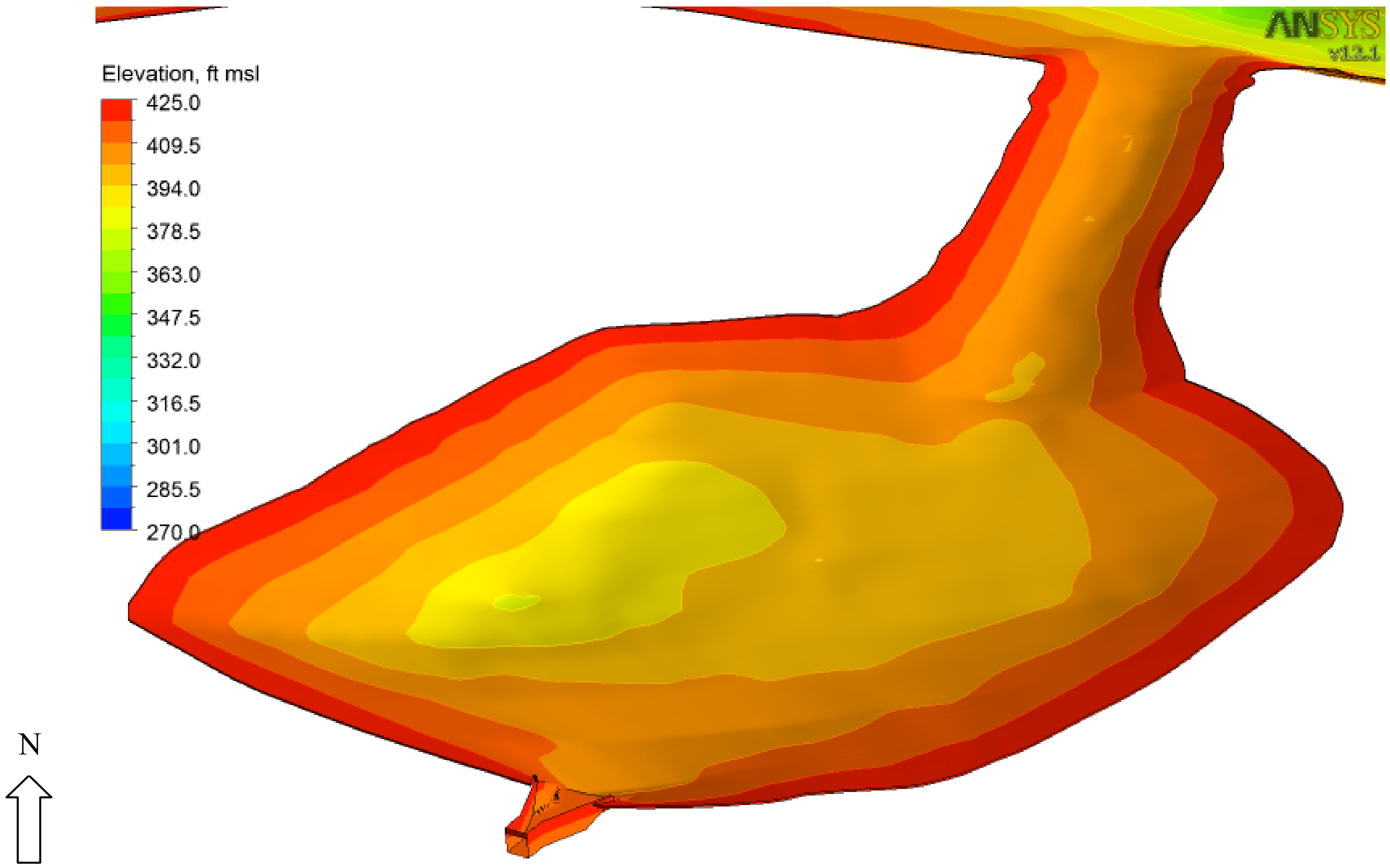

Figure 8 – Elevation contour plot near the discharge structure, bay and canal.

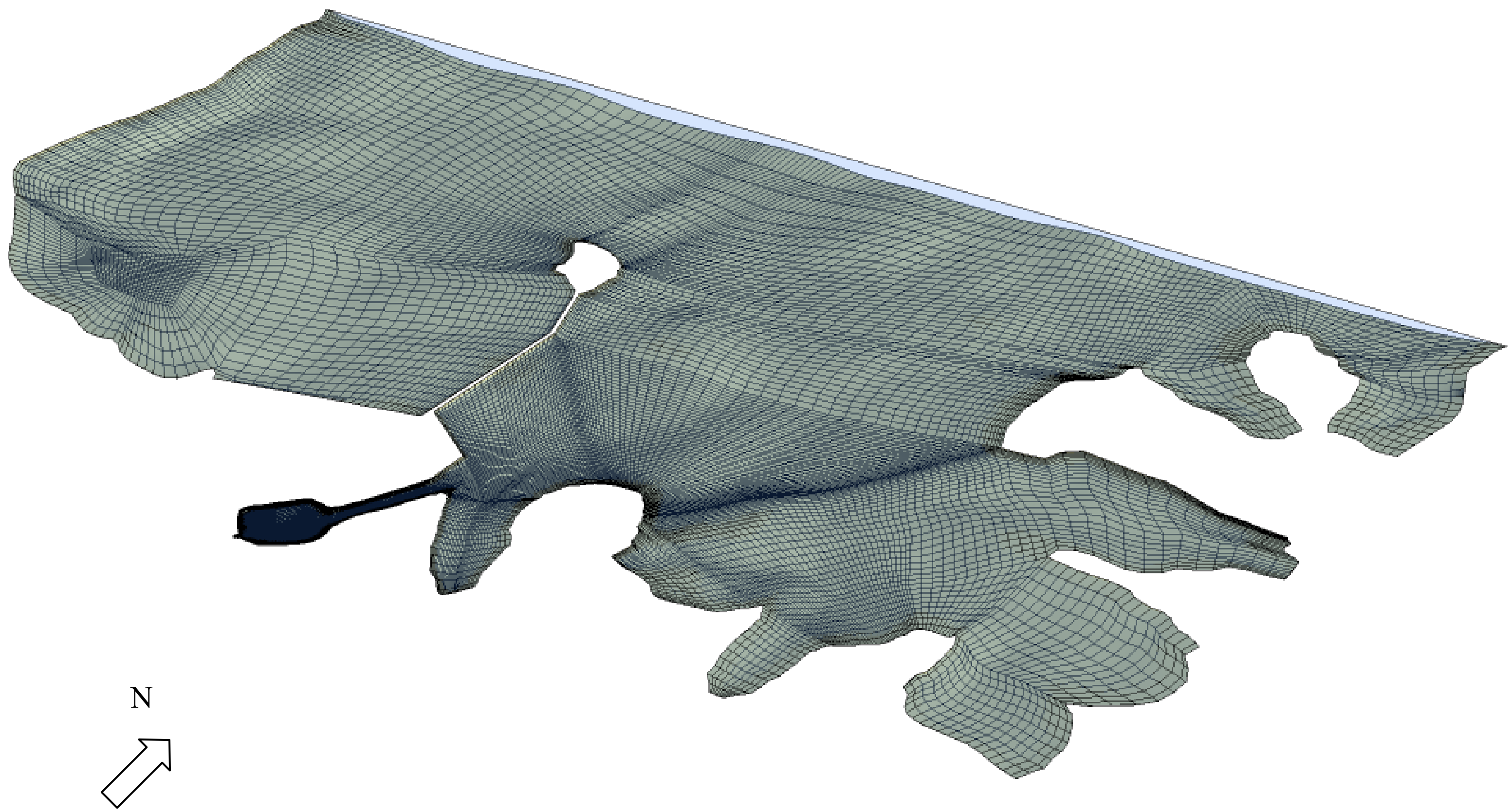

Figure 9 – Computational mesh.

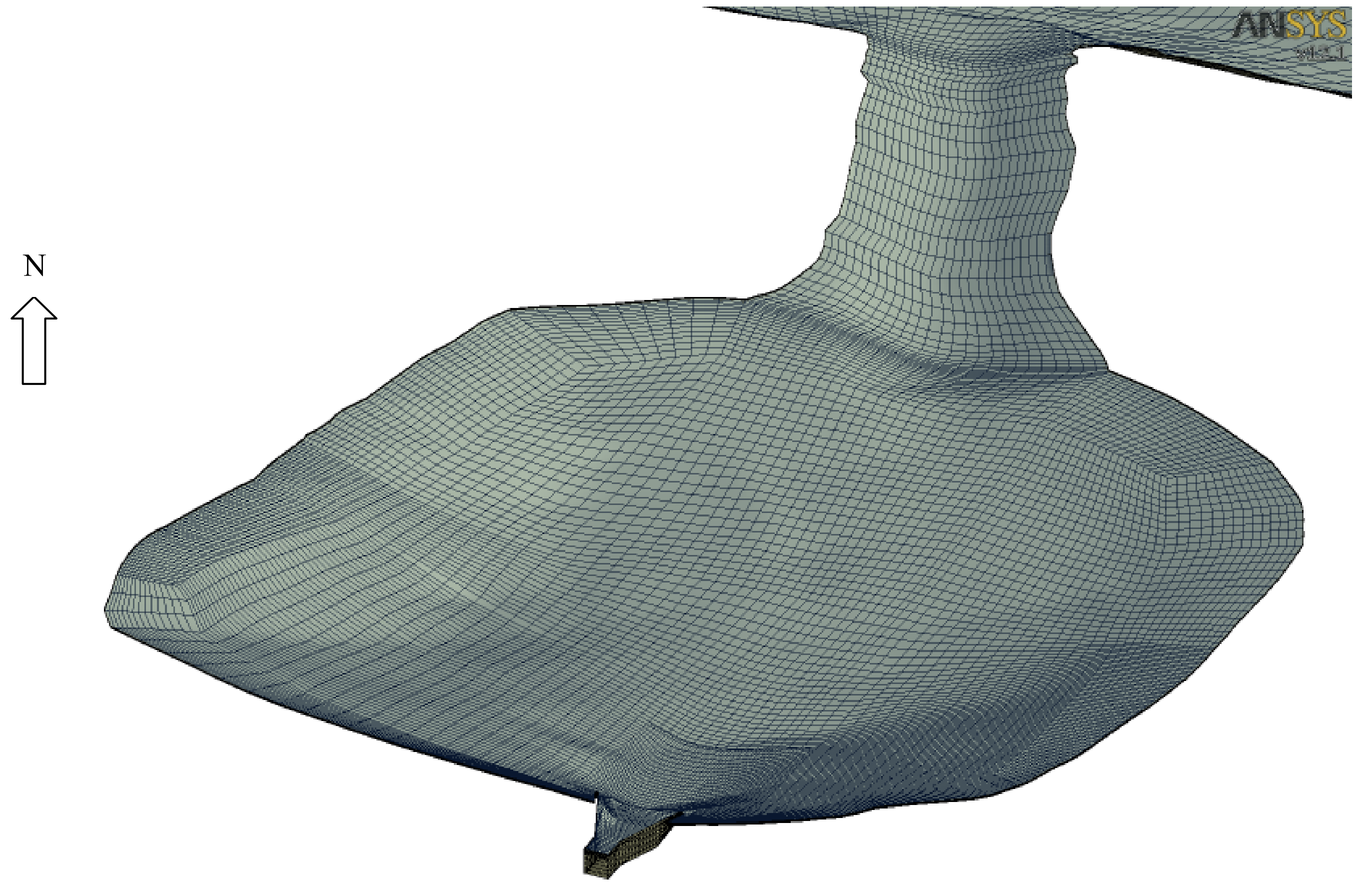

Figure 10 – View of the computational mesh near the discharge structure.

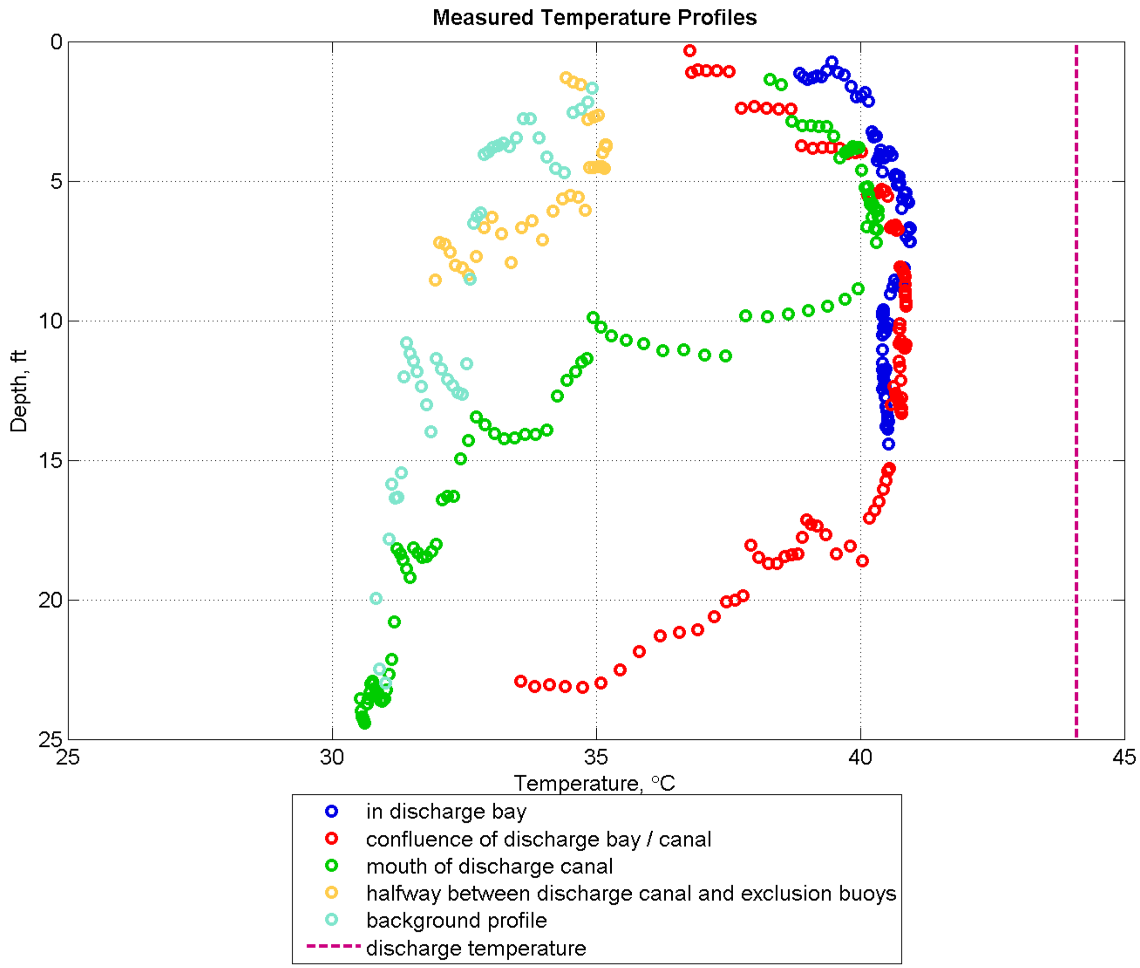

Figure 11 – Temperature profiles collected for validation.

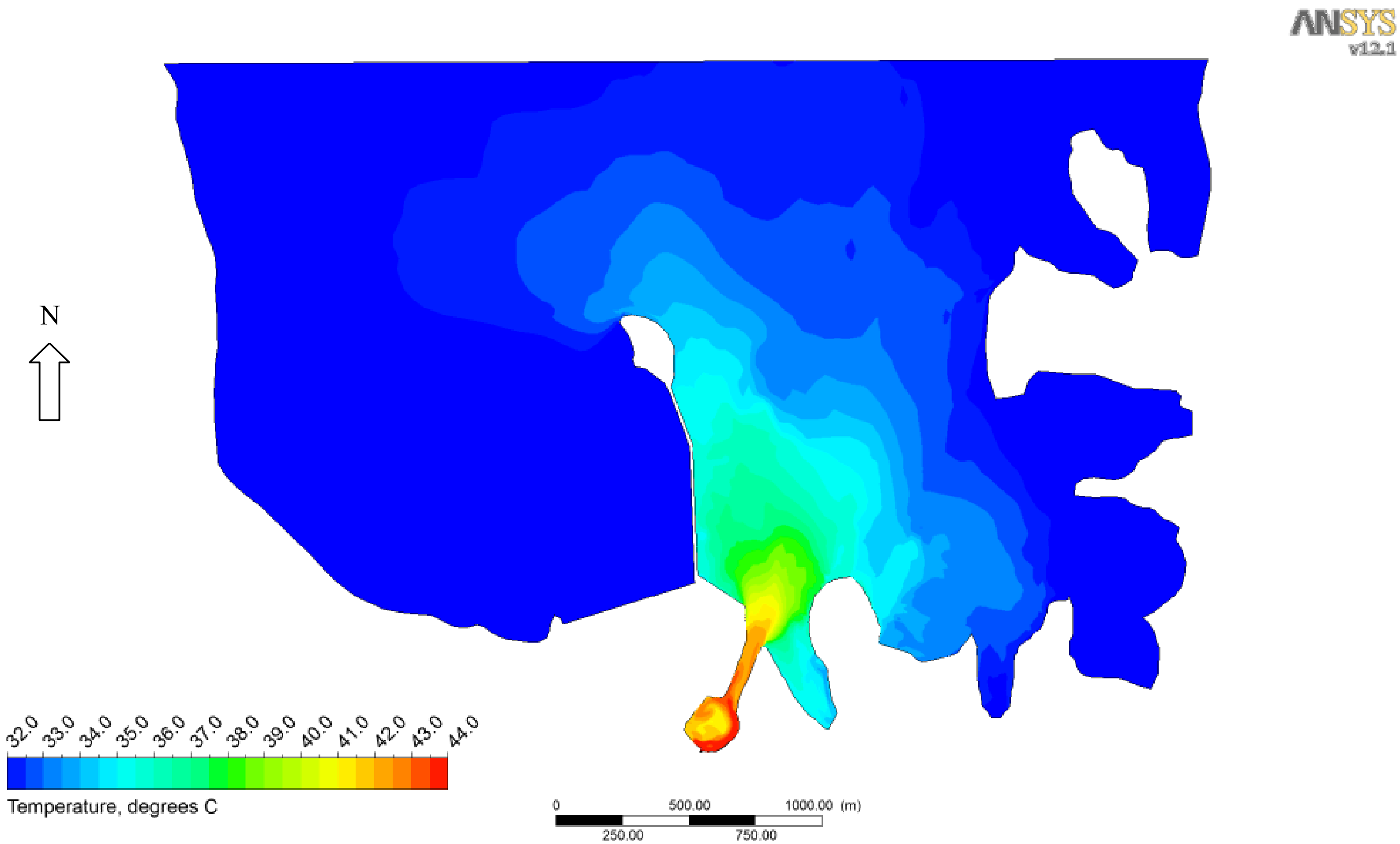

Figure 12 – Contour plot of surface temperature in the numerical model for validation.

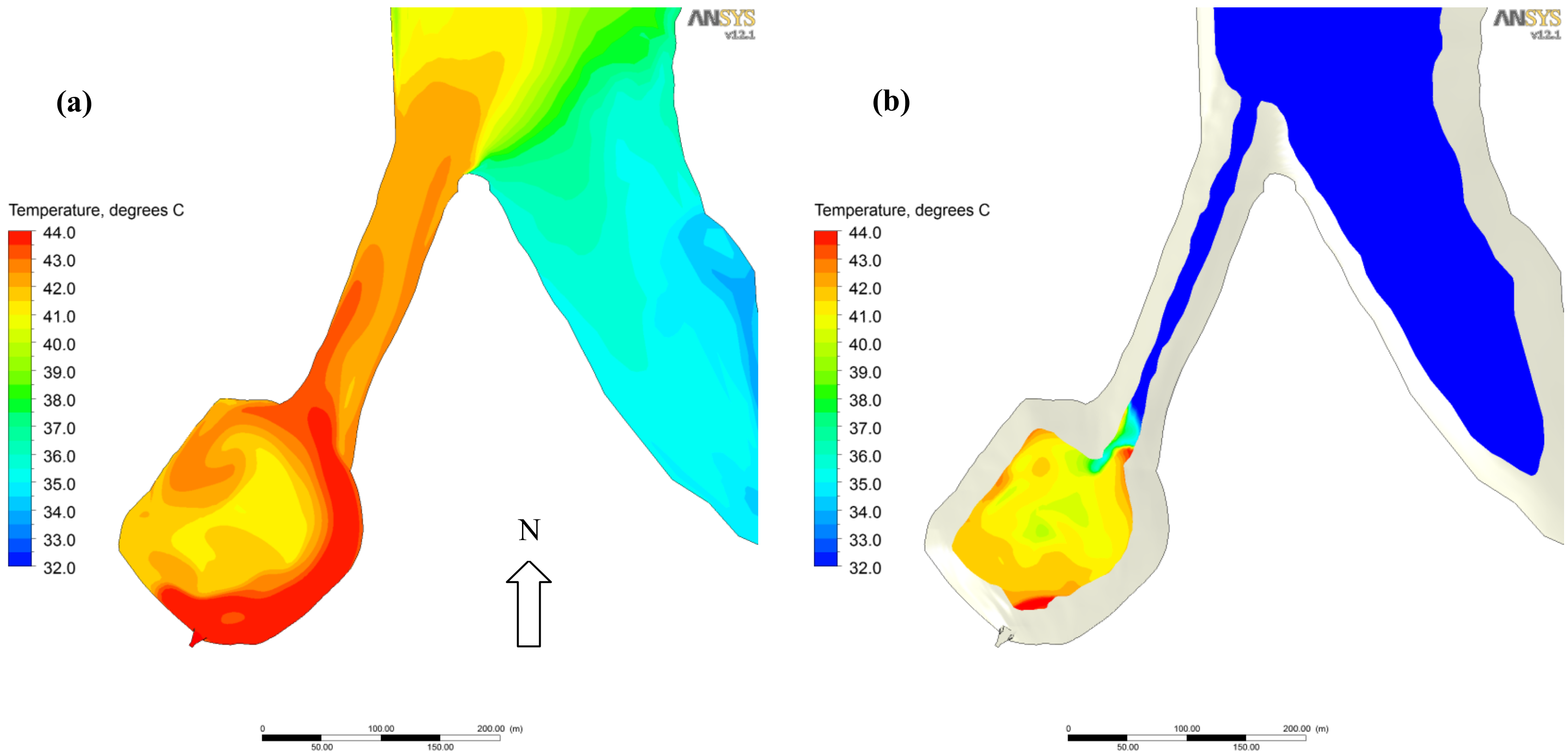

Figure 13 – Contour plot of temperature near the discharge bay at (a) the surface, and (b) 18 ft depth.

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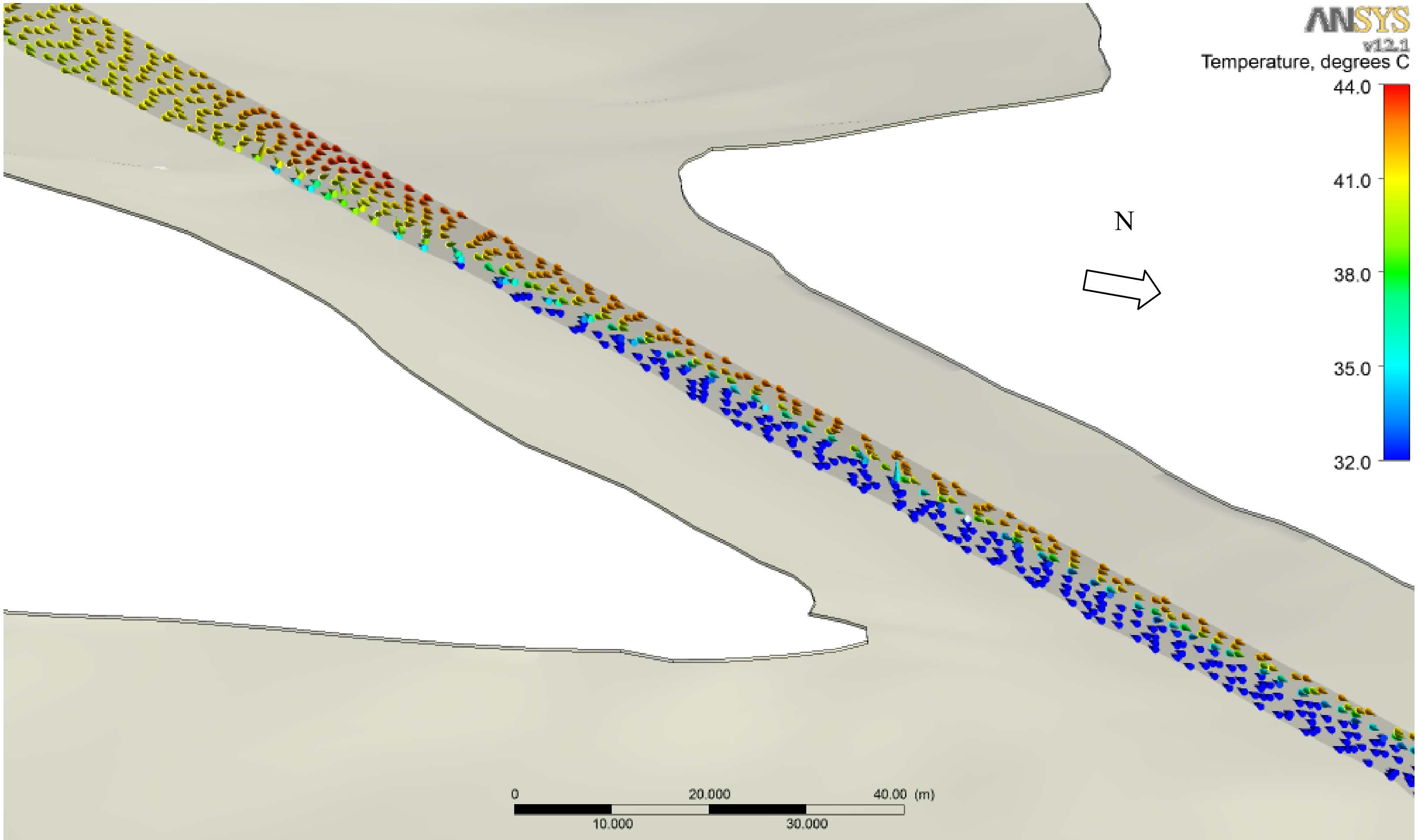

Figure 14 – Velocity vectors in the discharge canal colored by temperature.

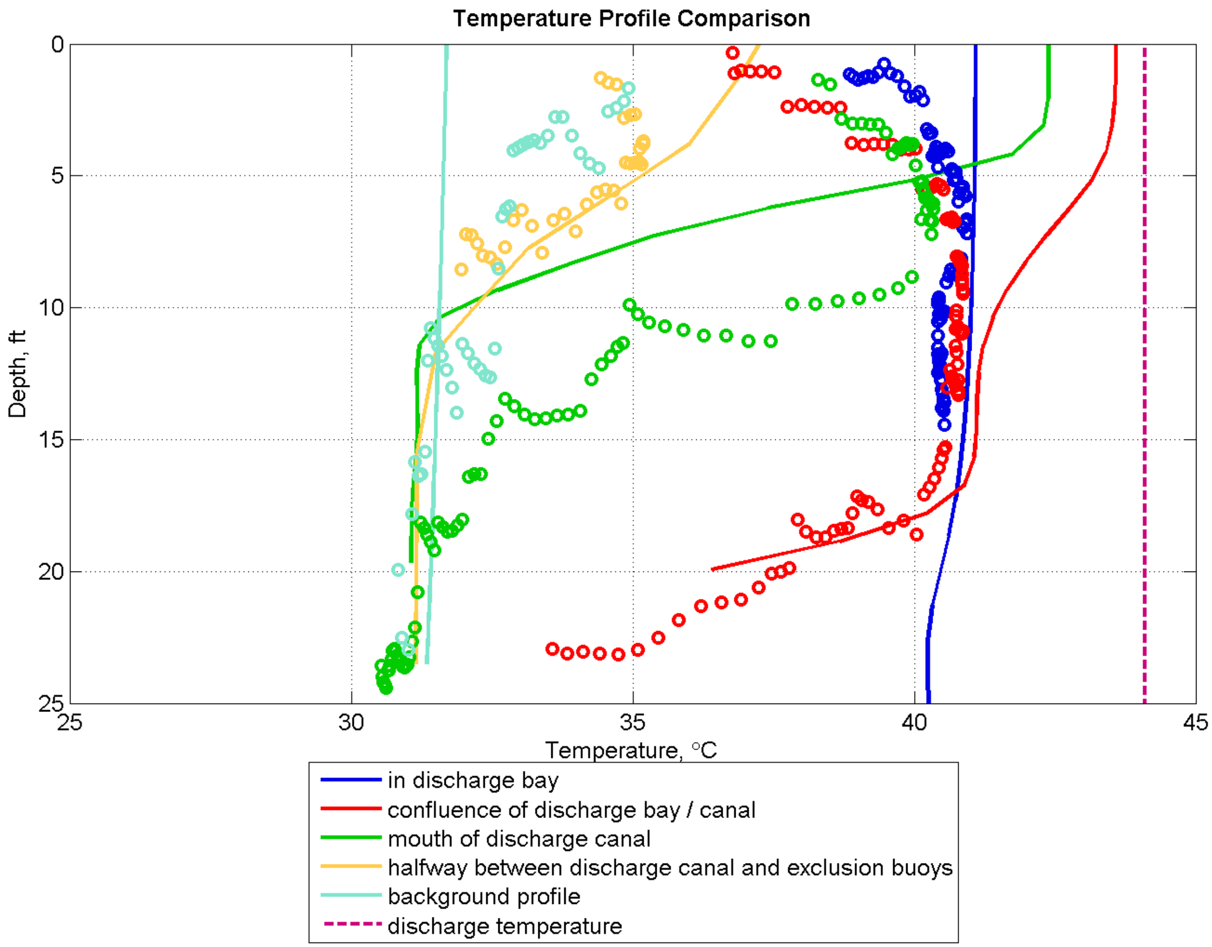

Figure 15 – Comparison between the CFD and collected temperature data.

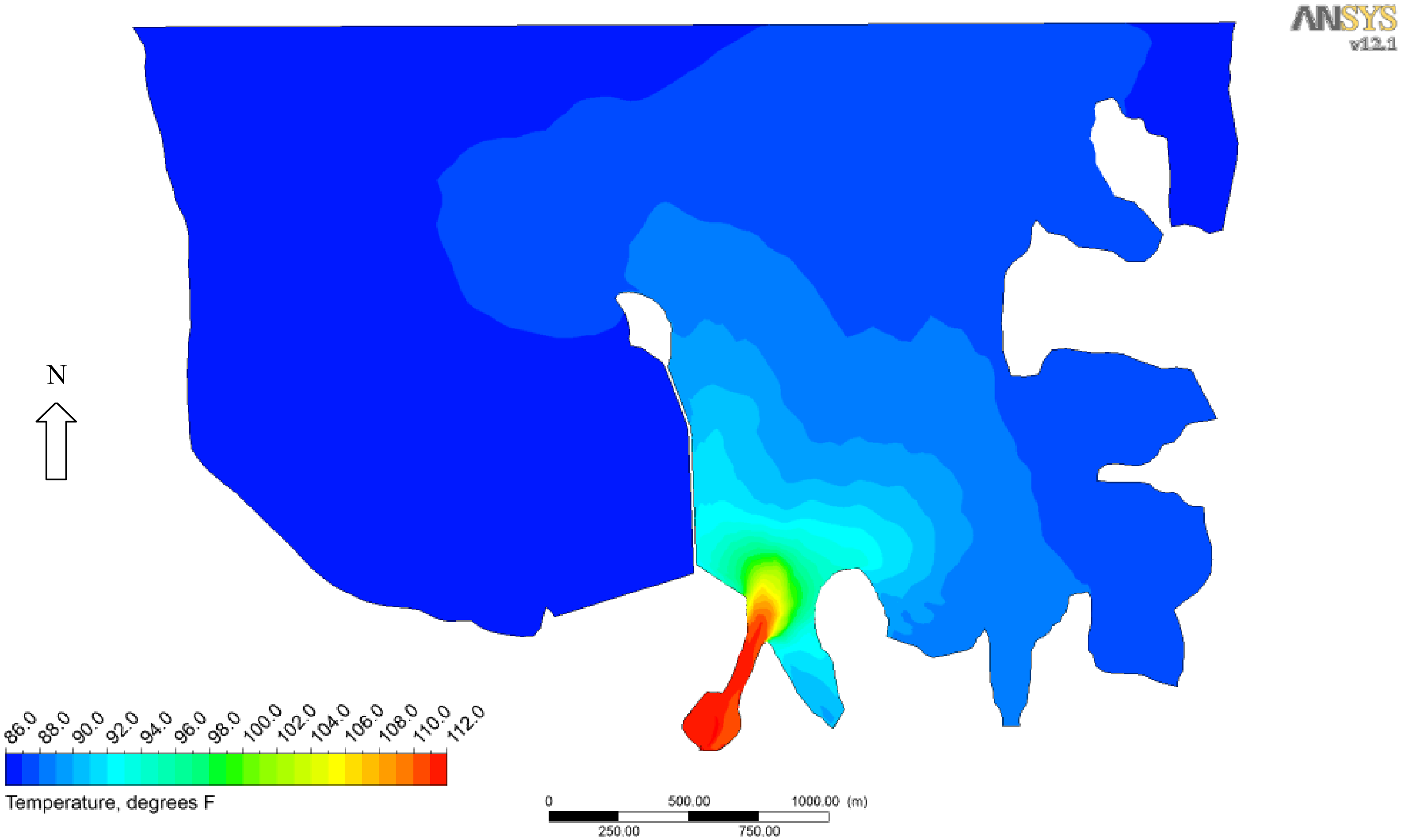

Figure 16 – Scenario 1S, surface temperature.

Figure 17 – Scenario 1S, 90°F thermal plume (purple).

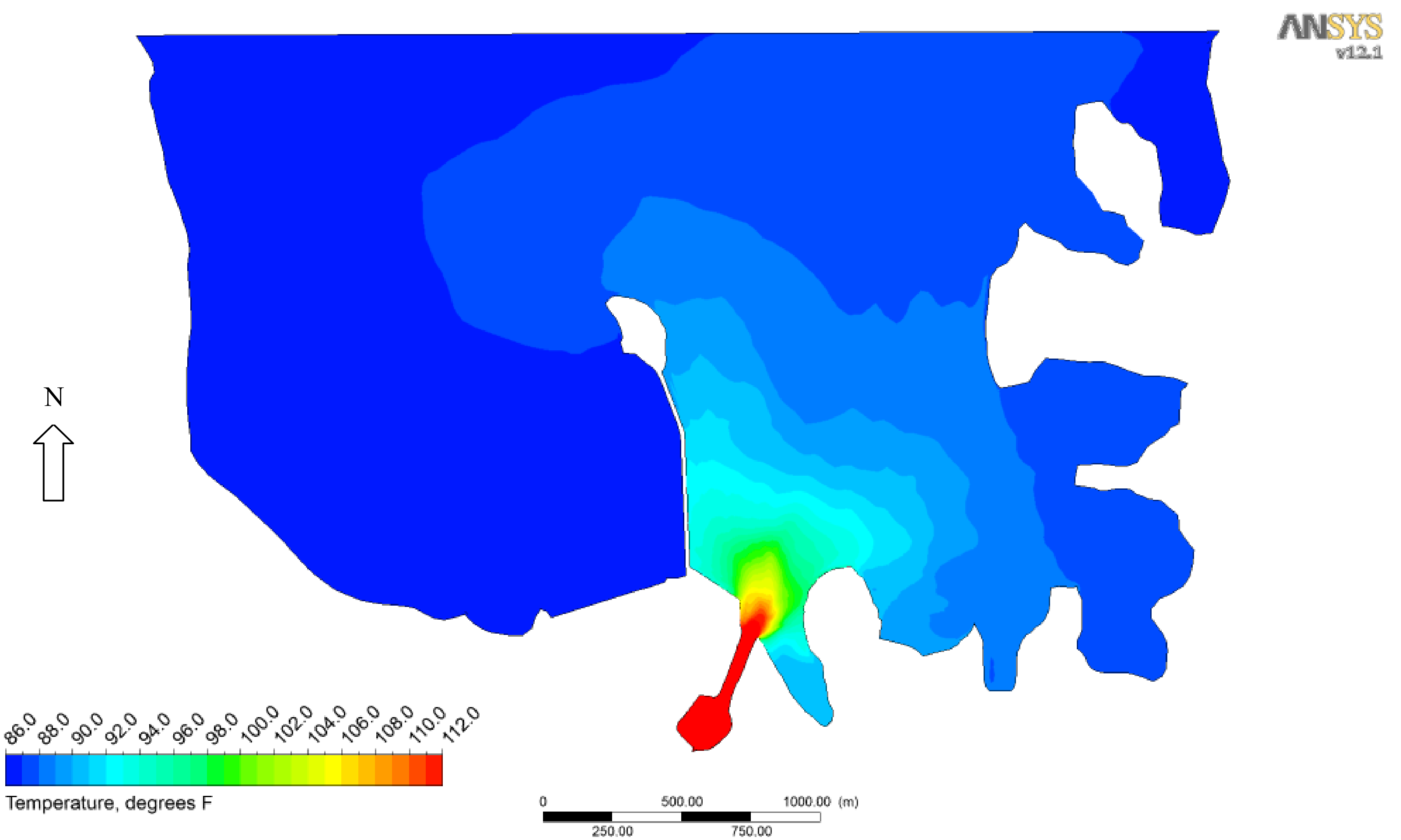

Figure 18 – Scenario 2S, surface temperature.

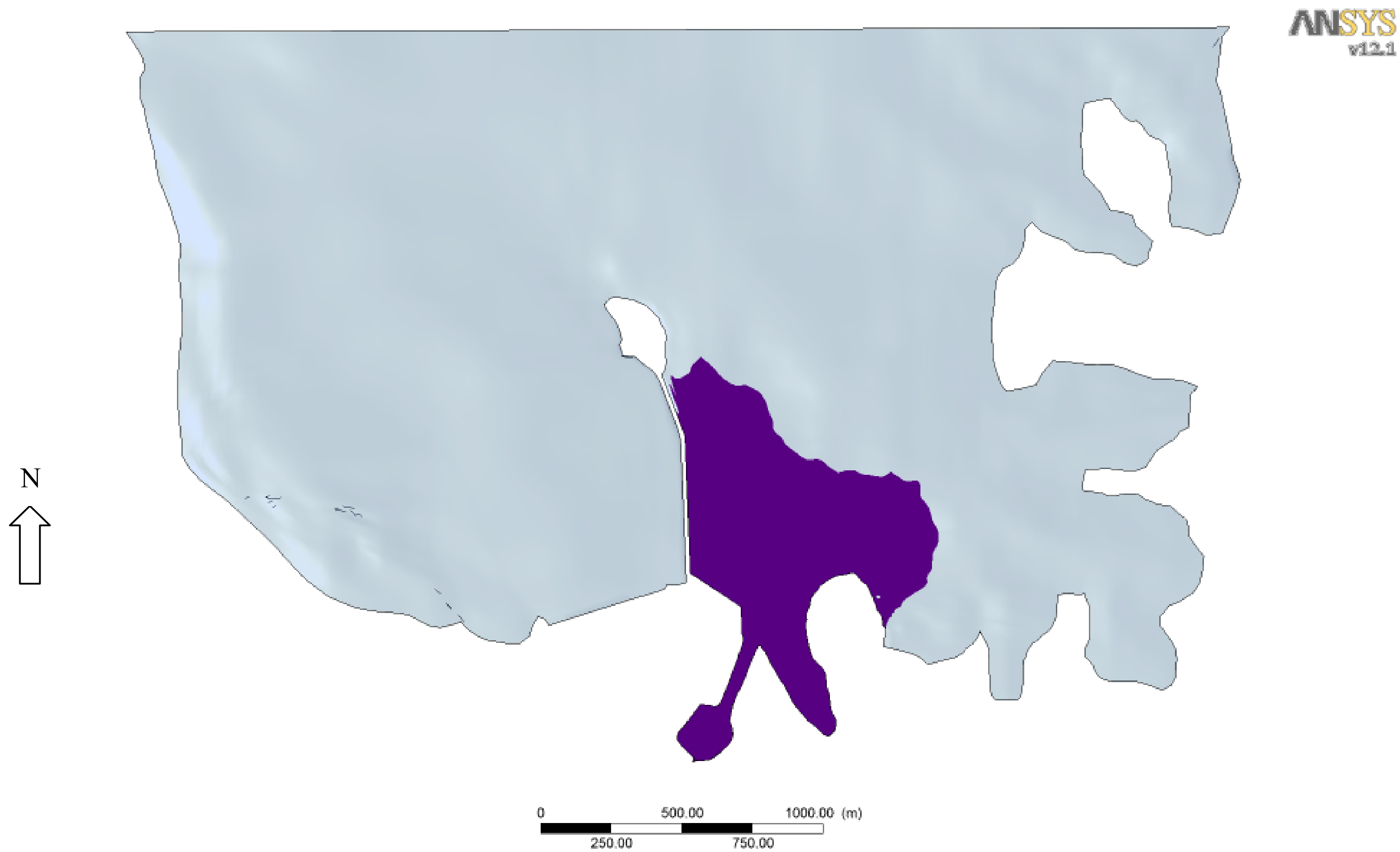

Figure 19 – Scenario 2S, 90°F thermal plume (purple).

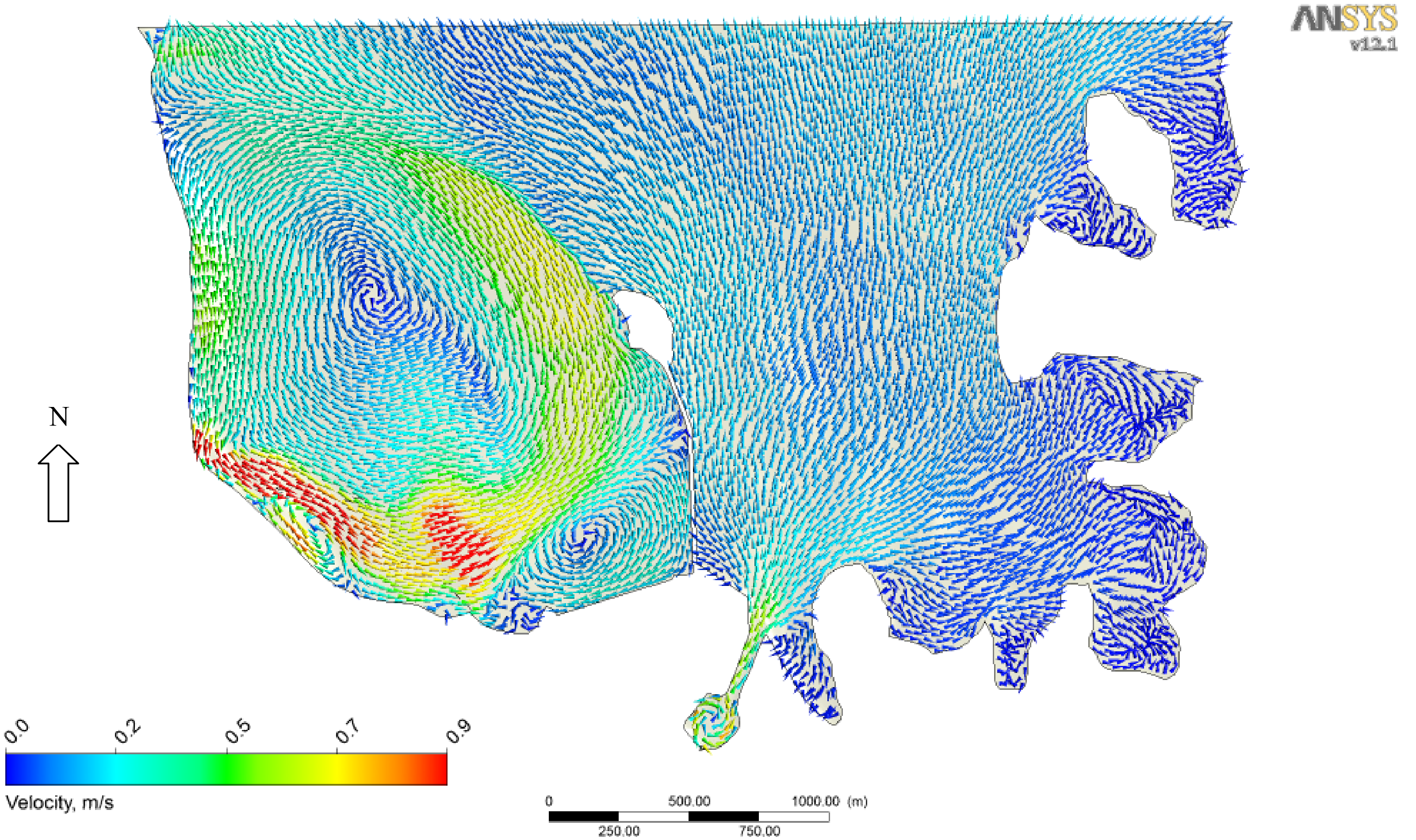

Figure 20 – Scenario 3S, surface velocity vectors.

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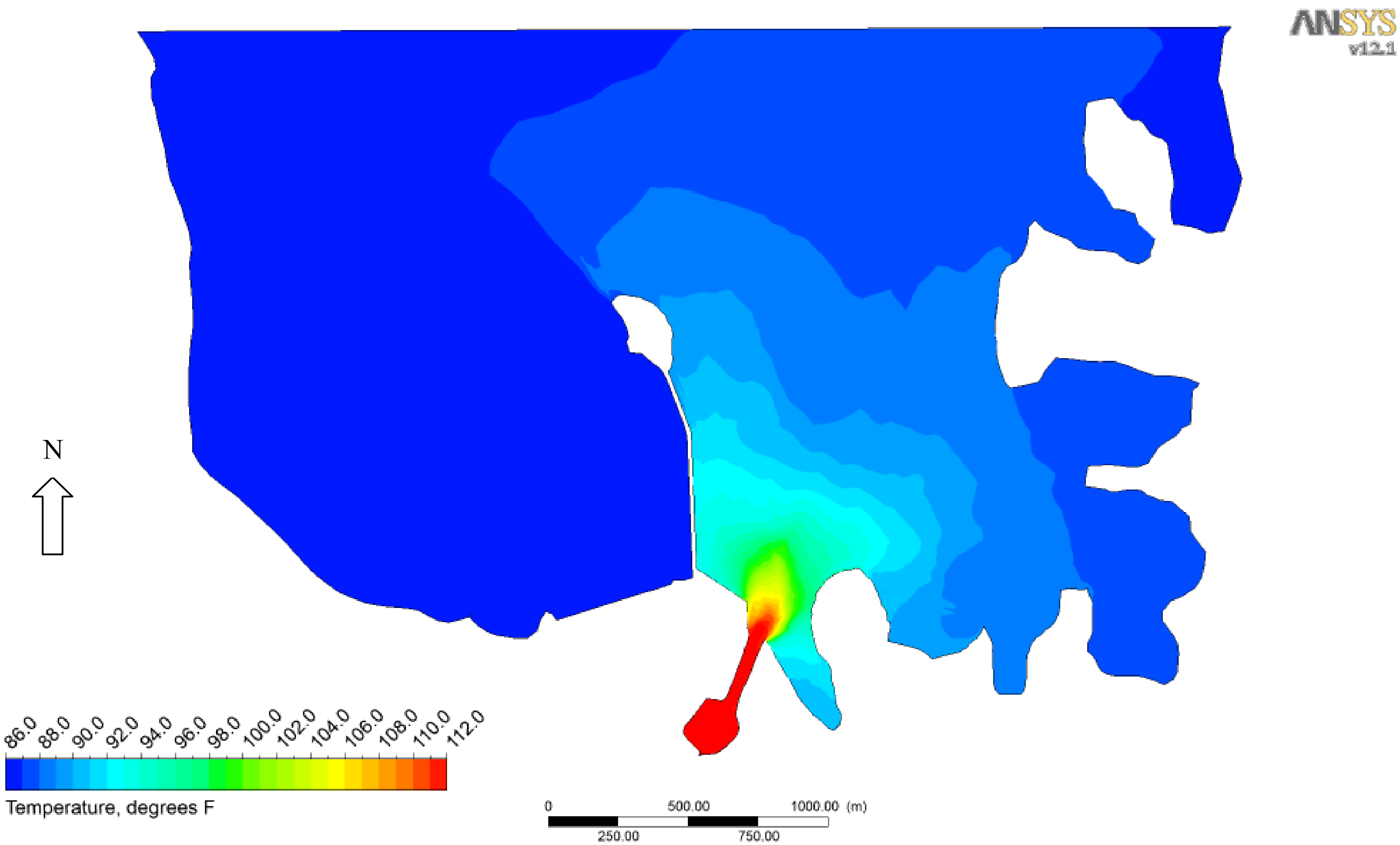

Figure 21 – Scenario 3S, surface temperature.

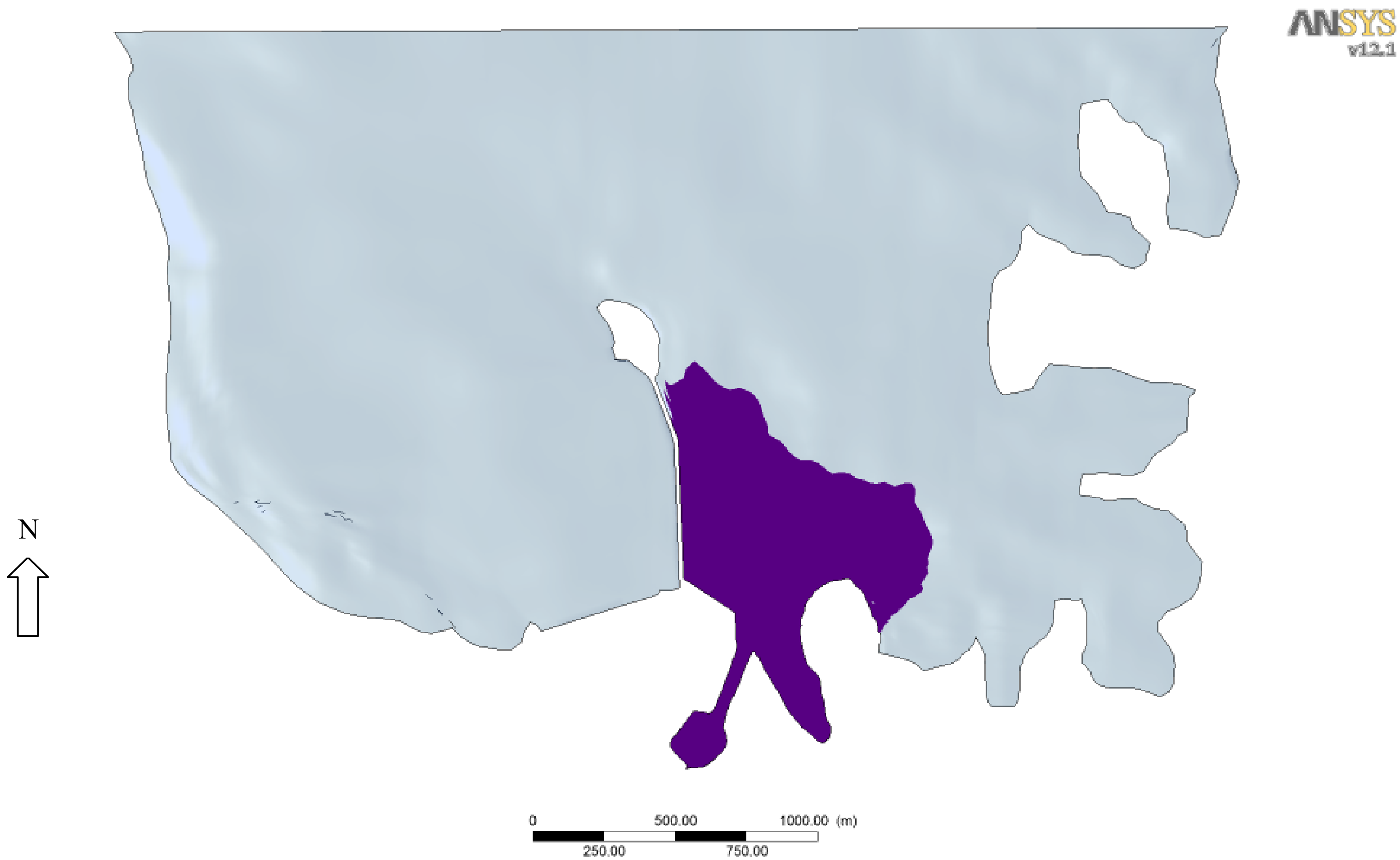

Figure 22 – Scenario 3S, 90°F thermal plume (purple).

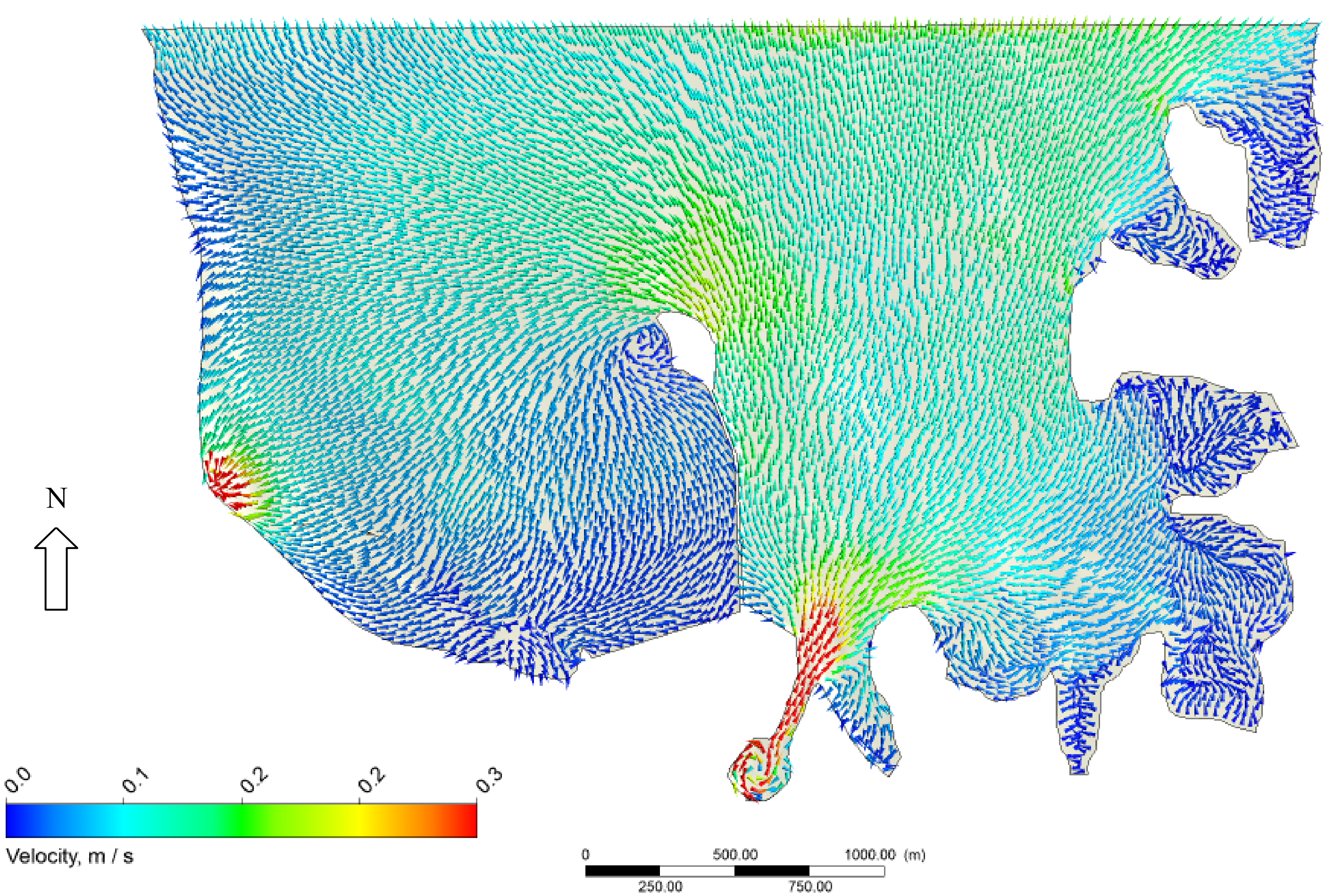

Figure 23 – Scenario 4S, surface velocity vectors.

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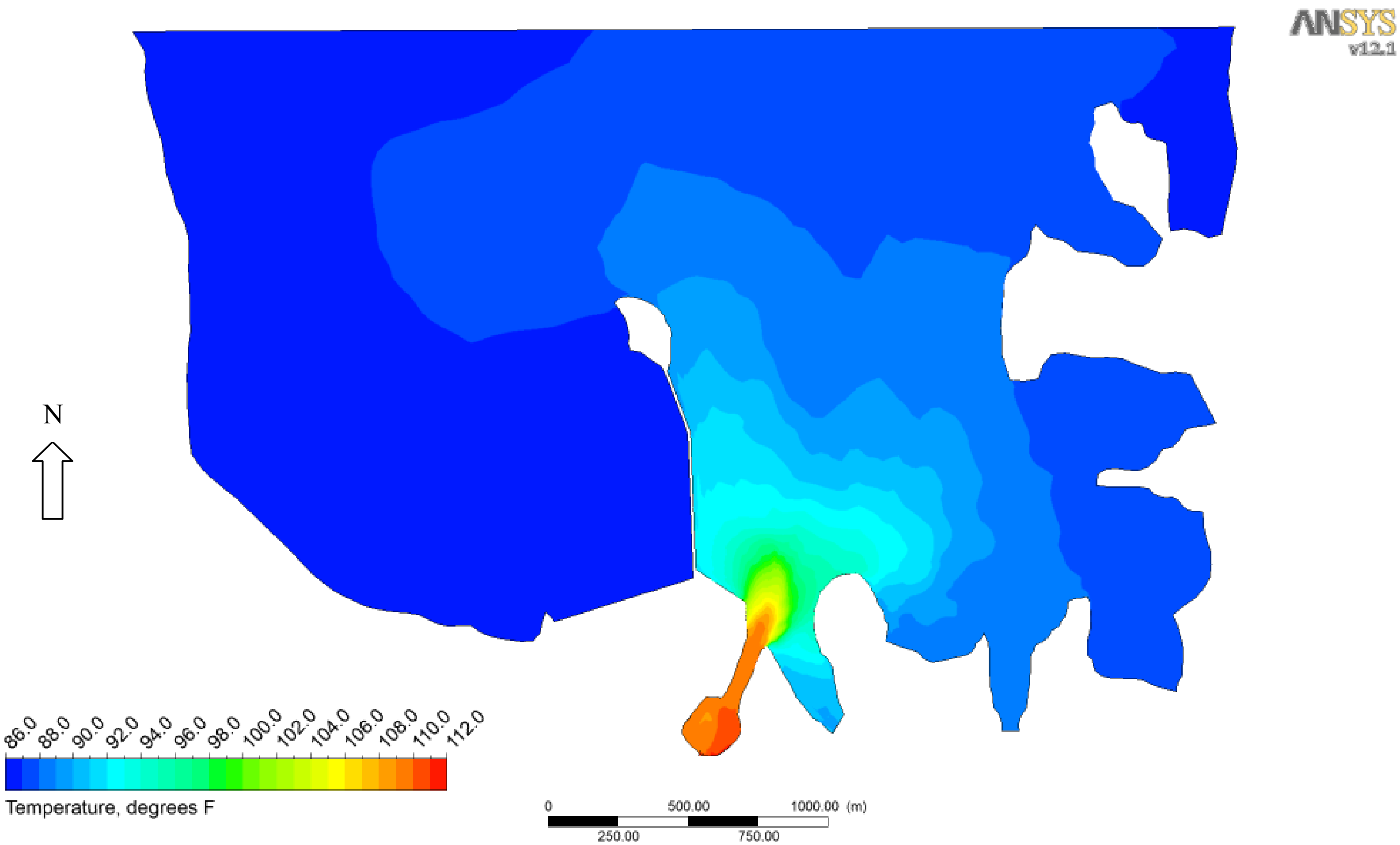

Figure 24 – Scenario 4S, surface temperature.

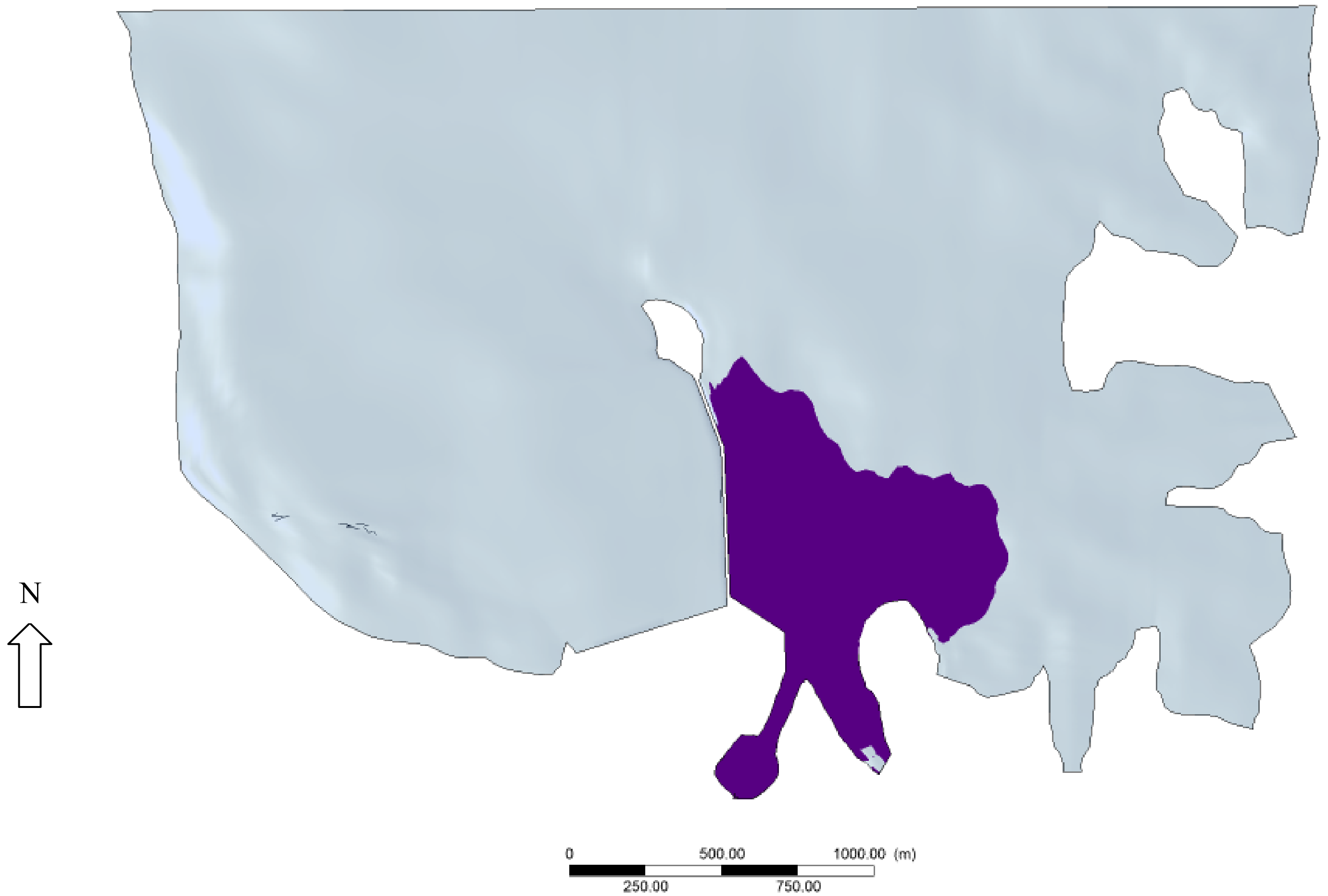

Figure 25 – Scenario 4S, 90°F thermal plume (purple).

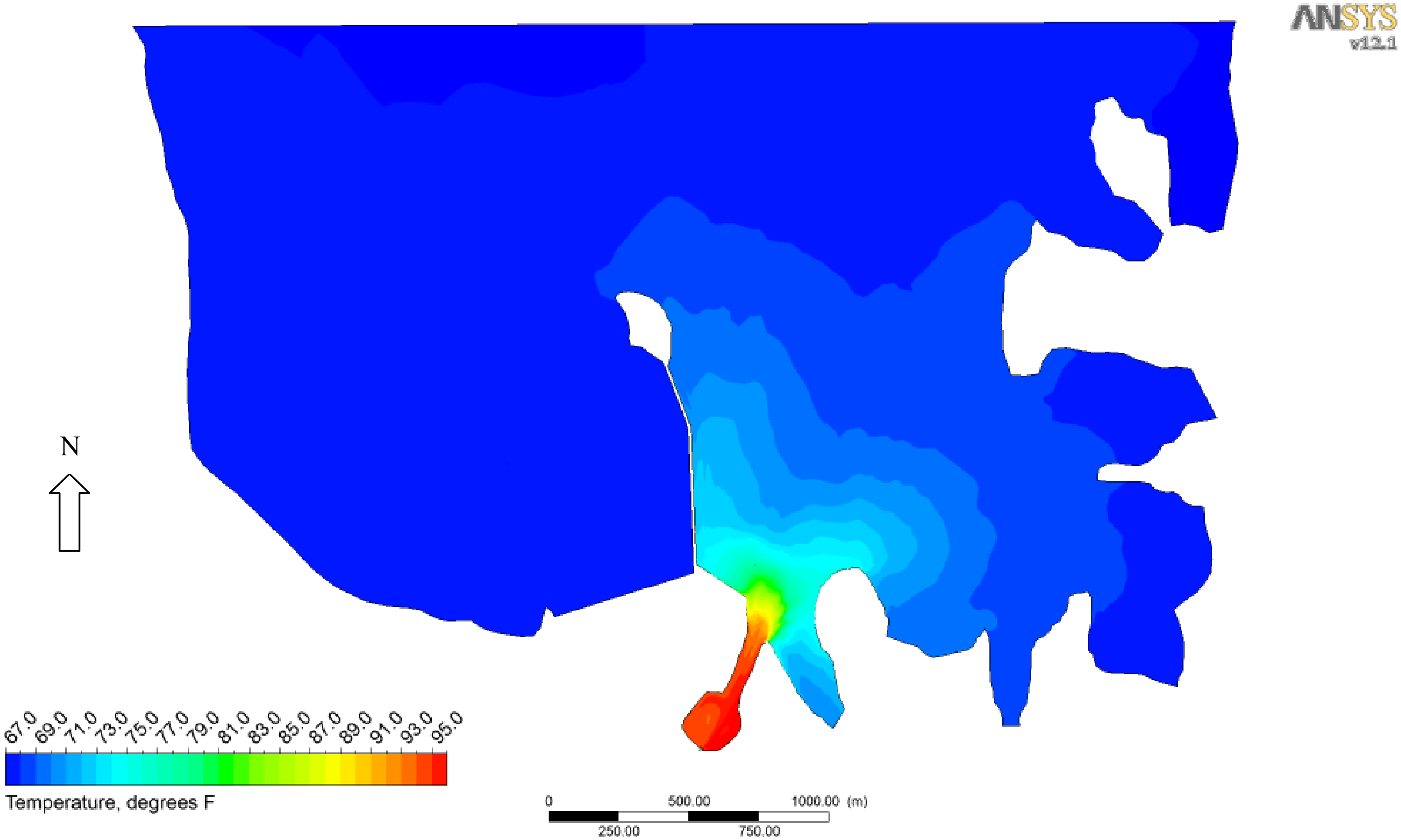

Figure 26 – Scenario 1W, surface temperature.

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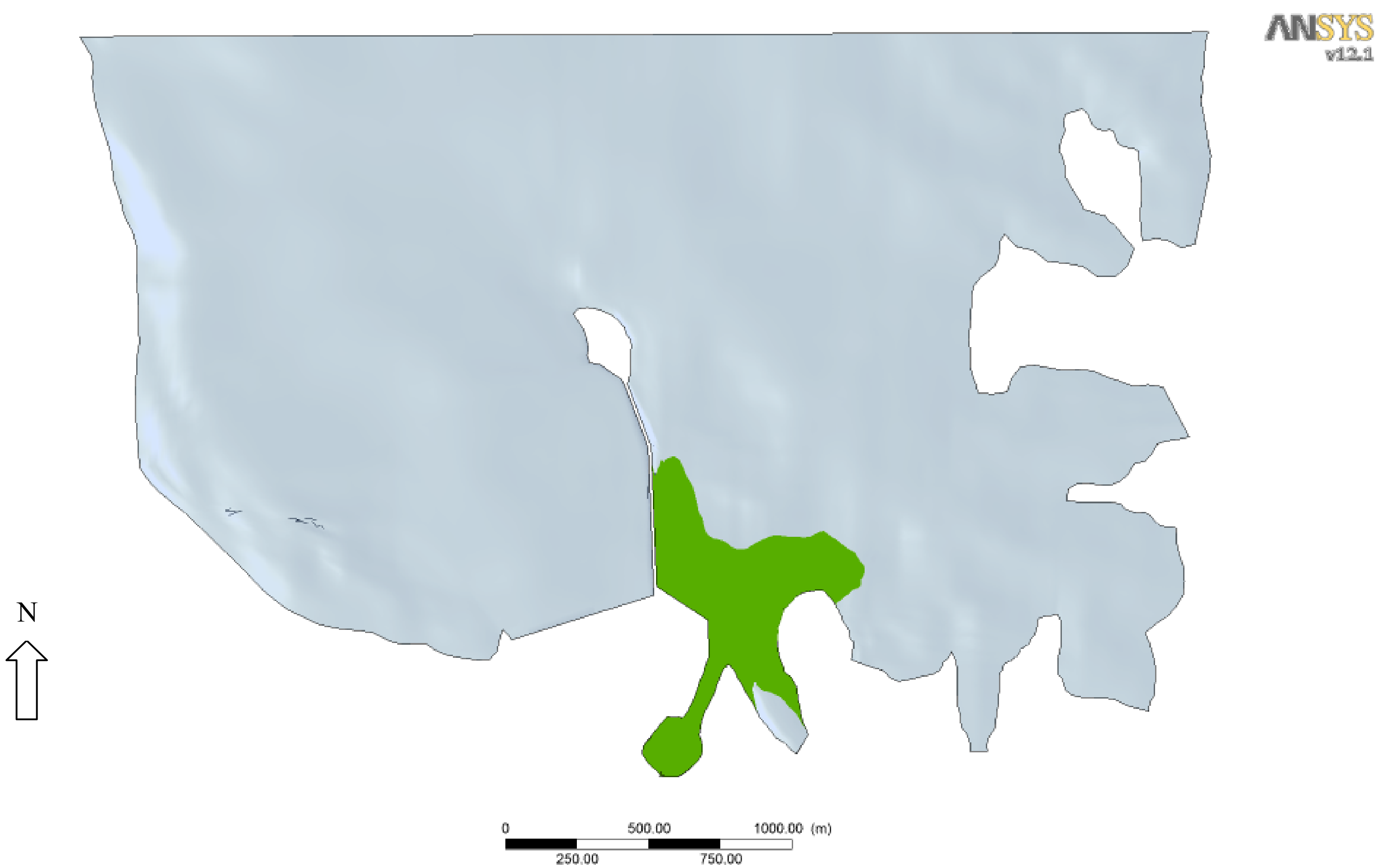

Figure 27 – Scenario 1W, ΔT = 5°F thermal plume (green).

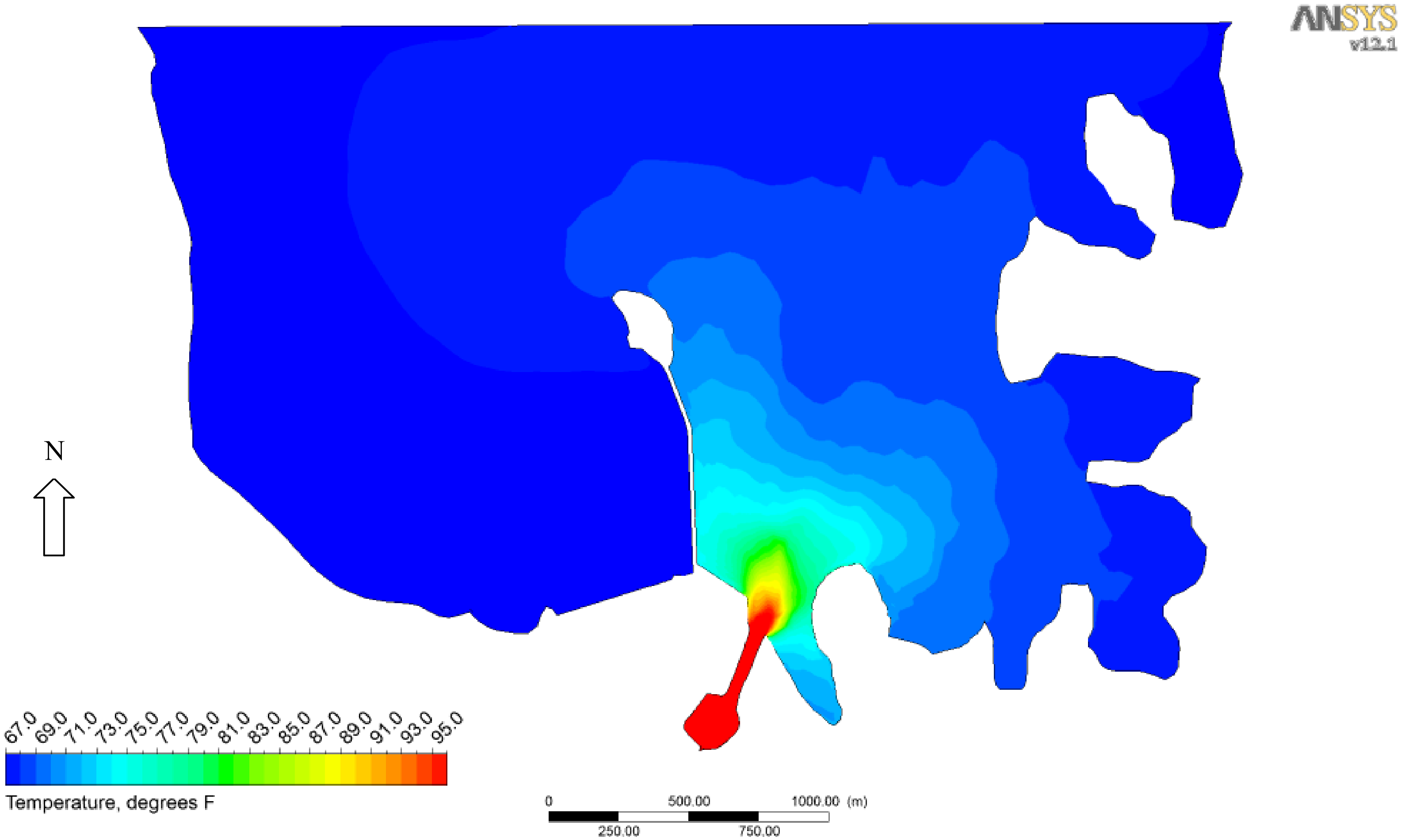

Figure 28 – Scenario 2W, surface temperature.

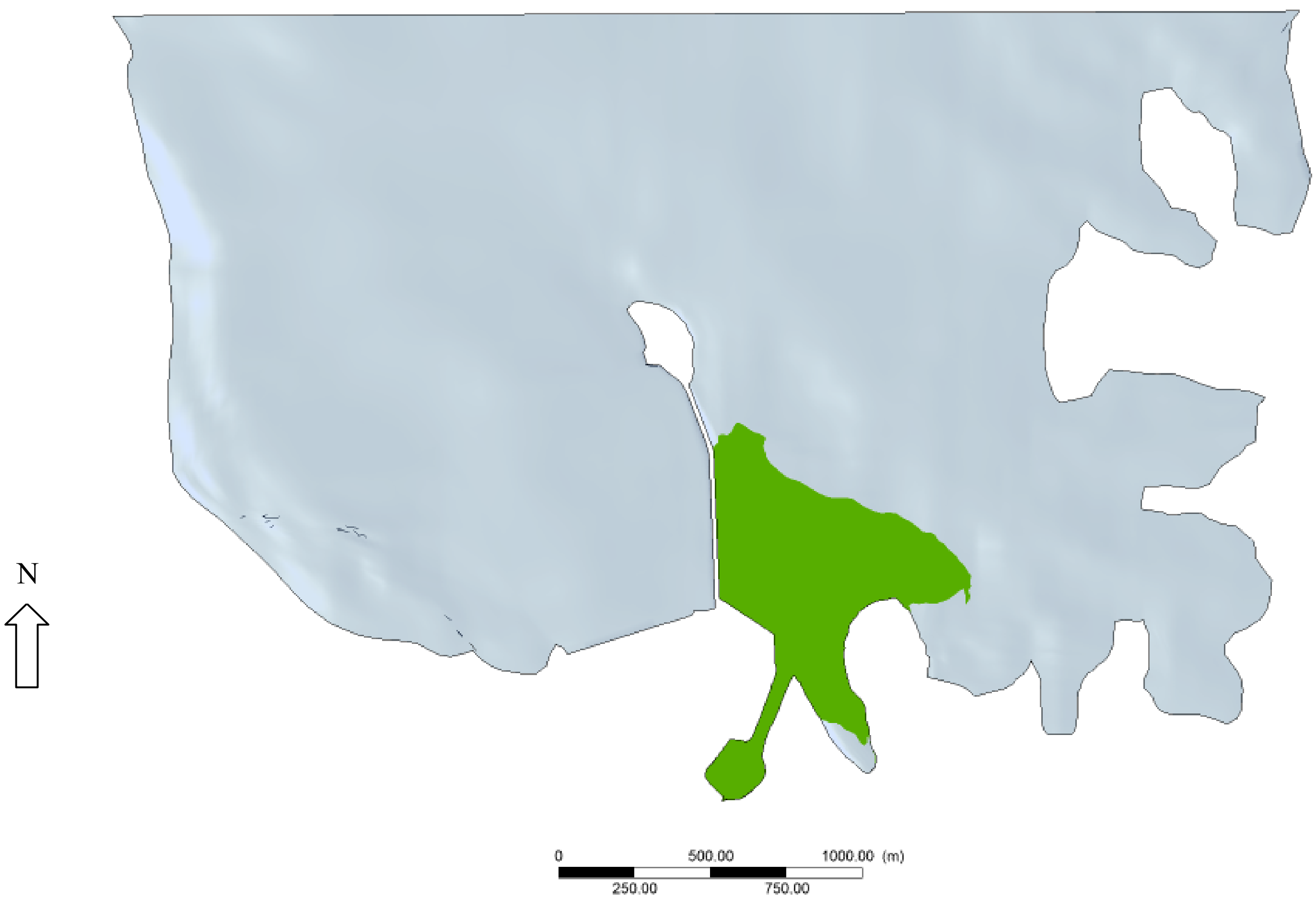

Figure 29 – Scenario 2W, ΔT = 5°F thermal plume (green).

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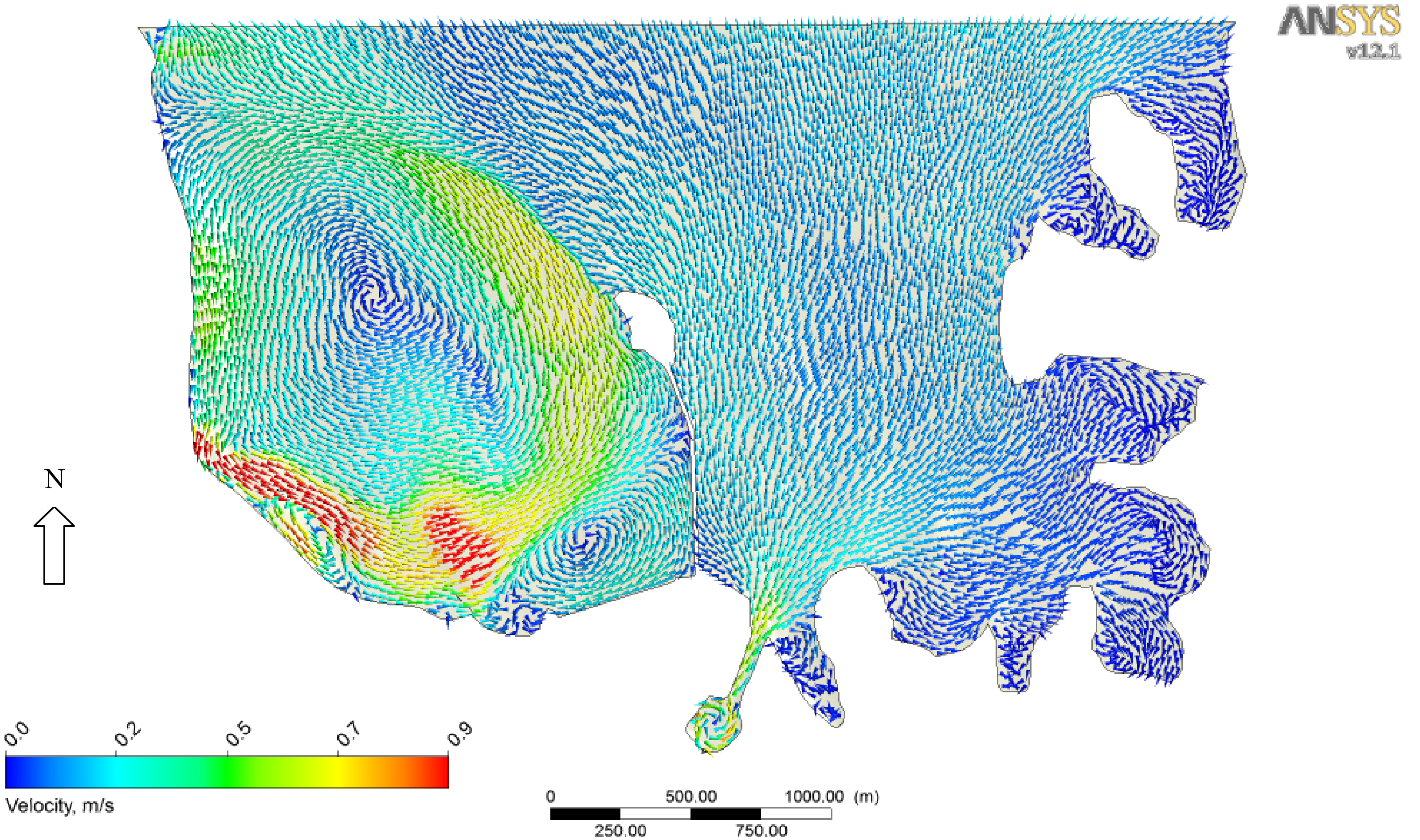

Figure 30 – Scenario 3W, surface velocity vectors

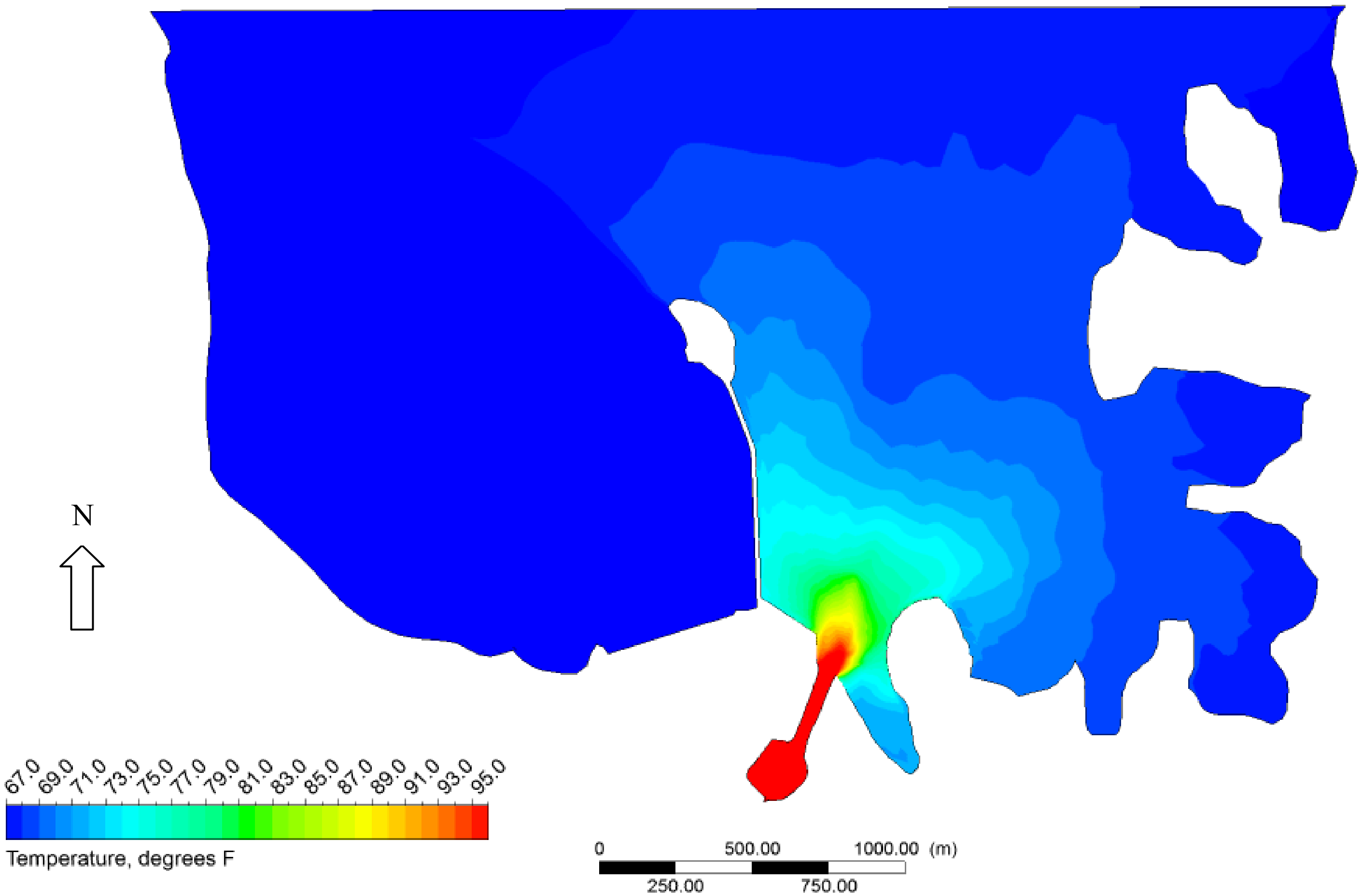

Figure 31 – Scenario 3W, surface temperature.

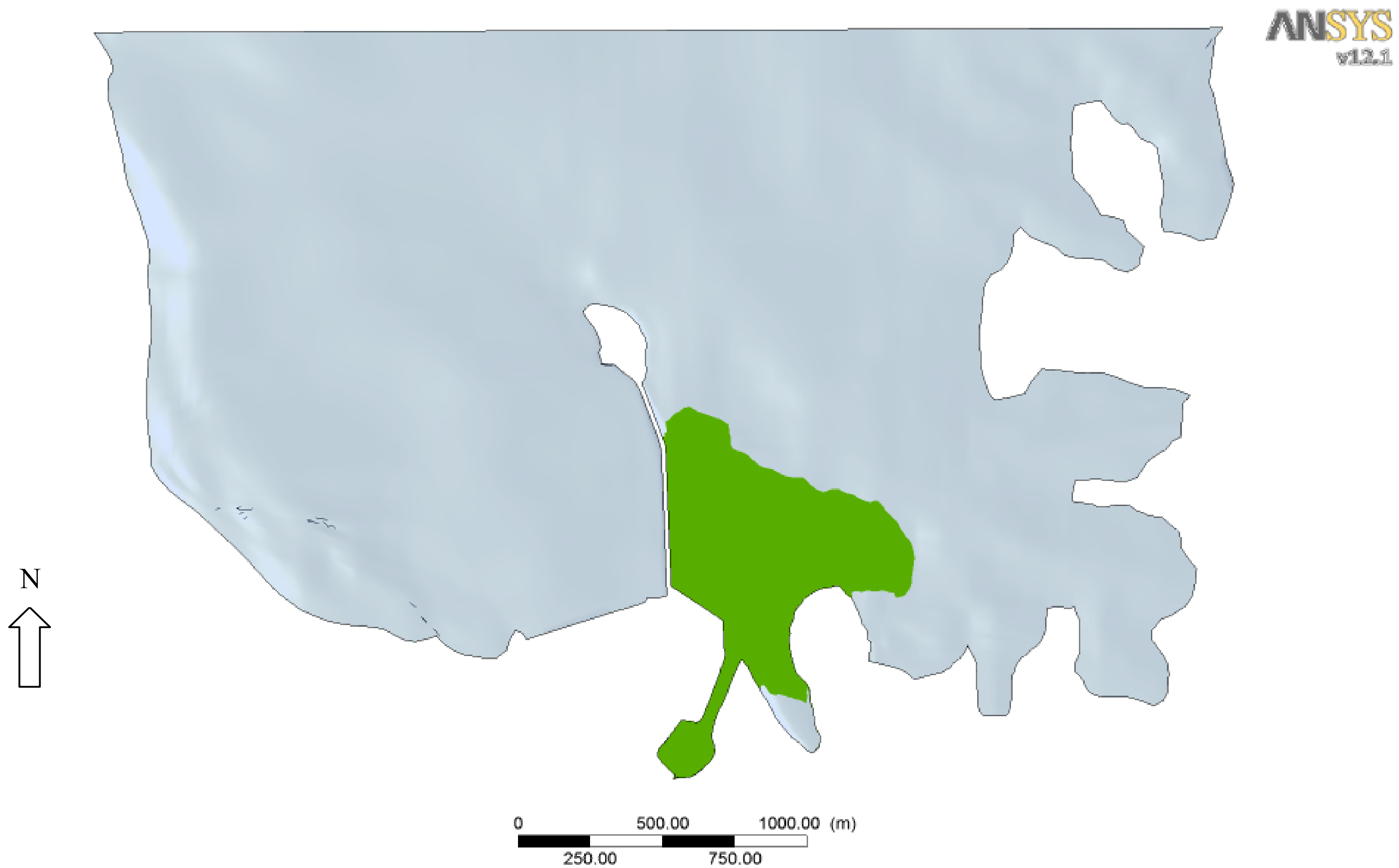

Figure 32 – Scenario 3W, ΔT = 5°F thermal plume (green).

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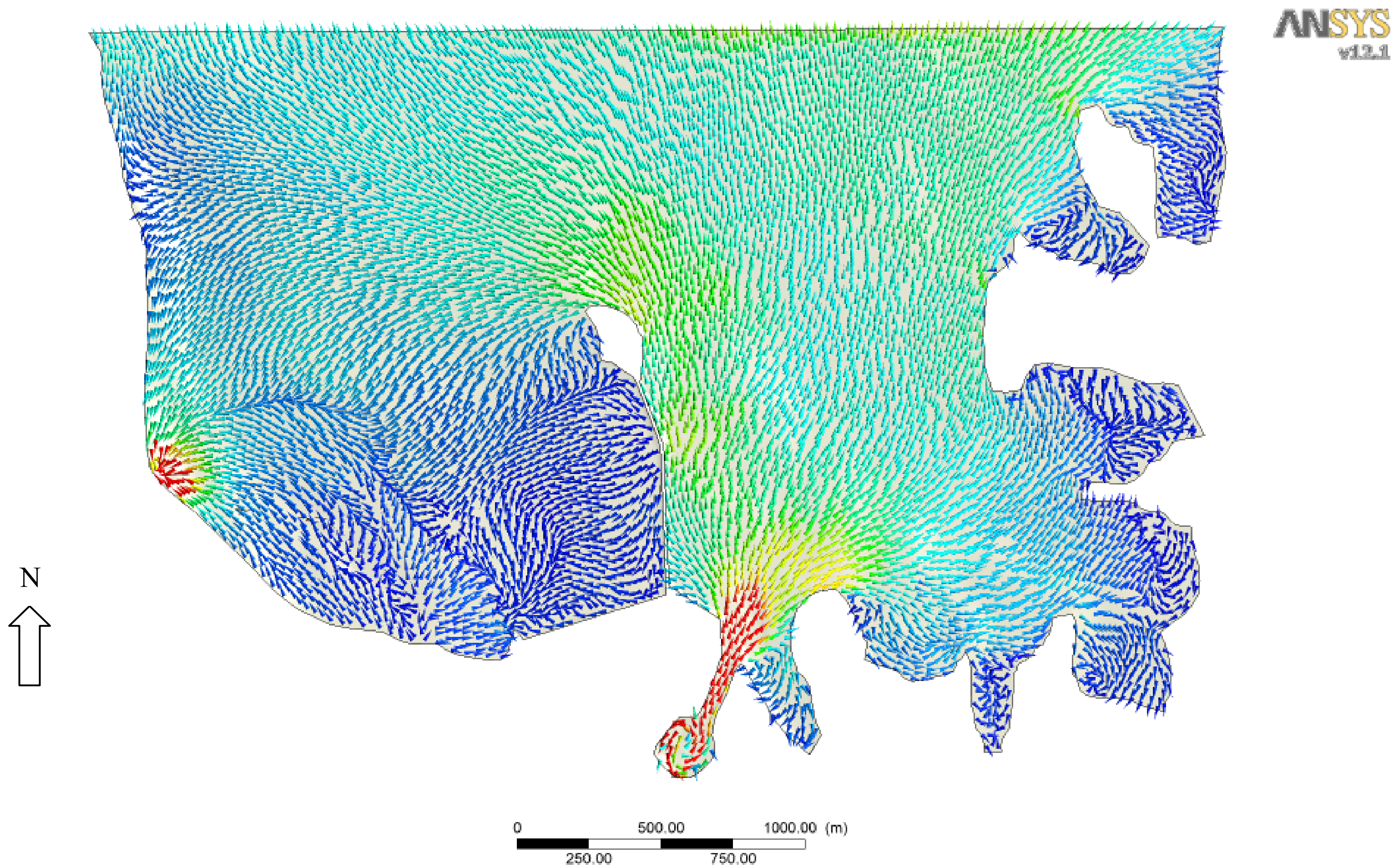

Figure 33 – Scenario 4W, surface velocity vectors

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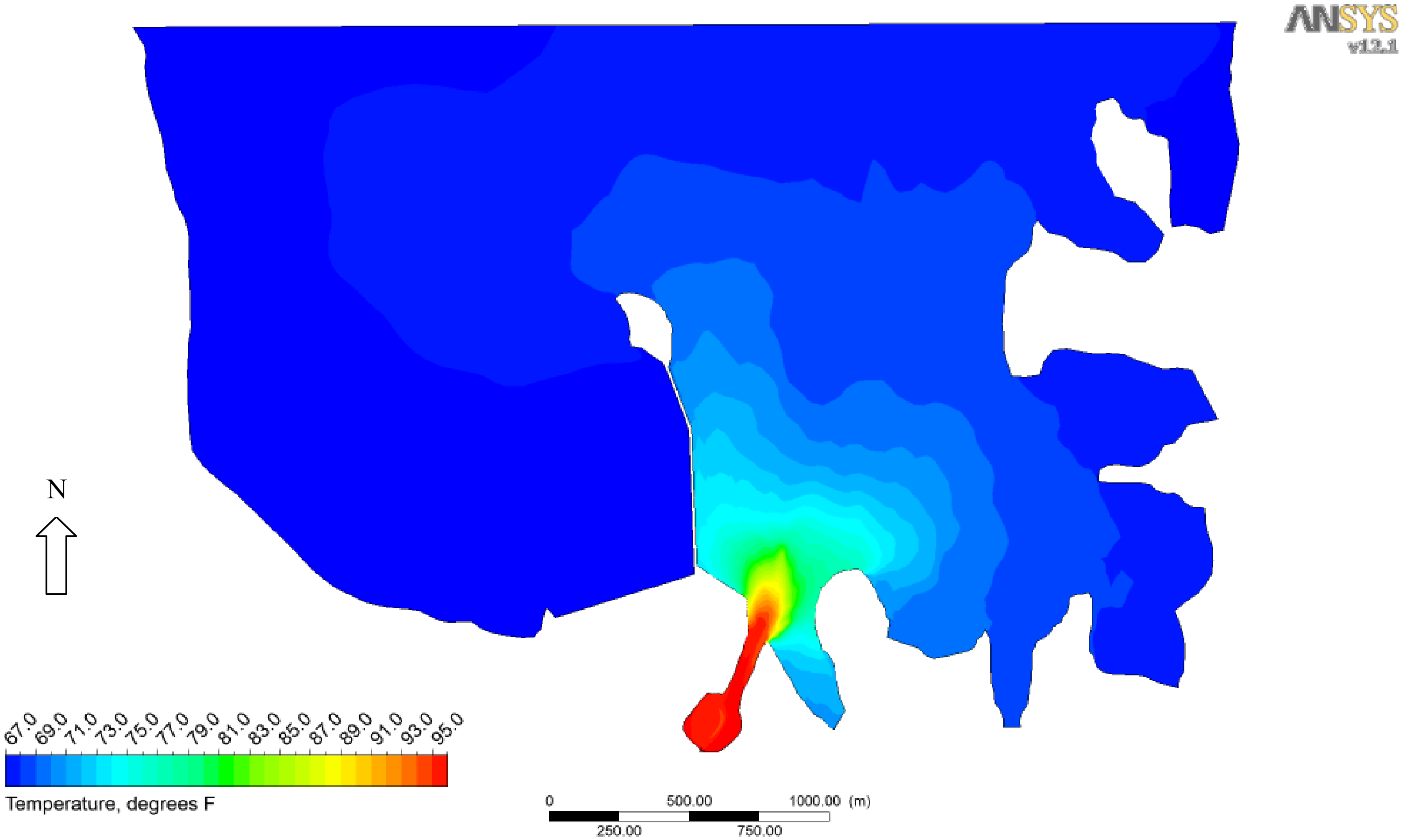

Figure 34 – Scenario 4W, surface temperature.

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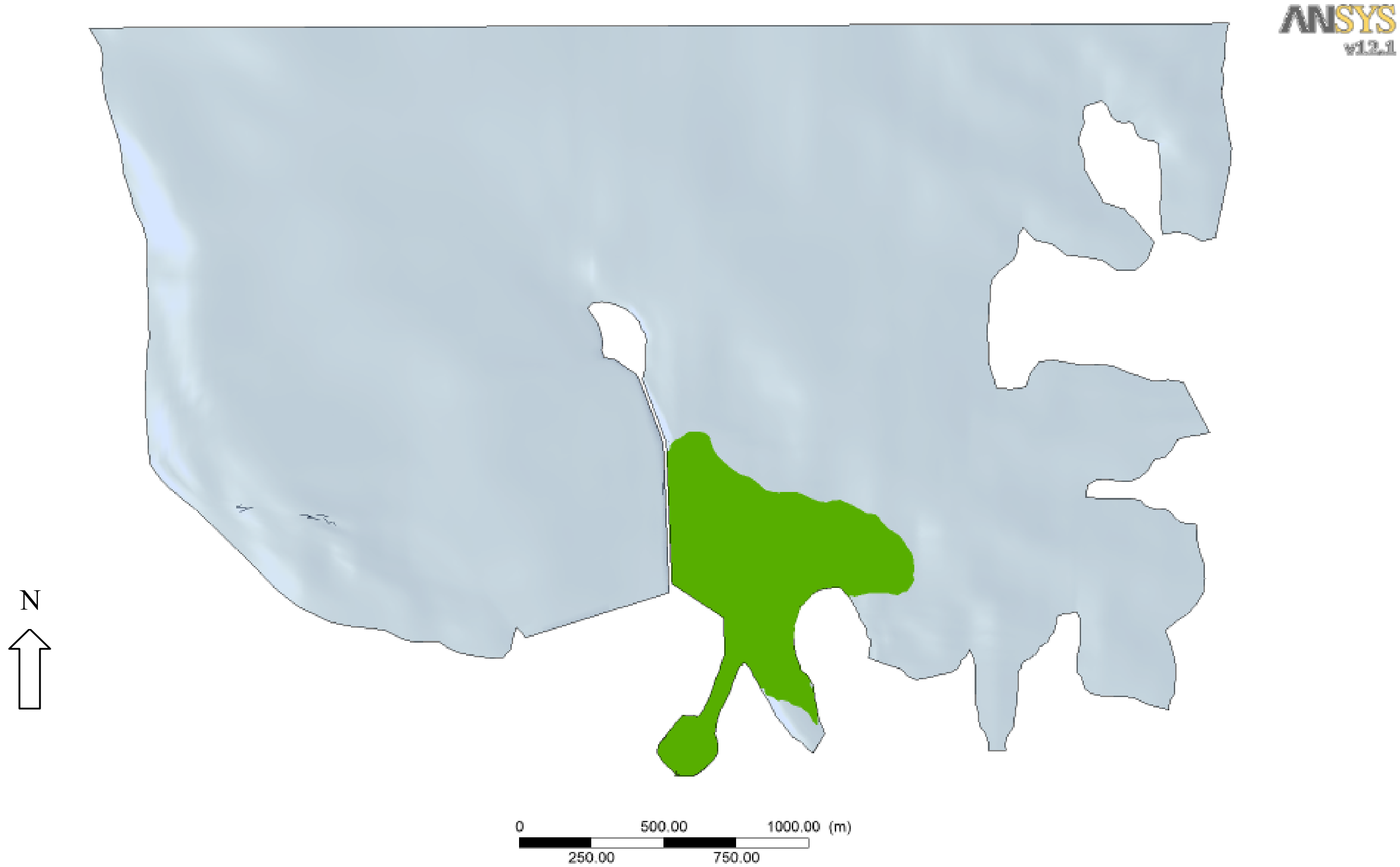

Figure 35 – Scenario 4W, ΔT = 5°F thermal plume (green).

12. APPENDIX A – DETAILS OF THE NUMERICAL MODEL

Geometry and Mesh

The geometry and mesh generation were described in §2 of this report. A custom-built digitizer in Matlab was used to digitized the contour map, and produce a surface. This surface was read into the ICEM mesh generator to create the meshes.

Boundary Conditions

The primary boundary condition in the CFD model was the flow rate and temperature applied discharge. In all simulations, a point source (or sink) was used to represent the flow being withdrawn through the cooling water intakes. Similarly, where the FPSF was operating, a mass and directional momentum point source was employed. The north surface of the domain was a zero-pressure “opening”. This allows fluid to flow into the domain through the north boundary without exerting unphysical influence on the flow. The bottom surface of the domain was set to a “wall” and the top surface, representing the water surface, was set to a “smooth wall” (i.e. no shear stress).

Computational Models

Thermodynamic

The density of water in the domain depended on temperature only, using a tested polynomial relationship between density and temperature.

Turbulence

The shear-stress transport model (SST) was used for all simulations, which is a blend of the well-recognized k-ε and k-ω turbulence models.

Numerics

Model

All simulations were performed using Ansys-CFX 12.0, a widely recognized industrial CFD software package. The model was run in steady-state mode as transient instabilities were not observed.

Discretization

For the simulation, a specified blend factor of 0.5 was used, which is a blend between first- and second-order schemes. This scheme was used to provide a balance between numerical accuracy and stability.

The temporal term in the transient simulations was discretized using a second-order implicit Euler scheme.

Convergence

The root-mean-square residuals were less than 1e-04 for all transport equations solved. This level of convergence is acceptable for a transient simulation, especially as the volume of the thermal plumes was not observed to change. Imbalances for all conserved variables were less than 1%.

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THERMAL MIXING ZONE EVALUATION
VIRGIL C. SUMMER NUCLEAR STATION
NPDES PERMIT
FAIRFIELD COUNTY, SOUTH CAROLINA

ADDENDUM:
ADDITIONAL MODELING CASES FOR REVISED RESERVOIR AMBIENT AND DISCHARGE TEMPERATURES

Prepared by

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Project Number GK5460

February 2014

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1. INTRODUCTION

South Carolina Electric and Gas Company (SCE&G, a subsidiary of SCANA Corporation) is making an application to the South Carolina Department of Health and Environmental Control (SCDHEC) for a renewal of its National Pollutant Discharge Elimination System (NPDES) permit for Unit 1 of the Virgil C. Summer Nuclear Station (VCSNS). VCSNS is located in Fairfield County near Jenkinsville, South Carolina.

Geosyntec Consultants (Geosyntec), and its wholly-owned subsidiary MMI Engineering (MMI), have supported SCE&G in the permit application process by providing modeling studies to determine the size of thermal mixing zones in Monticello Reservoir due to cooling water discharges from VCSNS Unit 1. This was reported in Geosyntec report *Thermal Mixing Zone Evaluation Virgil C. Summer Nuclear Station NPDES Permit* (Geosyntec Project reference GR4796; date January 9, 2012).

SCDHEC has since reviewed the report on the thermal plume sizes and has requested further information from SCE&G. This has included a request for additional modeling to determine the thermal plume sizes under the discharge conditions stated on the NPDES permit application and with revised ambient temperatures representing the highest and lowest ambient temperatures recorded over a longer period than used in the earlier modeling work.

This report is an addendum to the earlier thermal mixing zone report to provide the results of the additional models. As far as possible, the same model set ups have been used as in the original reported work with changes made only to the boundary and initial conditions in Monticello Reservoir to meet SCDHEC's request. This report is focused to provide principally the results of the additional modeling scenarios and does not include the full background to the work and computational model detail. As such, it should be read in conjunction with the original report.

2. MODELED TEMPERATURES

2.1 Reservoir Ambient Temperature

The preceding work used ambient temperatures in Monticello Reservoir which were based on Discharge Monitoring Report (DMR) temperature data for VCSNS Unit 1 for 2010, the most recent complete year of temperature monitoring data at the time. These ambient reservoir temperatures were:

- Summer Condition: 86.4°F – this was the highest monthly-averaged temperature measured at the Unit 1 intakes in 2010.
- Winter Condition: 66.6°F – this was the reservoir temperature when the highest monthly-averaged change in temperature (ΔT) was recorded in 2010 between the reservoir ambient conditions and the Unit 1 cooling water discharge.

To address SCDHEC questions about the original model runs, SCE&G compiled DMR temperature data for VCSNS Unit 1 for a 10-year period from 2003 through 2012. Inspection of the 10-year data set revealed that the monthly average intake temperature of 86.4°F recorded in August 2010, which was used in the modeling of summer critical conditions, was the highest monthly average intake temperature in the 10-year data set.

Based on review of the longer-term data and SCE&G's proposal to maintain 113°F as a daily maximum discharge limit year-round, SCDHEC requested additional modeling runs using the highest and lowest ambient temperatures from the 10-year temperature data set. Specifically, SCDHEC requested that the additional model scenarios use the highest possible discharge temperature of 113°F for summer and winter model runs and these ambient reservoir temperatures:

- Summer Condition: 87.9°F – this was the highest daily maximum Unit 1 intake temperature recorded from 2003 through 2012 (July 2010).
- Winter Condition: 46.4°F – this was a low monthly-averaged Unit 1 intake temperature recorded from 2003 through 2012 (January 2010).

2.2 Nuclear Station Cooling Water Discharge Temperature

In the preceding work, the VCSNS Unit 1 cooling water discharge temperatures were set to 113°F (summer) and 98.7°F (winter).

For the current calculations, the cooling water discharge temperature has been set to 113°F for both summer and winter conditions to match the NPDES permit application and as requested by SCDHEC.

3. MODELED SCENARIOS

There are four principal scenarios for Monticello Reservoir which were tested in the preceding work for both summer and winter temperature conditions:

1. **Scenario 1** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under high water-slack conditions (no flow through Fairfield Pumped Storage Facility [FPSF]).

2. **Scenario 2** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under low water-slack conditions (no flow through FPSF).

3. **Scenario 3** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under low water-rising conditions (FPSF pump-back); and

4. **Scenario 4** – Thermal discharge under peak load and discharge flow with Monticello Reservoir elevation under high water-falling conditions (FPSF generation).

All four scenarios were calculated in the preceding work, as it was not possible to determine *a priori* which scenario would provide the worst case in terms of the 90°F plume size (summer) and $\Delta T > 5°F$ plume size (winter).

For the current work under summer conditions, it has been judged that there is only a small change in temperatures compared with the preceding work – the discharge temperature remains the same (113°F) and the ambient temperature has increased by only 1.5°F. It can be reasonably assumed that the worst scenario previously calculated would also be the worst case for the new temperature conditions. This was Scenario 4 (High water Level; FPSF generating), which is the only summer condition case to have been recalculated in the current work.

Under winter conditions, the current requirement for discharge and ambient temperatures has changed more considerably compared with the preceding calculations (discharge temperature has increased from 98.7°F to 113°F; ambient temperature has decreased from 66.6°F to 46.4°F). Given these large variations, it has not been possible reasonably to assume that the worst case will remain the same as previously calculated. Hence, all four winter scenarios have been re-calculated in the current work.

The cases which have been calculated in the current work are summarized in Table 1. Scenarios denoted with a "W" are the winter runs and the scenario denoted with an "S" is the summer run.

Table 1. Scenarios Calculated in the Current Work

Case	***Scenario***	***Water Level (feet)***	***FPSF (cfs)***	***Discharge Temp (° F)***	***Ambient Temp (° F)***	***Cooling Water Flow (gpm)***
1	1W	425.0	0	113	46.4	532,000
2	2W	420.5	0	113	46.4	532,000
3	3W	420.5	41800	113	46.4	532,000
4	4W	425.0	-50400	113	46.4	532,000
5	4S	425.0	-50400	113	87.9	532,000

4. COMPUTATIONAL MODEL

As far as was possible, the same modeling conditions were applied to the computational model in the current work as were used in the preceding work. This has been considered essential for direct comparison of cases. The changes that have been made and their potential effect on the results are noted in the following sub-sections.

4.1 Geometry and Mesh

The exact same geometry and mesh that were used in the preceding work have been used in the current work.

4.2 Boundary and Initial Conditions

All boundary and initial conditions have been applied in the same manner, with the only changes being to the specified values of ambient and cooling water discharge temperatures.

4.3 Computational Models

The thermodynamic model has retained the same dependence of water density on temperature only using the same tested polynomial relationship.

The same Shear Stress Transport (SST) turbulence model has been used for all calculations.

4.4 Numerical Models

The preceding work used the ANSYS-CFX v12.0 software to perform the calculations; this is a commercially available, general purpose Computational Fluid Dynamics (CFD) software package which is widely applied throughout a range of industries. The current work has used a later release of the same software ANSYS-CFX v14.0[1]. There are no changes to the solution method between these releases.

[1] ANSYS releases a new version of the code generally every 12 months; the new versions typically have new models for more esoteric calculations (combustion; 2-phase flow; reaction kinetics, etc.) and some bug fixes. However the underlying engine of the software has not changed since they released v5 in the mid 1990's. There have been no changes between v12 and v14 to the sub-set of models we are using in this analysis.

The preceding work used time-dependent ("transient") calculations to determine the plume sizes. Although there was no variation of the flow conditions with time, a time-dependent solution method is required to resolve the thermal buoyancy forces which are significant in large parts of the reservoir. The same approach has been used in the current work.

For spatial discretization[2], the preceding work used a specified blend factor between first and second order schemes for all transported variables, with a blend factor of 0.5. In the current work a hybrid differencing scheme has been used, which applies second-order differencing as widely as possible in the domain, only reverting to first-order differencing in regions of high gradients in the transported variables. This was largely a change in style, rather than substance. The hybrid scheme has the potential to be marginally more accurate, but with perhaps slightly less stability.

For temporal discretization[3], the preceding work used a second-order implicit Euler scheme. In the current work, a first-order implicit Euler scheme was used as the second-order scheme is only considered essential where there are true transient conditions, rather than using a transient scheme to reach a steady solution.

Convergence in the preceding work was judged to be achieved by three metrics: (i) when the Root-Mean-Square (RMS) residuals were reduced below 1.0e-4 for all transport equations solved at each time step in the time-dependent solution; (ii) when the variable imbalances for all conserved variables were less than 1 percent; (iii) when the thermal plume sizes were observed not to vary in time. The same approach has been used in the current work with the exception that RMS residuals were reduced to 1.0e-5. This was largely a change in style, rather than substance.

[2] *Discretization* describes a numerical technique which is used in computational models. The flow domain – in this case the reservoir – is split into a very large number of grid cells, typically 10^5 – 10^6 and the flow details (velocity, pressure, temperature, turbulence) are calculated in each grid cell. The numerical method must have some means of passing information between neighbouring cells and other near-neighbours – this is the spatial discretization scheme.

[3] Similarly the flow data must be passed between time steps – this requires the temporal discretization scheme

5. RESULTS

5.1 Preceding Work

The principal results for plume sizes which were calculated in the preceding work are repeated here for comparison. Only the results for the cases which have been re-run in the current work are shown in Table 2. The average depths have been updated to be somewhat greater, as they were not presented correctly in the preceding report[4]; the plume volume, area, and average depth are the same.

The following thermal conditions were used in the preceding work:

- Winter: ambient temperature: 66.6°F; discharge temperature: 98.7°F.
- Summer: ambient temperature: 86.4°F; discharge temperature: 113°F.

Table 2. Calculated Plume Sizes Repeated from the Preceding Work

Case	***Scenario***	***Volume (acre-ft)***	***Surface Area (acre)***	***Average Depth (ft)***	***Maximum Depth (ft)***
		Winter Conditions $\Delta T = 5°F$			
1	1W	799	77	10.4	40
2	2W	1,005	107	9.4	36
3	3W	1,148	120	9.6	36
4	4W	1,043	110	9.5	40
		Summer Conditions $T = 90°F$			
5	4S	1,790	163	6.1	40

[4] The results from the preceding analysis were originally provided in the tables in Section 7 “Results Summary – T = 90°F Plume” and Section 8 “Results Summary – ΔT = 5°F Plume” of report: *Thermal Mixing Zone Evaluation Virgil C. Summer Nuclear Station NPDES Permit* (Geosyntec Project reference GR4796; date January 9, 2012).

5.2 Current Work

The equivalent results for the plume sizes calculated in the current work are shown in Table 3.

The following thermal conditions were used in the current work:

- Winter: ambient temperature: 46.4°F; discharge temperature: 113°F.
- Summer: ambient temperature: 87.9°F; discharge temperature: 113°F.

Table 3. Calculated Plume Sizes from the Current Work

Case	***Scenario***	***Volume (acre-ft)***	***Surface Area (acre)***	***Average Depth (ft)***	***Maximum Depth (ft)***
		Winter Conditions ΔT = 5°F			
1	1W	1,031	125	8.2	40
2	2W	1,109	388	2.9	36
3	3W	1,246	130	9.6	36
4	4W	1,503	218	6.9	40
		Summer Conditions T = 90°F			
5	4S	4,841	378	12.8	40

Contour plots showing the extent of the thermal plumes at the surface of the reservoir for each case are presented in Figures 1 through 5.

5.3 Results Discussion – Winter Condition

The preceding work showed that the worst case in winter was Scenario 3 (low water; pump-back operation at FPSF). This was the worst case for both the $\Delta T = 5°F$ plume volume and area on the reservoir surface.

In the current work, the worst case for $\Delta T > 5°F$ plume volume is Scenario 4 (high water; generation at FPSF) and the worst case for area on the surface of the reservoir is Scenario 2 (low water; no flow through FPSF) (Table 3). The $\Delta T > 5°F$ plume remains to the east of the island at the end of the jetty (Figures 1, 3, and 4) for all cases except Scenario 2, where it just passes around the northernmost extent of the island (Figure 2).

In general, the plumes calculated with the ambient temperature 46.4°F and discharge temperature 113°F (Table 3) have greater volume and greater extent on the surface of the reservoir than the equivalent plumes in the preceding work with ambient temperature 66.6°F and discharge temperature 98.7°F (Table 2). There are a number of effects which influence this. Firstly, the higher discharge temperature results in a greater body of water with $\Delta T > 5°F$; the lower ambient temperature also acts to increase this plume size. However, counter to that, the lower ambient temperature also provides a greater cooling effect and has the potential to reduce the thermal plume size. Overall, it appears that the increased discharge temperature and lower ambient temperature act to increase the size of the winter thermal plume, as defined by $\Delta T > 5°F$, to a greater extent than the lower ambient temperature provides cooling.

Scenario 2 is also slightly unusual in that the average plume depth (or thickness) is shallow; this increases its area on the surface of the reservoir relative to the other scenarios. This is most likely due to the low water level used in Scenario 2, which is set at 420.5 ft mean sea level (msl), compared with the high water level cases using 425 ft msl. Scenario 3 also has the low water level, but there is increased mixing in the reservoir due to pump-back operations at FPSF.

5.4 Results Discussion – Summer Condition

The T = 90°F thermal plume for Scenario 4 (high water; generation at FPSF) is considerably larger for the current conditions than in the preceding work. The increase is evident in the volume, extent on the surface area, and depth of the thermal plume (Tables 2 and 3).

The only change in the conditions for this scenario was the increase in the ambient temperature from 86.4°F to 87.9°F. Although this is a small increase, it is significantly closer to the T = 90°F limit that defines the thermal plume, and thus less able to cool the discharged water.

As shown in Figure 5, the thermal plume remains to the east of the island and does not extend towards the FPSF or the VCSNS Unit 1 cooling water intake structure.

6. CONCLUSIONS

Additional calculations have been carried out for cooling water discharges from VCSNS Unit 1 into Monticello Reservoir. The additional calculations have been made at the request of SCDHEC to investigate a number of effects: lower ambient temperature in the winter; higher ambient temperature in the summer; and cooling water discharge of 113°F in the winter.

In winter, reducing the ambient temperature in the reservoir and increasing the cooling water discharge temperature has the effect of increasing slightly the $\Delta T > 5°F$ thermal plume size. The worst case for plume volume is Scenario 4 (high water; FPSF pumping back to Monticello Reservoir) and worst case for plume area on the reservoir surface is Scenario 2 (low water; no flow through FPSF). The $\Delta T > 5°F$ plume remains to the east of the island at the end of the jetty (located between the VCSNS cooling water intake structure and the discharge point) for all cases except Scenario 2, where it just passes around the northernmost extent of the island.

In summer, increasing the ambient temperature in the reservoir to 87.9°F has a large effect on the $T = 90°F$ thermal plume. This is because there is little cooling potential in the reservoir when the ambient temperature is already close to the thermal plume limit. However, the thermal plume remains to the east of the island.

Both winter and summer cases show larger thermal plumes than were calculated in the preceding work, due to the revised ambient and discharge temperatures specified by SCDHEC. However, it is significant that in all cases calculated, the thermal plumes due to the cooling water discharge remain entirely or predominantly to the east of the island that separates the VCSNS cooling water intake structure and discharge. The thermal plumes do not approach the FPSF intake, the VCSNS Unit 1 cooling water intake structure, or the northern reach of Monticello Reservoir.

FIGURES

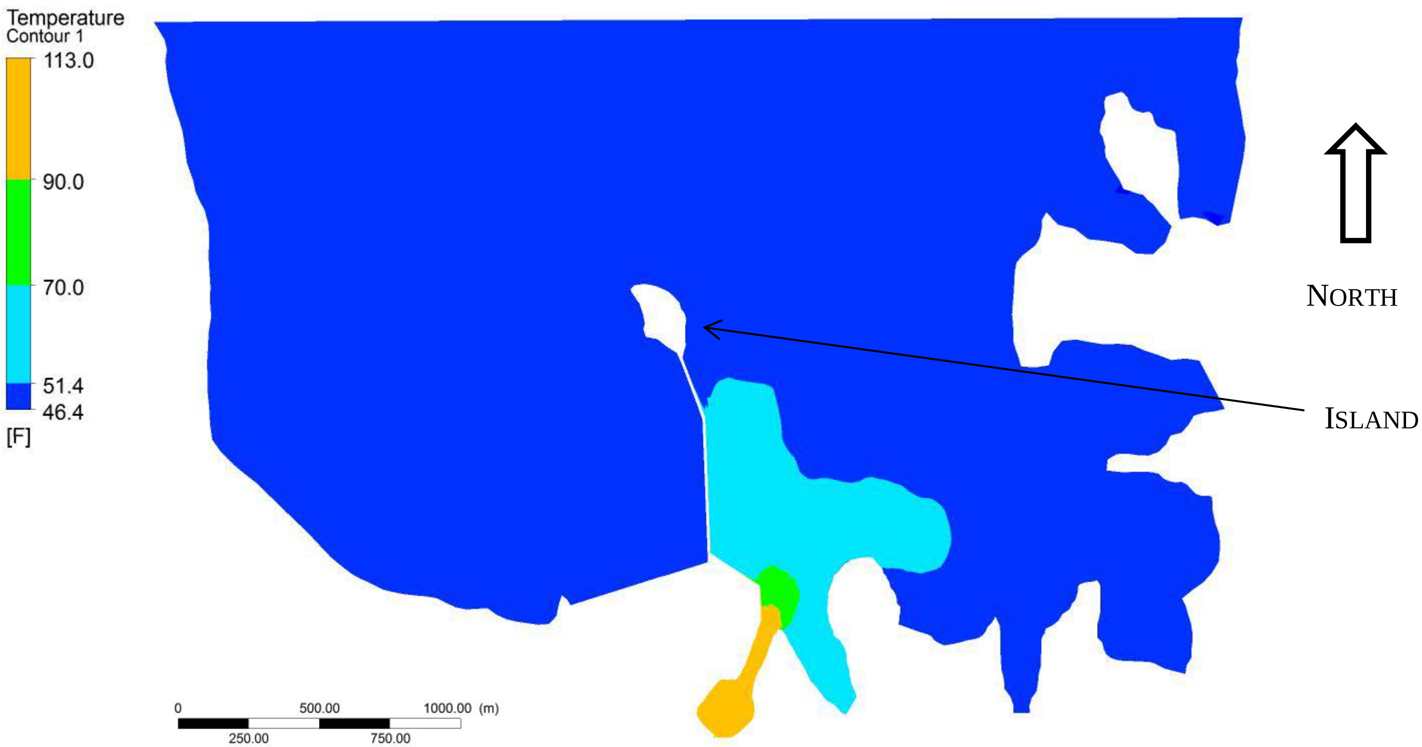


Figure 1. Scenario 1: Winter - High Water; No Flow through FPSF.

Contour plot showing the extent of the $\Delta T > 5°F$ plume which for $T_{ambient} = 46.4°F$ has the value $T_{plume} = 51.4°F$

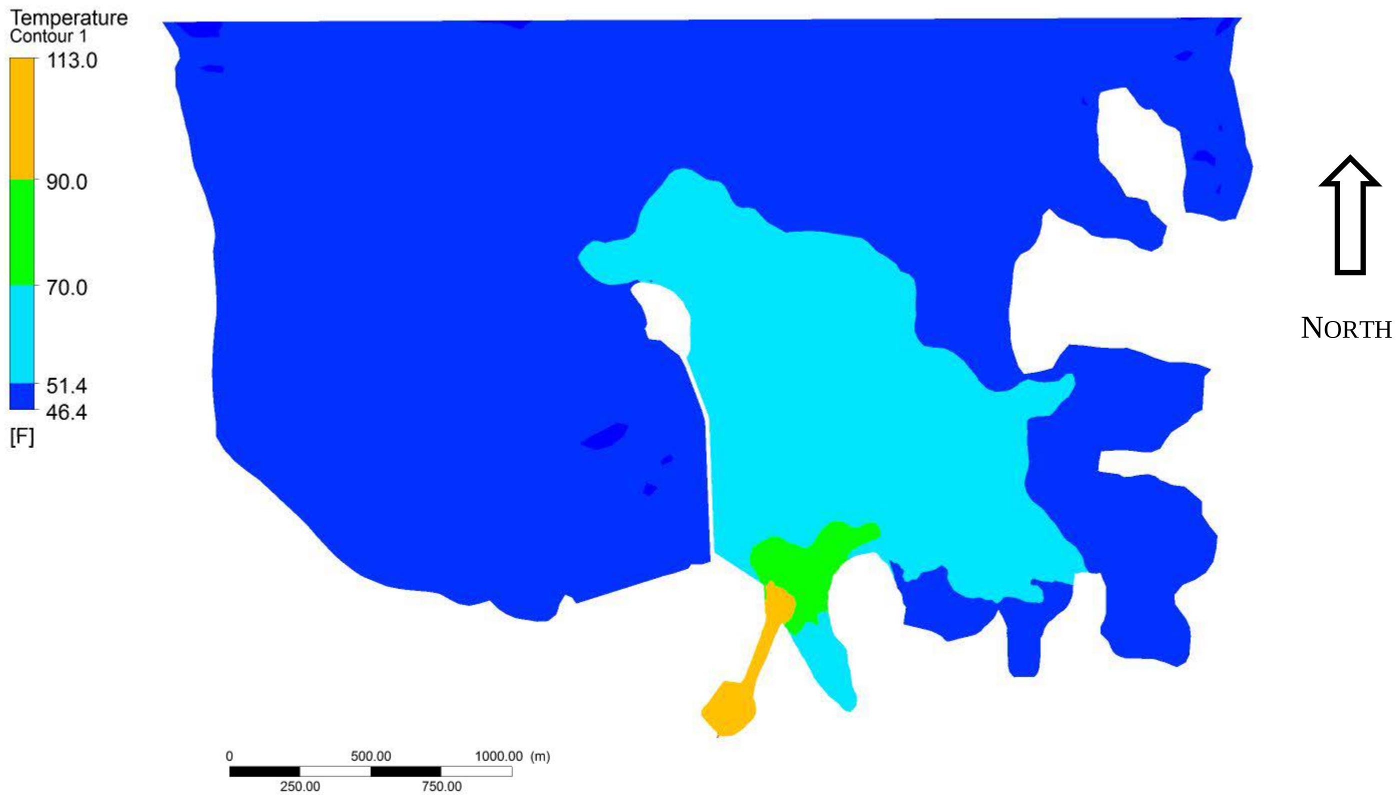


Figure 2. Scenario 2: Winter - Low Water; No Flow through FPSF.

Contour plot showing the extent of the $\Delta T > 5°F$ plume which for $T_{ambient} = 46.4°F$ has the value $T_{plume} = 51.4°F$

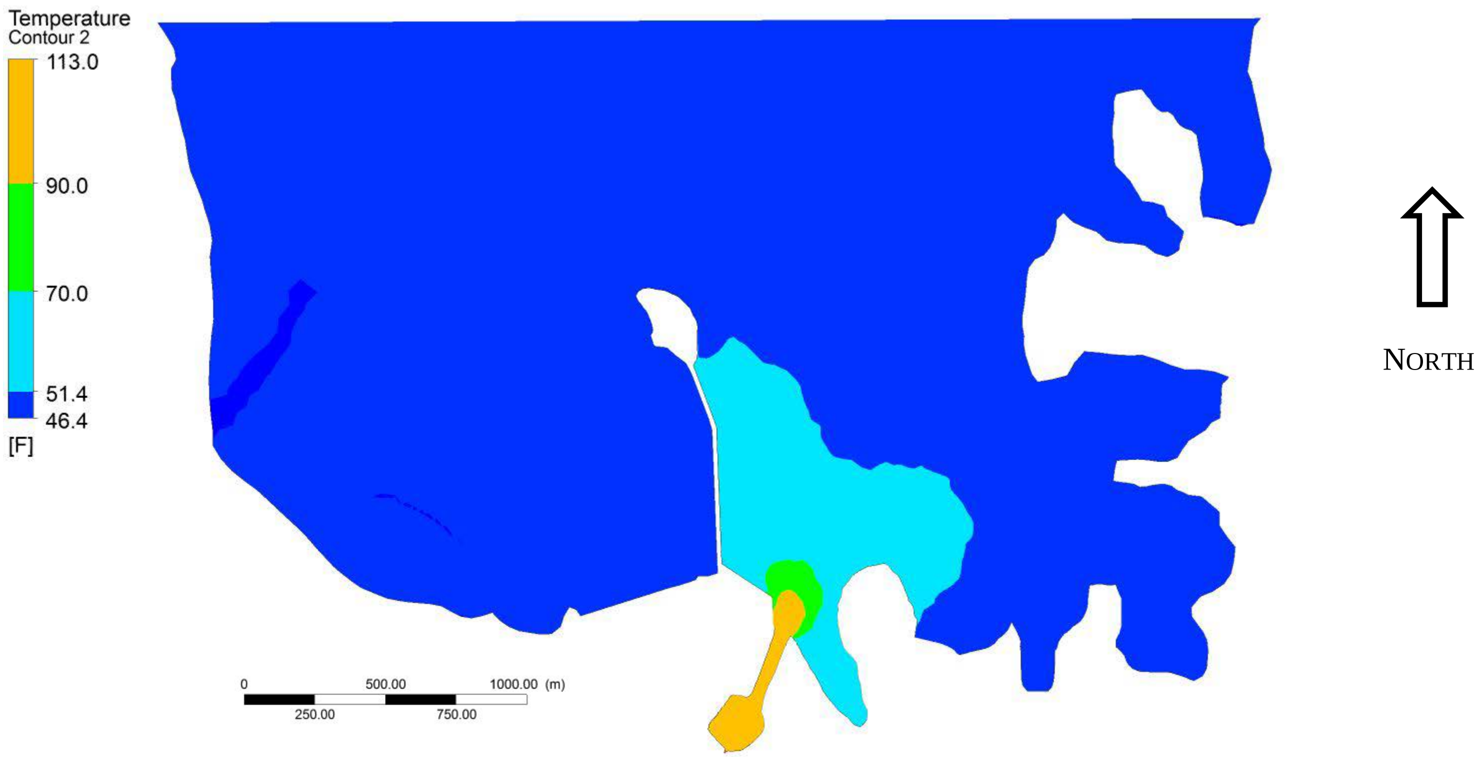


Figure 3. Scenario 3: Winter - Low Water; FPSF Pumping Back to Reservoir.

Contour plot showing the extent of the $\Delta T > 5°F$ plume which for $T_{ambient} = 46.4°F$ has the value $T_{plume} = 51.4°F$

Figure 4. Scenario 4: Winter - High Water; FPSF Generating (Discharging from Reservoir).

Contour plot showing the extent of the ΔT > 5°F plume which for $T_{ambient}$ = 46.4°F has the value T_{plume} = 51.4°F

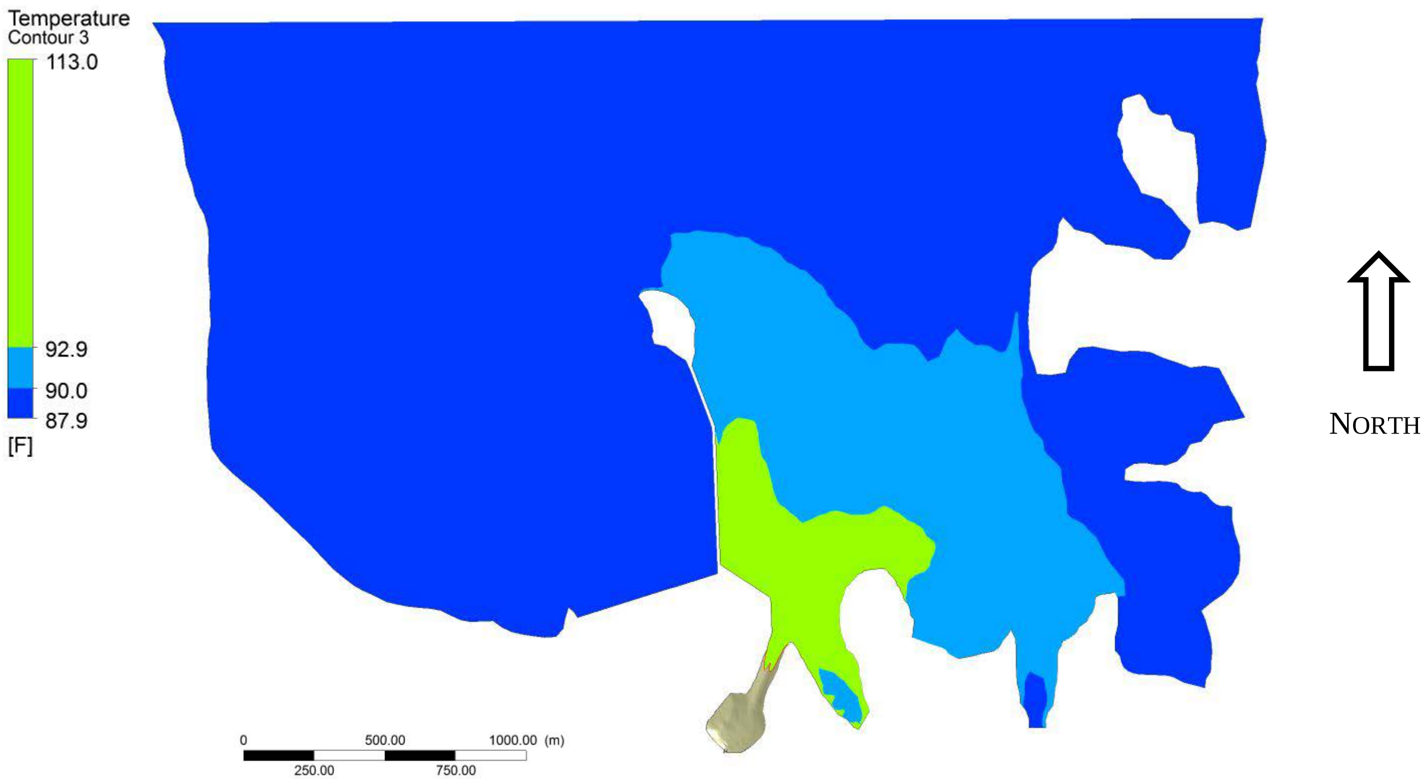


Figure 5. Scenario 4: Summer - High Water; FPSF Generating (Discharging from Reservoir).

Contour plot showing the extent of the T = 90°F plume;
also shown is $\Delta T > 5°F$ plume which for $T_{ambient} = 87.9°F$ has the value $T_{plume} = 92.9°F$

APPENDIX C

PARR HYDROELECTRIC PROJECT – WATER QUALITY ADDENDUM – JUNE 2014

At the Water Quality TWC meeting on February 4, 2014, the TWC noted that the Parr Water Quality Report identified multiple dissolved oxygen (DO) levels below 4.0 mg/l in the Parr Shoals Dam tailrace. The TWC agreed that SCE&G would consolidate historic USGS data to examine those excursions and to provide any operations that might be associated with the data. SCE&G requested hourly DO, temperature and river flow data from 2004 through 2013 for the following USGS stations:

1. USGS 02160991 Broad River near Jenkinsville, SC
2. USGS 02156500 Broad River near Carlisle, SC
3. USGS 02160700 Enoree River at Whitmire, SC
4. USGS 02160105 Tyger River near Delta, SC

Our analysis of the data focused on the period from July through September of each year from 2004 through 2013. For this analysis, we plotted hourly readings of flow, temperature, and DO levels at each of the gage stations. Those plots and the raw data will be available to the TWC upon request. Included below are data from the Jenkinsville gage, located immediately downstream of the Parr Shoals Dam along the east bank of the tailrace (FIGURE 1 through FIGURE 10). Since flow data is not collected at the Jenkinsville gage, flow data from the Alston gage, USGS 02161000, was used.

FIGURE 1 2004 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000

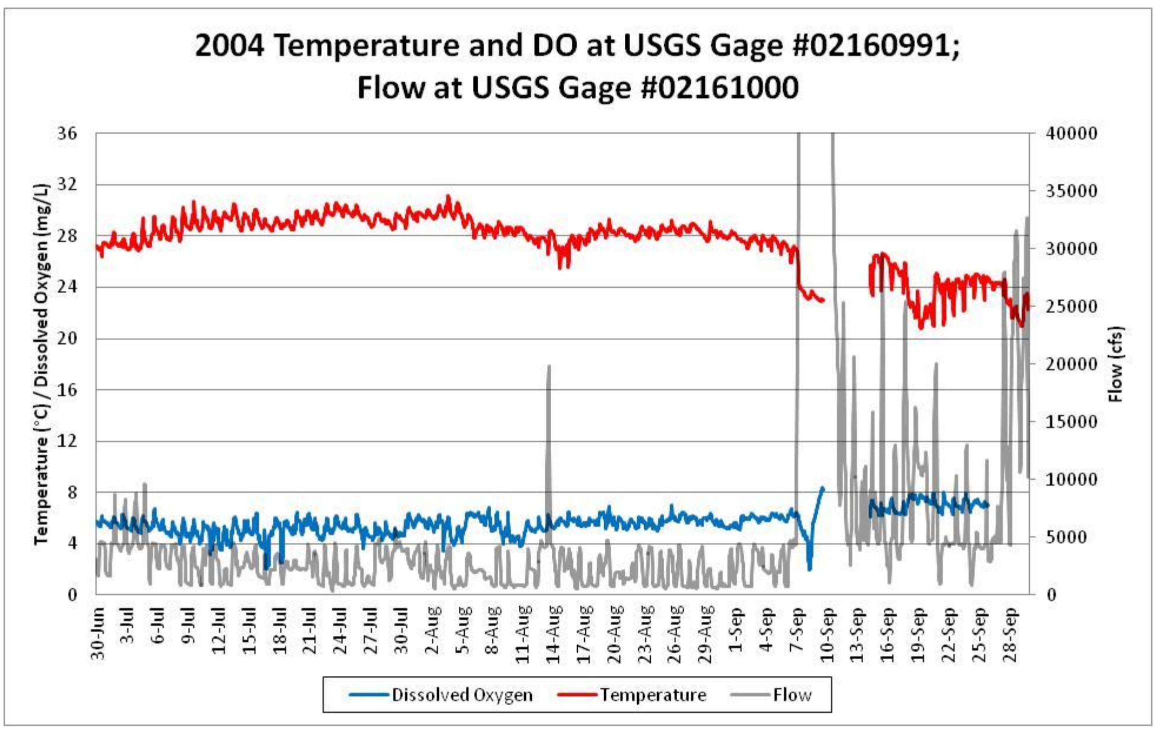


FIGURE 2 **2005 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

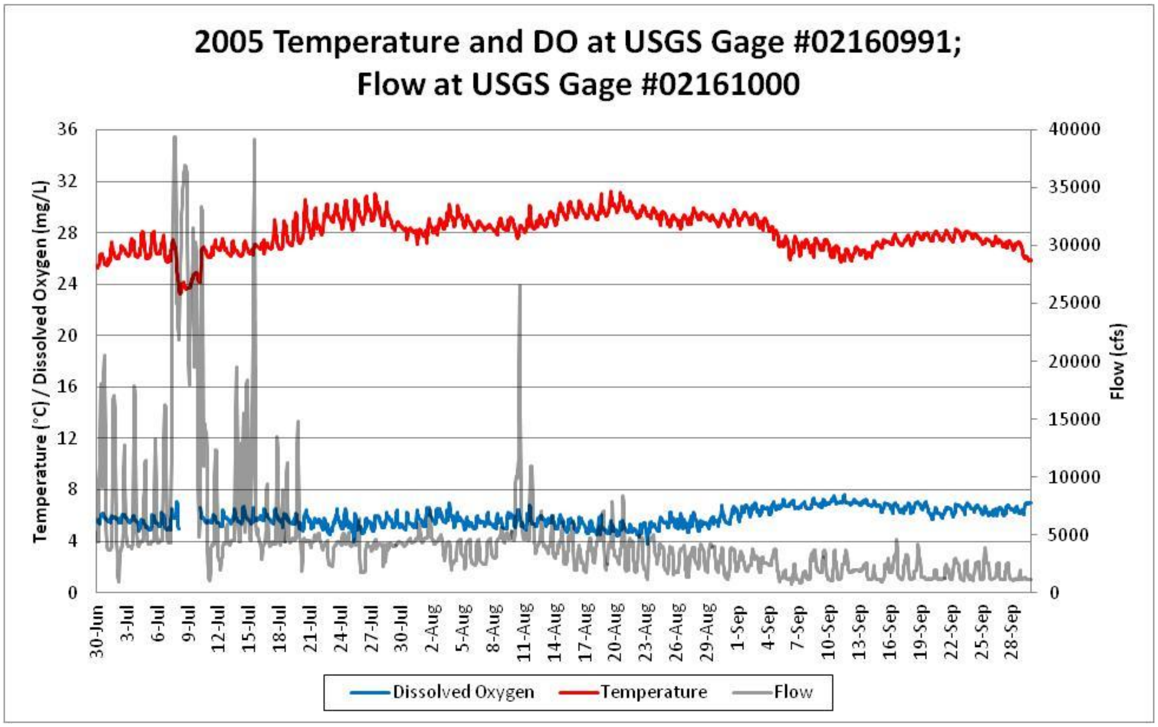


FIGURE 3 **2006 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

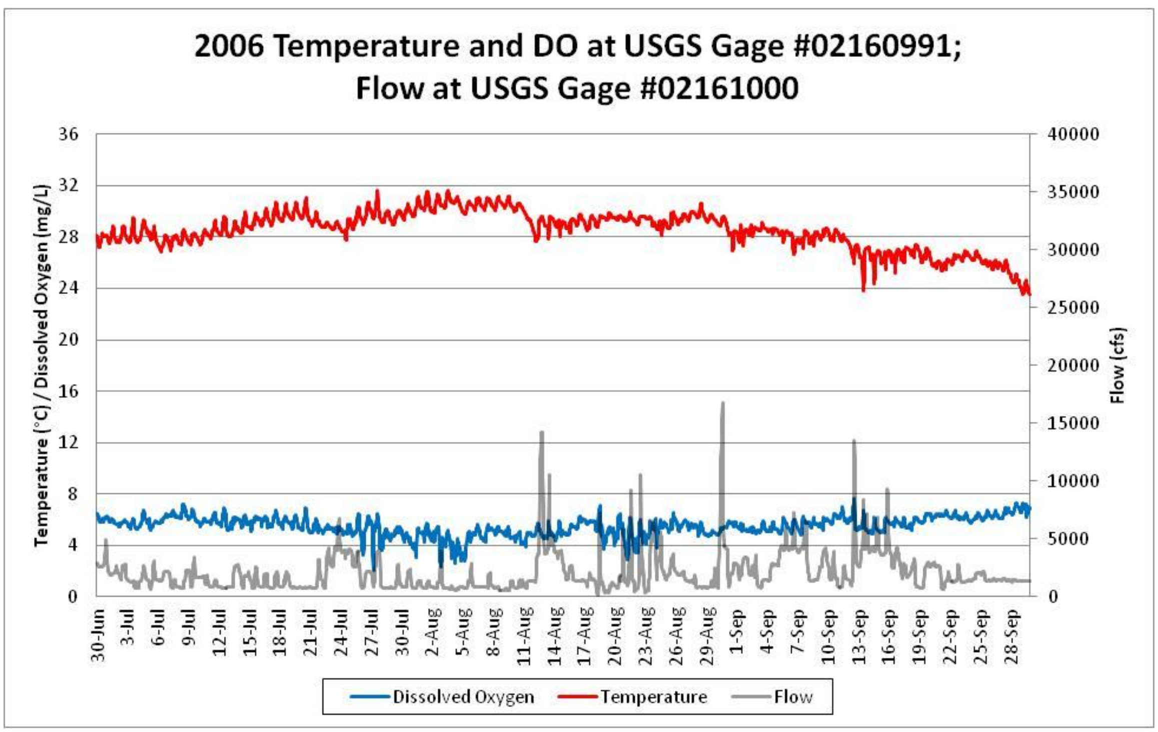


FIGURE 4 **2007 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

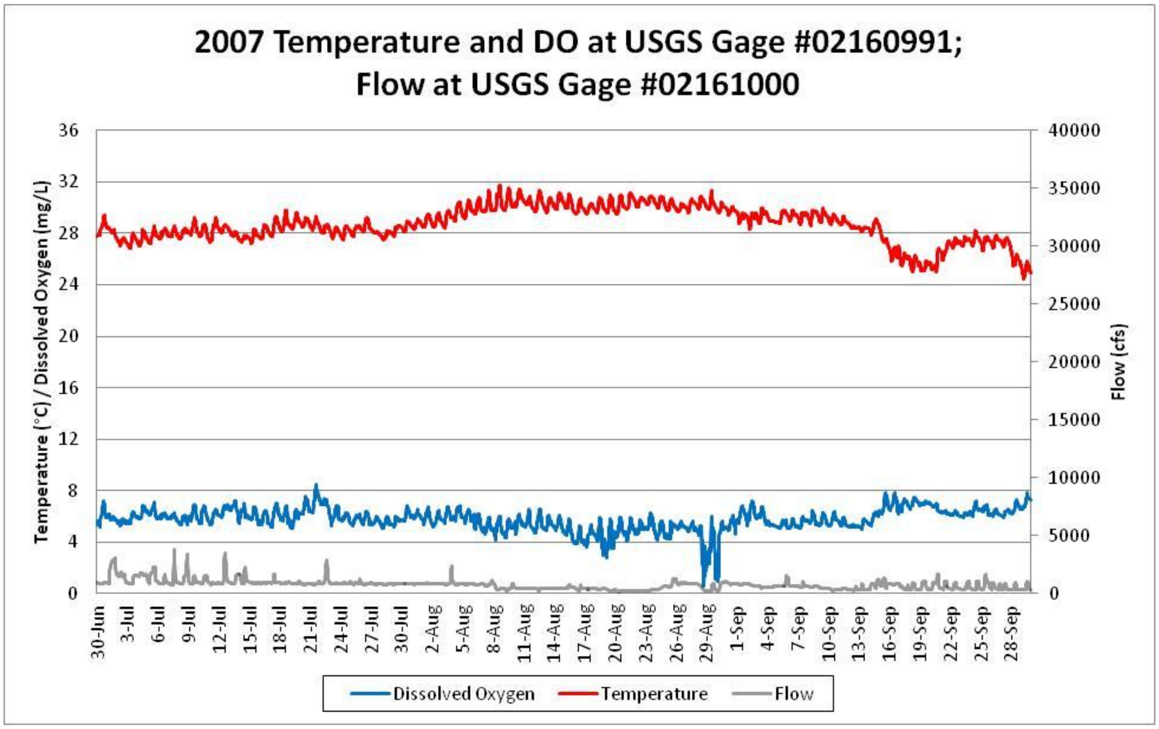


FIGURE 5 **2008 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

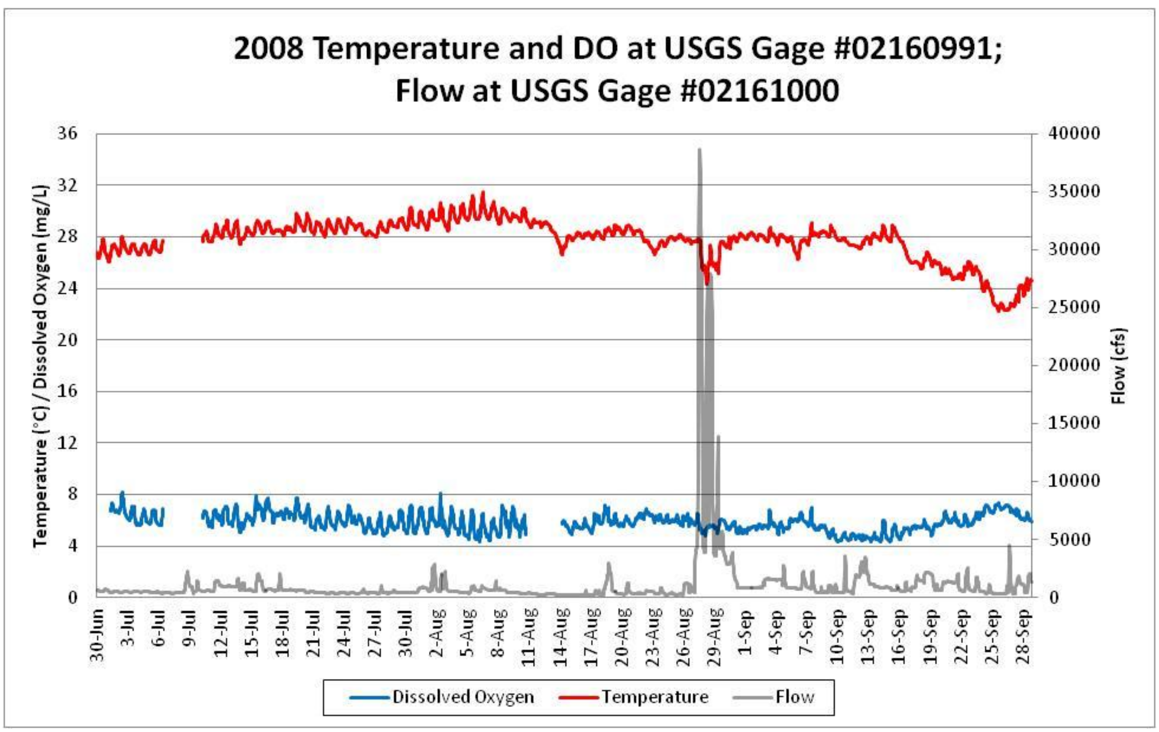


FIGURE 6 **2009 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

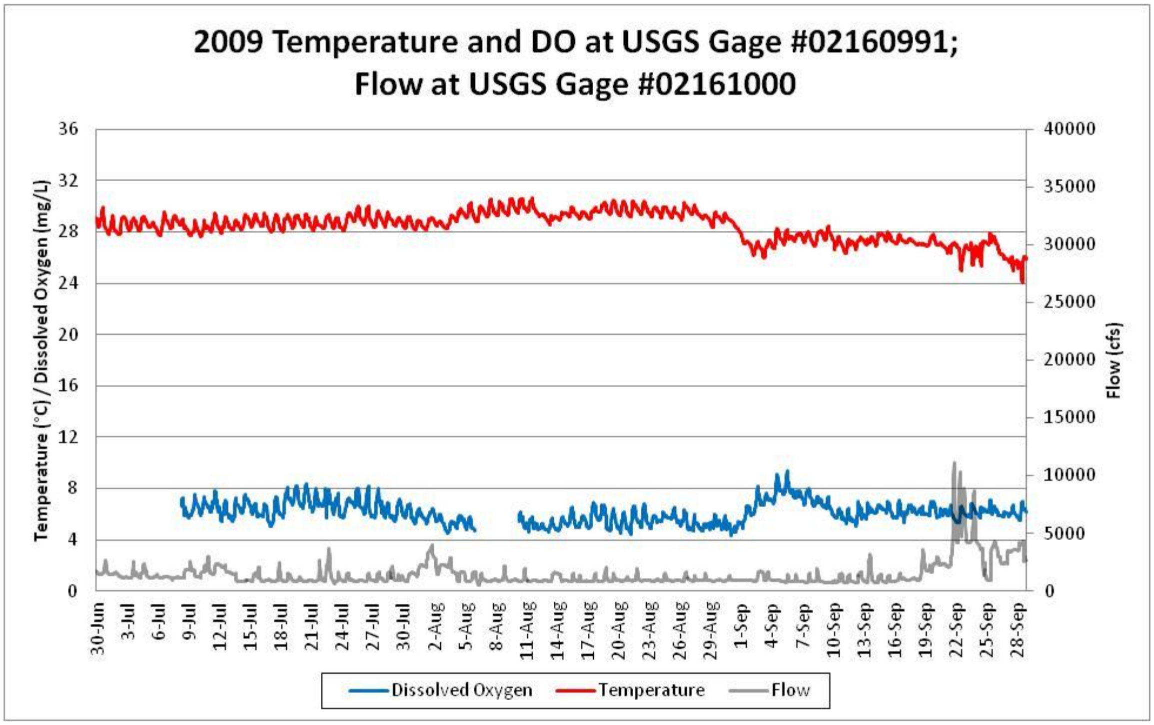


FIGURE 7 **2010 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

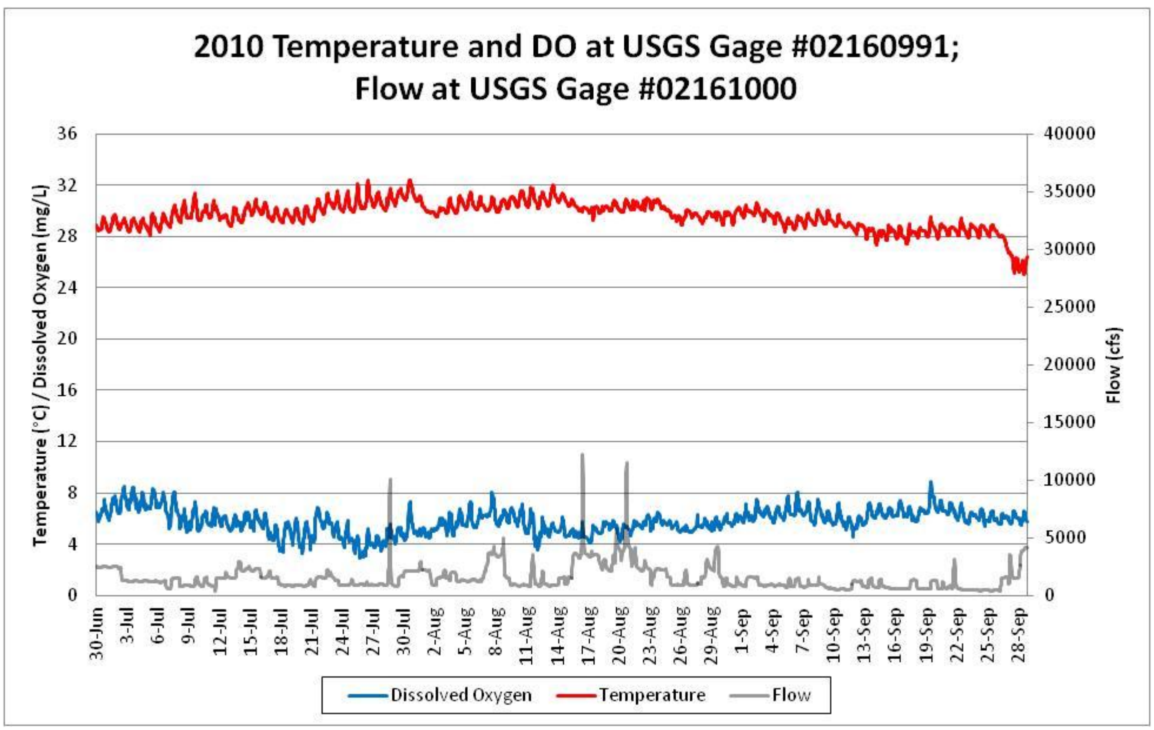


FIGURE 8 **2011 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

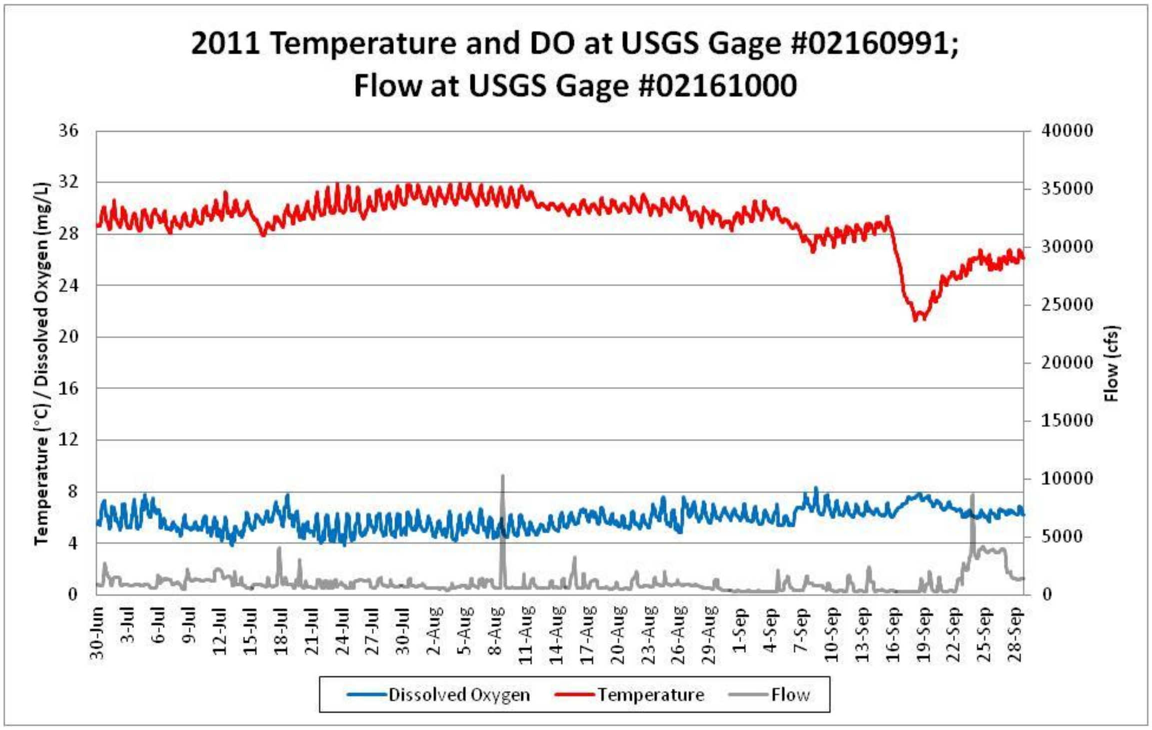


FIGURE 9 **2012 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000**

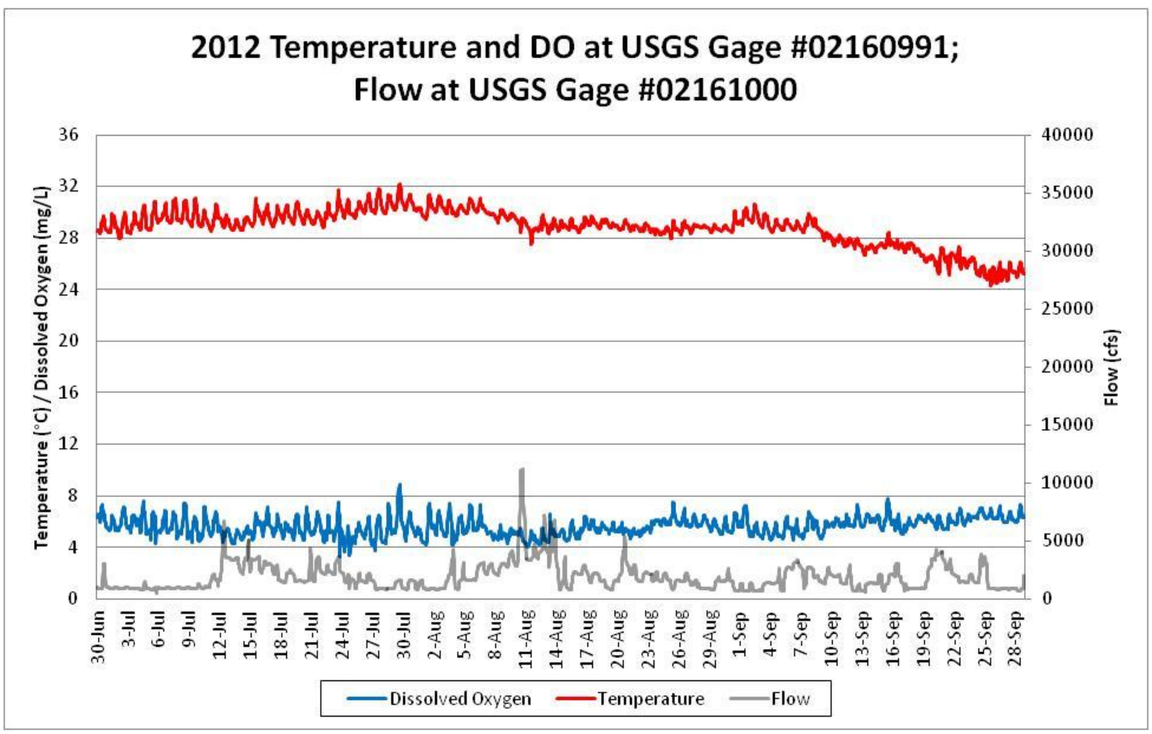
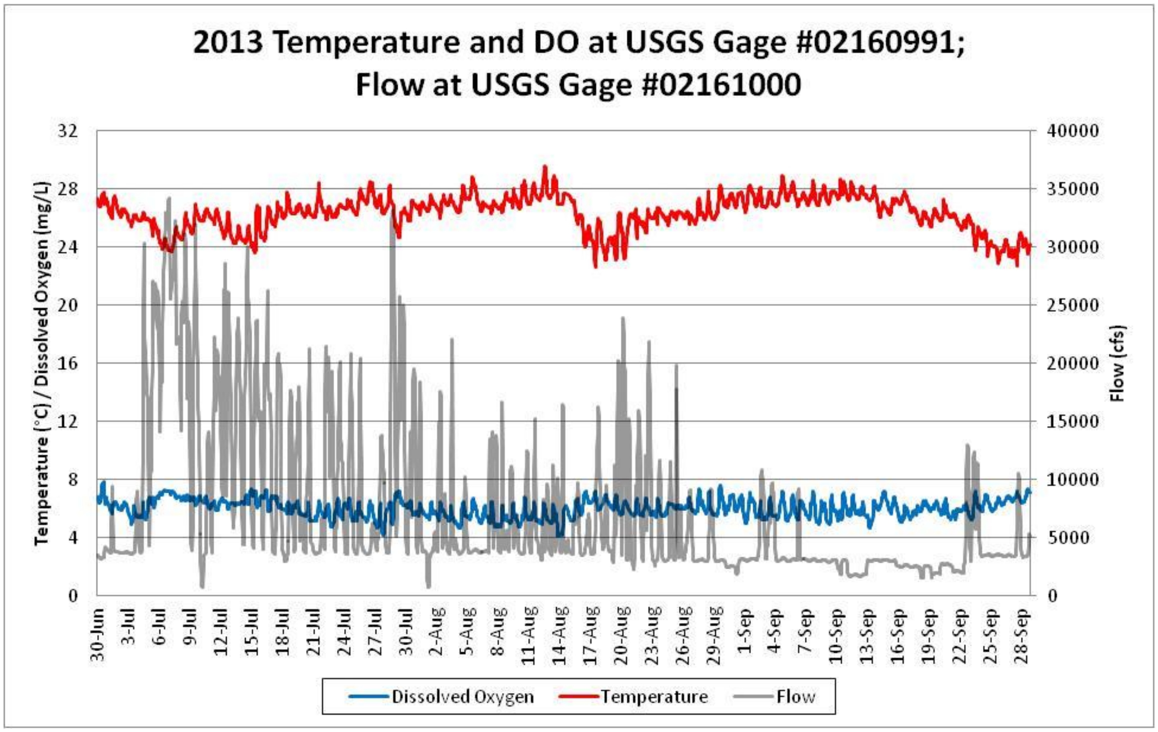


FIGURE 10 2013 TEMPERATURE AND DISSOLVED OXYGEN AT USGS 02160991; AND FLOW AT USGS 02161000



Review of the data verified that there are periodic excursions of DO levels less than 4.0 mg/l. These events are not consistent from year to year and do not typically have a long duration. We have presented representative excerpts of the raw data in TABLE 1 through TABLE 4 to demonstrate the month, flow, temperature, time of day, and DO level experienced.

TABLE 1 JULY 19-20, 2010: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/19/2010	9:00 pm	4.3	29.5	900.7
7/19/2010	10:00 pm	4.0	29.4	900.7
7/19/2010	11:00 pm	3.7	29.4	900.7
7/20/2010	12:00 am	3.9	29.3	900.7
7/20/2010	1:00 am	3.8	29.3	900.7
7/20/2010	2:00 am	3.8	29.2	888.0
7/20/2010	3:00 am	3.7	29.2	875.3
7/20/2010	4:00 am	3.6	29.1	862.7
7/20/2010	5:00 am	3.3	29.1	862.7
7/20/2010	6:00 am	3.7	29.0	837.7
7/20/2010	7:00 am	4.0	29.1	837.7
7/20/2010	8:00 am	4.5	29.2	825.3

TABLE 2 JULY 13, 2011: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/13/2011	5:00 am	4.6	29.7	1474.9
7/13/2011	6:00 am	3.9	29.3	1369.9
7/13/2011	7:00 am	3.8	29.3	939.3
7/13/2011	8:00 am	4.1	29.5	812.9

TABLE 3 JULY 24, 2012: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/24/2012	6:00 am	4.2	29.6	2107.6
7/24/2012	7:00 am	3.9	29.6	1789.4
7/24/2012	8:00 am	3.6	29.5	1536.0
7/24/2012	9:00 am	3.9	29.7	1459.7
7/24/2012	10:00 am	4.3	30.1	1429.5
7/24/2012	11:00 am	4.3	30.1	1429.5
7/24/2012	12:00 pm	4.4	30.2	1444.6
7/24/2012	1:00 pm	4.4	30.3	1444.6
7/24/2012	2:00 pm	4.7	30.6	1399.6
7/24/2012	3:00 pm	5.6	30.9	1444.6
7/24/2012	4:00 pm	5.7	31.0	1954.6
7/24/2012	5:00 pm	5.5	30.9	2124.8
7/24/2012	6:00 pm	4.8	30.8	1971.4
7/24/2012	7:00 pm	3.5	30.1	1154.4
7/24/2012	8:00 pm	3.4	29.9	875.3
7/24/2012	9:00 pm	3.6	29.9	1520.7
7/24/2012	10:00 pm	3.6	29.9	1676.9
7/24/2012	11:00 pm	4.1	29.9	1724.8

TABLE 4 JULY 27, 2012: DO EXCURSION

Date	Time	DO (mg/L)	Temperature (°C)	Flow (cfs)
7/27/2012	6:00 am	4.2	30.0	1490.1
7/27/2012	7:00 am	3.7	29.9	1196.5
7/27/2012	8:00 am	3.8	30.0	900.7
7/27/2012	9:00 am	4.3	30.0	837.7

Our review of this data lead us to the conclusion that the low DO levels frequently occur during the early morning hours when DO levels often begin to decline (diel fluctuation) and flows begin to decline. Based on this observation we reviewed the location of the USGS monitor which is located along the bank in a back eddy just downstream of the Parr Shoals Dam. We also asked the USGS to provide any information they had on the type of monitoring equipment used and how it had changed over time. The following is a consolidation of email excerpts that we received from Michael Hall of the USGS:

> The current DO probe that the USGS uses at the Parr Dam monitoring site is a YSI 6150 ROX, which is an optical DO probe with a self cleaning wiper system. Looking back over the last year and a half, there have been no corrections needed to the sensor data for fouling or calibration drift. The sensors and sonde are cleaned at least monthly, but sometimes more often in the summer months if needed. The DO membrane itself rarely has any visible fouling because of the wiper system. Calibration is checked monthly and readings are also verified at each visit with a separate calibrated field meter. YSI states that the accuracy of the ROX DO is +/- 0.1 mg/L or 1% of reading, whichever is greater. The USGS applies corrections to the data if the combined fouling and drift differences exceed +/- 0.3 mg/L.
>
> [USGS hasn't] noticed any issues with the quality of the readings and can't ever recall the water being stagnant where the sonde housing is placed. The flow at the sonde is mostly negative due to a swirling motion, but any debris or other trash that is floating in the pool gets "flushed" fairly quickly, so I would assume the water is constantly being refreshed. If you would like, we can arrange to be on site during different unit releases to better determine if there is a stagnant issue.
>
> Prior to the ROX sensor [installation – June 2011], [USGS] used a YSI 5739 and YSI Rapid Pulse DO Probes. All three sensors have the same accuracy according to YSI. [USGS doesn't] have the exact dates that the ROX was installed, but [they] believe it was in the 2011 water year. The frequency of cleaning for the older probes was 2 to 4 weeks depending on season and flow events. Those probes didn't self clean, so during the summer months they usually needed more attention"

It is our suspicion that some, if not all, of these low DO events are related to low flows in the tailrace and backflow or stagnant flows at the USGS monitor. To test this theory, we have planned to collect additional data in the tailrace during July and August of 2014 and compare it with USGS data collected at the same time. We will focus on these warmer summer months when flows are lower and more likely for us to observe any deviations.

DO readings will be collected along a transect starting at the furthest turbine discharge on the west end of the Parr Shoals powerhouse and proceed to the east towards the USGS monitor using a Hydrolab Surveyor 4a with a Hydrolab MS 5 sonde or similar equipment. DO readings will be collected at the mid-depth of the water column from a maximum of 10 sample locations along the transect. Collections will be performed at one hour before sunrise, at sunrise, and one hour after sunrise. Collections will also be coordinated with lower flow events – possibly scheduled for each sampling. We will perform up to eight collections during July and August of 2014 to detect any differences in the transect DO measurements and the USGS data measurements.

The transect data will be compared to the USGS data. We will use figures and tables to display the collected data and patterns in the DO level will be described based on time, flow, and distance from the USGS monitor. We will consolidate this information into a letter report to share with the TWC for review and discussion.

APPENDIX F

BASELINE FISHERIES REPORT

BASELINE FISHERIES RESOURCES REPORT

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

Prepared for:

South Carolina Electric & Gas Co.
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

November 2013

Baseline Fisheries Resources Report

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BASELINE FISHERIES RESOURCES REPORT

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS CO.

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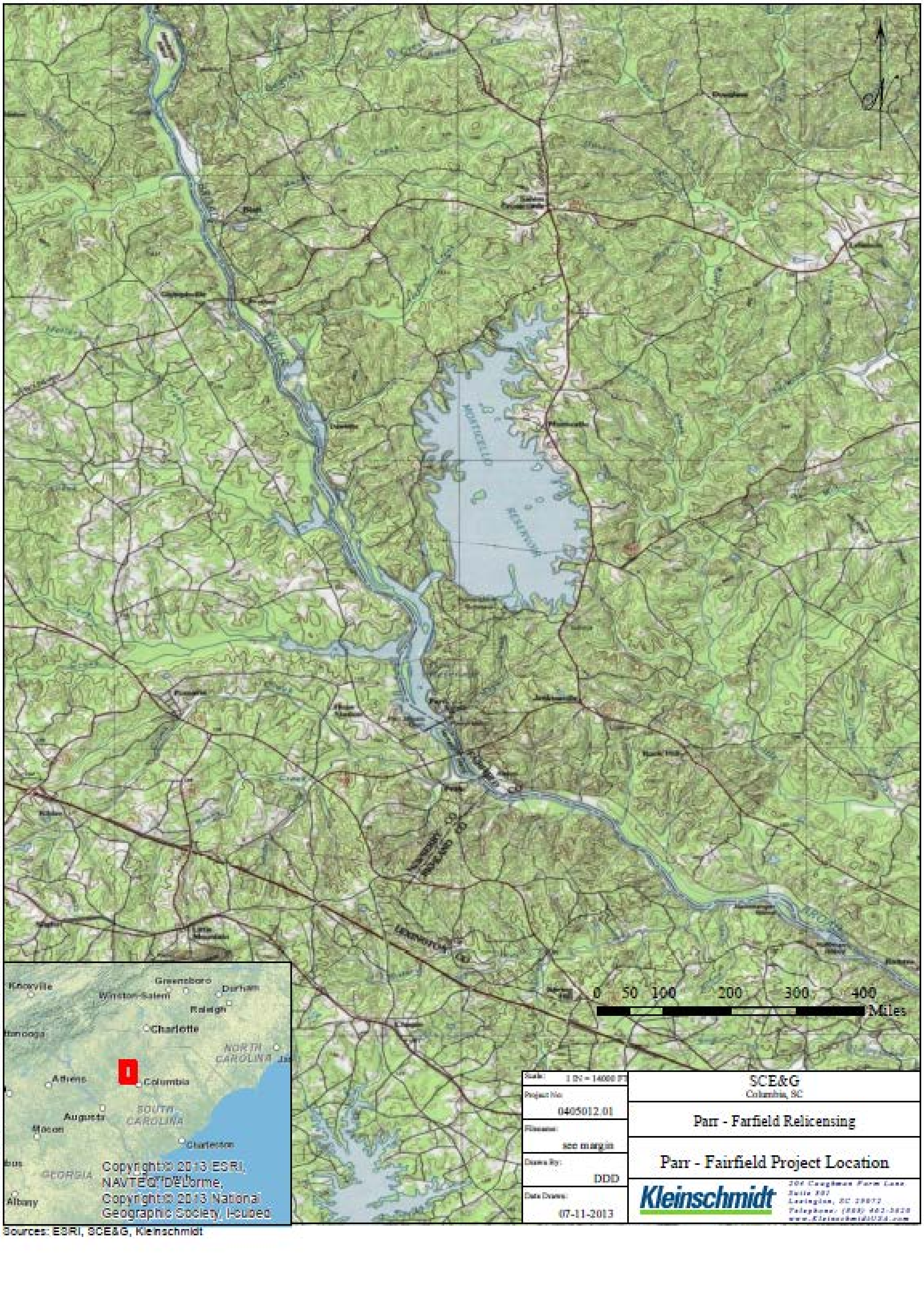
PARR HYDROELECTRIC PROJECT
FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS CO.

1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project (FERC No. 1894) ("Parr Fairfield Project" or "Project"), owned and operated by the South Carolina Electric & Gas Company ("SCE&G" or "Licensee"), is currently licensed by the Federal Energy Regulatory Commission ("FERC" or "the Commission") through June 2020. The Project consists of the 14.9 megawatt (MW) Parr Hydro Development and the 511.2 MW Fairfield Pumped Storage Facility Development. These Developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina, approximately 31 river miles downstream of Neal Shoals and 24 river miles upstream of Columbia Diversion Dam (Figure 1).

During preliminary relicensing discussions that began in the fall of 2012, the South Carolina Department of Natural Resources (SCDNR), U.S. Fish and Wildlife Service (USFWS), NOAA National Marine Fisheries Service (NMFS), American Rivers and other stakeholders indicated a need for information characterizing the fisheries resources of the Project. The purpose of this request was to provide a baseline for assessing potential impacts of the relicensing and continued operation of the Project. This baseline fisheries report was subsequently prepared utilizing existing fisheries data available for the waters associated with the Parr Fairfield Project including Parr Reservoir, Lake Monticello, and the Lower Broad River, located below the Parr Shoals Dam.



Path: G:_Client_Data\SCE&G\Parr Fairfield_MXD\Project Boundary.mxd

Sources: ESRI, SCE&G, Kleinschmidt

FIGURE 1 LOCATION MAP FOR THE PARR FAIRFIELD HYDROELECTRIC PROJECT

2.0 GOALS AND OBJECTIVES

The goal of this report is to describe the fisheries communities occurring in Parr Reservoir, Lake Monticello, and the reach of the Broad River downstream of the Parr Shoals Dam in order to provide a baseline for assessing potential effects of relicensing and continued operations at the Project.

3.0 EXISTING FISHERY DATA

The Broad River basin supports a diverse fish community representative of Piedmont rivers in South Carolina. A recent basin-wide inventory documenting 51 species from nine families, with Cyprinidae contributing the most species (14), followed by Centrarchidae (10 species) and Catostomidae (10 species) (Bettinger et al. 2003). The Broad River also supports a smallmouth bass (*Micropterus dolomieu*) fishery unique among Piedmont rivers in South Carolina. Smallmouth bass were first introduced to the Broad River in South Carolina by SCDNR in 1984 to enhance sportfishing opportunities (Bettinger et al. 2003); however, stocking has recently been curtailed due to significant natural reproduction (Hal Beard, SCDNR, Personal Communication). Smallmouth growth rates in the Broad River are comparable to other Piedmont systems in the Southeast (Bettinger et al. 2003).

Recent and relevant data describing the fisheries community of the Project vicinity comes primarily from two sources. Specifically, data for Parr and Monticello Reservoirs (areas upstream of Parr Dam) are primarily from surveys conducted by SCANA Corporate Environmental Services and its contractors in support of licensing and compliance activities for the V.C. Summer Nuclear Station (Normandeau 2007, 2008 & 2009; SCANA, 2013). Conversely, data from the reach of the Broad River downstream of the Parr Dam are primarily from an ongoing fish community study being conducted by SCDNR Region 3 Freshwater Fisheries staff (Ron Ahle, SCDNR, unpublished data). These data are discussed in greater detail below.

3.1 RESERVOIR FISHERIES

Available data suggest that the Parr and Monticello reservoirs support warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent survey work by SCANA Corporate Environmental Services and their contractors has documented 30 species of fish occurring in Parr Reservoir and 24 in Lake Monticello (Table 1). Although some seasonal variations in community structure have been documented, the fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch often being the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). Additional detail regarding the community structure for each of the reservoirs is provided below and detailed relative abundance and catch per unit effort (CPUE) data for the above referenced studies are included in Appendix A.

TABLE 1 FISH SPECIES DOCUMENTED AT PARR AND MONTICELLO RESERVOIRS (SOURCE: NORMANDEAU 2007, 2008, 2009; SCANA 2013)

COMMON NAME	SCIENTIFIC NAME	PARR	MONTICELLO
Black crappie	*Pomoxis nigromaculatus*	x	x
Blue catfish	*Ictalurus furcatus*	x	x
Bluegill	*Lepomis macrochirus*	x	x
Channel catfish	*Ictalurus punctatus*	x	x
Flat bullhead	*Ameiurus platycephalus*	x	x
Flathead catfish	*Pylodictis olivaris*	x	
Gizzard shad	*Dorosoma cepedianum*	x	x
Golden shiner	*Notemigonus chrysoleucas*	x	x
Highfin carpsucker	*Carpiodes velifer*	x	
Largemouth bass	*Micropterus salmoides*	x	x
Longnose gar	*Lepisosteus osseus*	x	
Northern hogsucker	*Hypentelium nigricans*	x	x
Notchlip redhorse	*Moxostoma collapsum*	x	x
Pumpkinseed	*Lepomis gibbosus*	x	x
Quillback	*Carpiodes cyprinus*	x	x
Redbreast sunfish	*Lepomis auritus*	x	x
Redear sunfish	*Lepomis microlophus*	x	x
Robust Redhorse	*Moxostoma robustum*	x	
Sandbar shiner	*Notropis scepticus*	x	
Shorthead redhorse	*Moxostoma macrolepidotum*	x	x
Smallmouth bass	*Micropterus dolomieu*	x	x
Snail bullhead	*Ameiurus brunneus*		x
Spottail shiner	*Notropis hudsonius*	x	x
Threadfin shad	*Dorosoma petenense*	x	x
Warmouth	*Lepomis gulosus*	x	
White bass	*Morone chrysops*	x	
White catfish	*Ameiurus catus*	x	x
White perch	*Morone americana*	x	x
Whitefin shiner	*Cyprinella nivea*	x	x
Yellow bullhead	*Amierus natalis*	x	x
Yellow perch	*Perca flavescens*	x	x

3.1.1 Parr Reservoir

SCE&G commissioned Normandeau Associates to conduct surveys of Parr Reservoir fish community in the fall of 2006 and spring of 2007. Fish were collected at three locations in the lower reservoir. Three gear types (electrofishing, gill nets, hoop nets) were employed, but all (476) fish were collected by electrofishing and gill netting (Normandeau 2007). Four groups dominated collections: Ictaluridae (33.8 % of total; 3 species), Moronidae (24.8 %; one species), Centrarchidae (17.6 %; 6 species), and Clupeidae (12.6%; one species) (Figure 2). Seventeen fish species, all relatively common Piedmont species, were collected. Channel catfish (26.1% of the total), white perch (24.8% of the total), gizzard shad (12.6% of the total), largemouth bass (7.8% of the total), blue catfish (7.1% of the total), and bluegill (7.1% of the total) were the species most often collected.

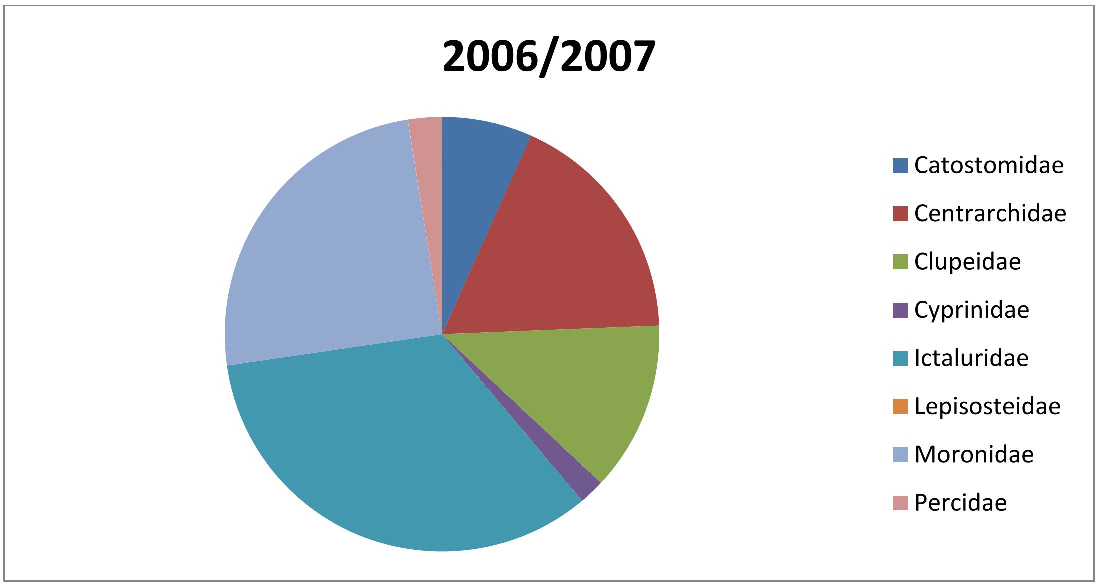


Figure 2 Relative Abundance by Family of Fish Collected in Parr Reservoir, Fall 2006 and Spring 2007

Normandeau collected additional samples at the same three locations in July 2008 and February 2009 using electrofishing gear and gill nets (Normandeau 2008, 2009). Hoop nets, which were ineffective collecting fish in 2006-2007, were not used in 2008. Collections in July 2008 were dominated by gizzard shad (52.4 % of total), accounting for the dominance of Clupeids in the sample (Figure 3). Substantial numbers of bluegill (14.3 %), white perch (7.6 %), largemouth bass (6.1 %), blue catfish (4.3 %), and channel catfish (3.7 %) were also collected (Normandeau

2008). February 2009 collections were dominated by Centrarchids, which accounted for almost 50% of the catch, followed by Ictalurids, Cyprinids and Clupeids (Figure 4). From a species perspective, bluegill (33.6%), largemouth bass (9.2%), spottail shiner (9.2%), channel catfish (9.2%) and blue catfish (8.4%) were dominant (Normandeau 2009). The numerical dominance of gizzard shad in July 2008 samples reflects the fact that large numbers of small (50-100 mm TL) gizzard shad were present. Gizzard shad young-of-the-year grow rapidly, but are heavily preyed upon by a variety of predatory fish species including largemouth bass, crappies, and catfishes (Michaletz 1997). Thus, large numbers of young shad are typically present in summer (most spawning occurs in April and May), but numbers tend to decline in fall and winter as predation takes its toll. Gizzard shad are also prone to sudden die-offs in late summer (Mettee et al. 1996).

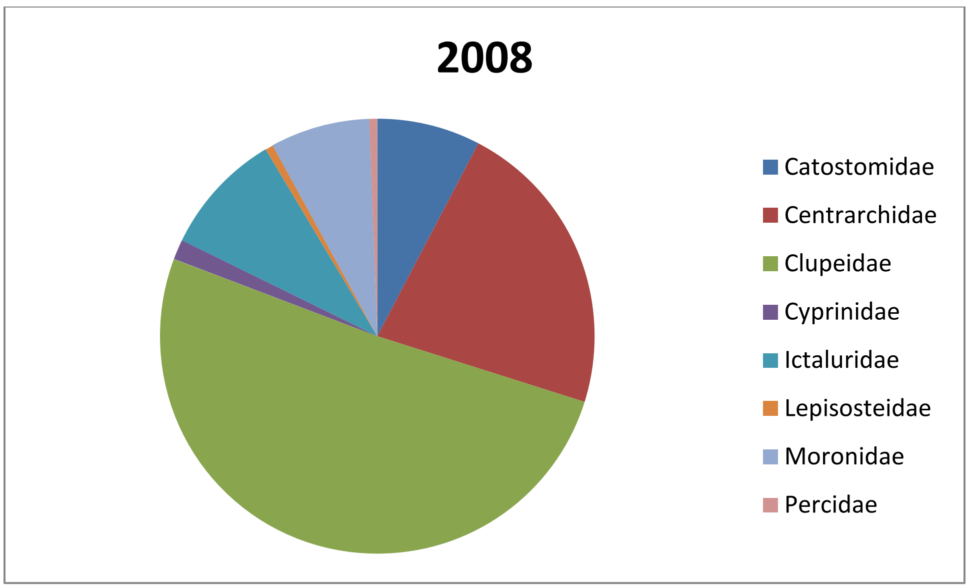


FIGURE 3 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN PARR RESERVOIR, SUMMER 2008

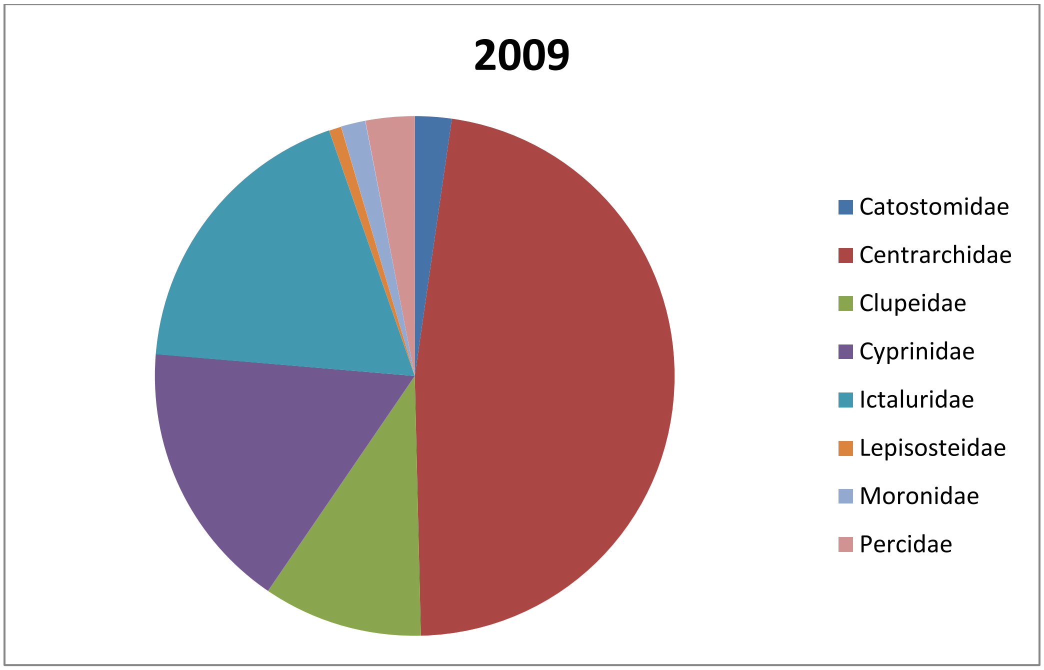


FIGURE 4 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN PARR RESERVOIR, WINTER 2009

Additional gillnet and boat electrofishing was conducted during the spring and fall of 2012 by personnel from SCANA Corporate Environmental Services, yielding 20 species (SCANA 2013). Results were very similar to those obtained by Normandeau during the spring of 2006 and fall of 2007 and were dominated by Ictalurids, Morones, Centrarchids and Clupeids (Figure 5). From a species perspective, channel catfish (24.5%), white perch (18.9%), gizzard shad (13.2%), bluegill (12.6%) and blue catfish (10.1%) accounted for 79% of the catch. Only blue catfish, bluegill and channel catfish appeared in both spring and fall samples, supporting the Normandeau assertion of significant seasonal variation among species such as white perch and gizzard shad.

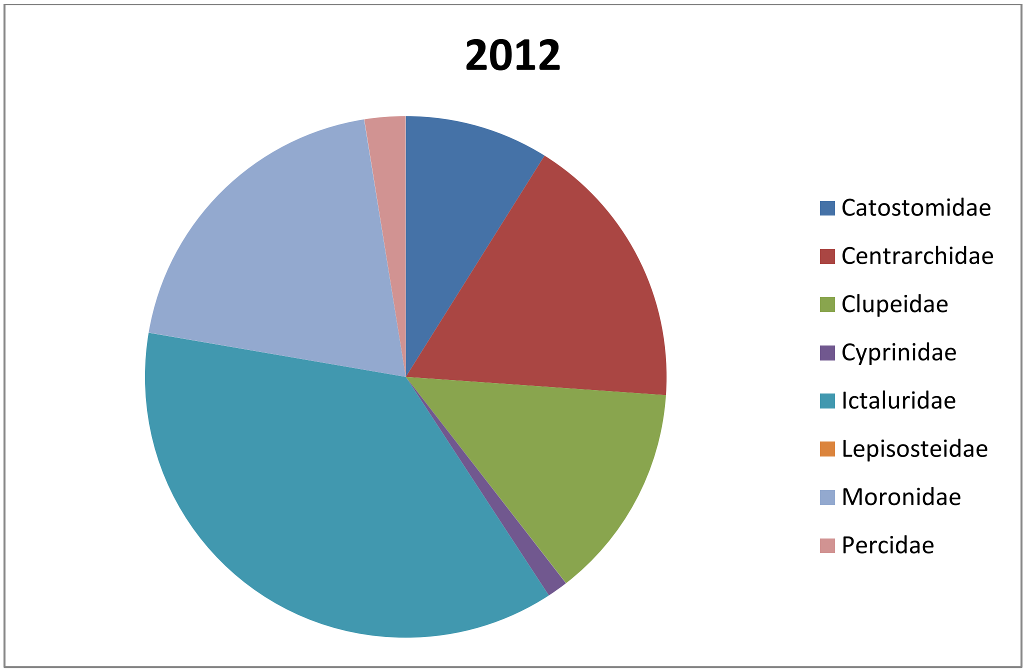


FIGURE 5 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN PARR RESERVOIR, SPRING AND FALL 2012

It should be noted that two robust redhorse (*Moxostoma robustum*) have been documented from Parr Reservoir, one during the July 2008 Normandeau sampling and a second in the fall of 2012 by SCANA staff (Normandeau 2009, SCANA 2013). The robust redhorse is a large, long-lived member of the redhorse sucker family. In 1995, a Robust Redhorse Conservation Committee (RRCC) was created to improve the status of the species throughout its former range. The RRCC is a cooperative, voluntary partnership formed under a Memorandum of Understanding (MOU) between state and federal resource agencies, private industry, and the conservation community. From 2004 through 2012, the SCDNR has stocked a total of 25,316 fingerling robust redhorse suckers in the Broad River above the Parr Hydroelectric Facility. Through 2012, a total of seven robust redhorse suckers have been captured in the Broad River drainage above the Parr Hydroelectric Facility by various state and private entities (SCANA 2013).

3.1.2 MONTICELLO RESERVOIR

Sampling of Monticello Reservoir by Normandeau in the fall of 2006 and spring of 2007 yielded results similar to those of Parr Reservoir for the same time period, with the fish community dominated by Centrarchids (48.8 %), Clupeids (19.6 %) and Ictalurids (17.3 %) (Figure 6).

Bluegill (32.6%), gizzard shad (19.6%), blue catfish (11.0%), white perch (9.5%) and largemouth bass (8.7%) were the species most often collected (Normandeau 2007).

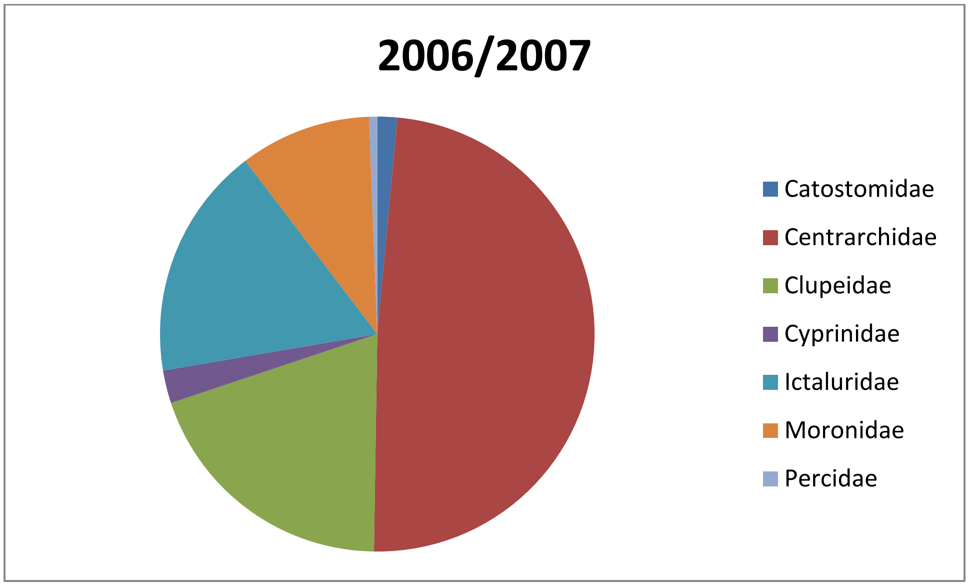


FIGURE 6 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN MONTICELLO RESERVOIR, FALL 2006 AND SPRING 2007

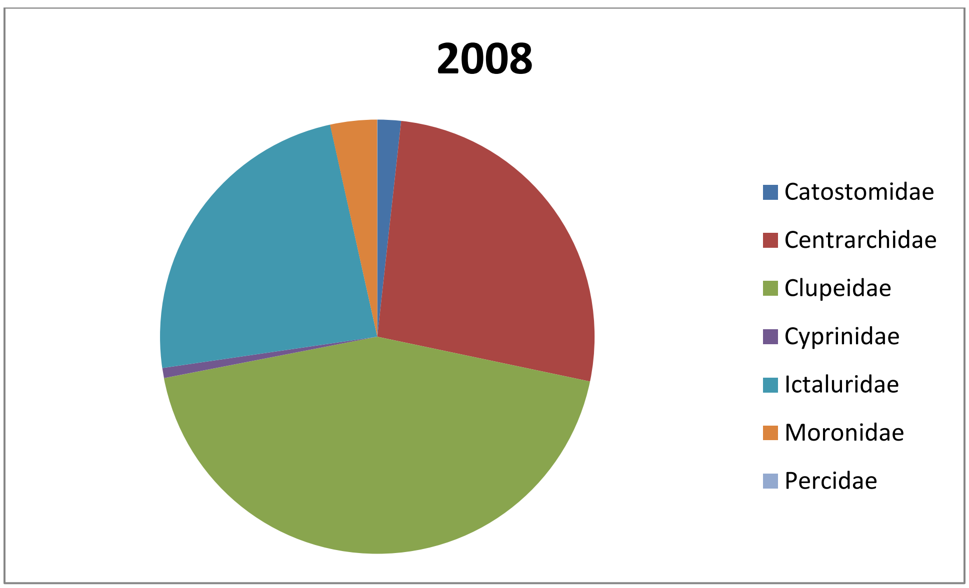


FIGURE 7 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN MONTICELLO RESERVOIR, SUMMER 2008

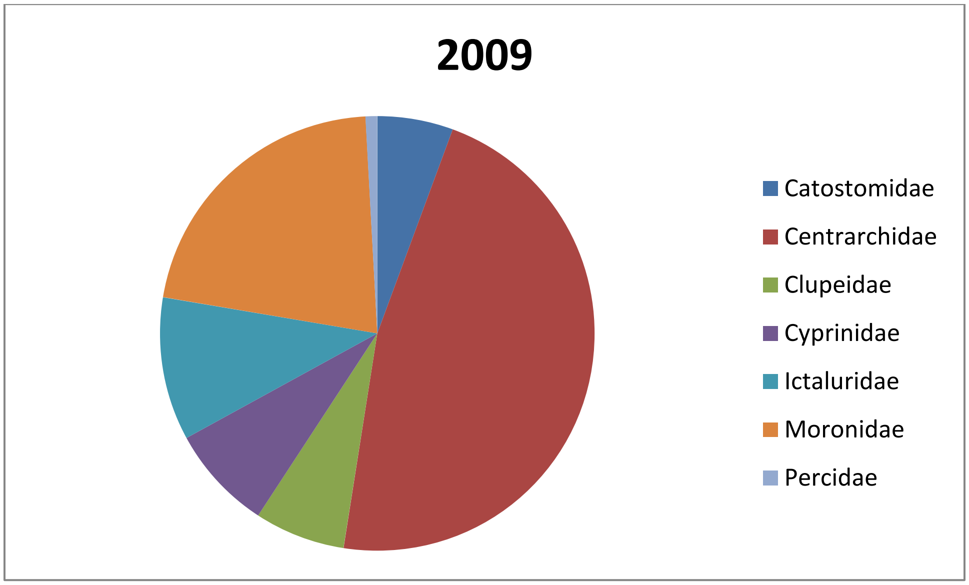


FIGURE 8 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN MONTICELLO RESERVOIR, WINTER 2009

Additional sampling of Monticello Reservoir fish was conducted in July 2008 to obtain information on possible seasonal differences in the reservoir's fish populations. Clupeids, Centrarchids and Ictalurids dominated the sample (Figure 7), with three species—gizzard shad (42.2 %), bluegill (23.2 %), and blue catfish (20 %)—accounting for more than 85 % of all fish captured. Smaller numbers of white perch (3.6 %), channel catfish (2.6 %), largemouth bass (1.4 %), and white catfish (1.4 %) were also collected. As previously noted, the same species dominated samples in 2006-2007, only bluegill ranked first in abundance and gizzard shad second. Relatively high numbers of gizzard shad in Parr and Monticello Reservoir collections in July 2008 reflect the fact that large numbers of small (50-100 mm TL) gizzard shad were present. Gizzard shad young-of-the-year grow rapidly, but are subject to high rates of mortality. Thus, it is understandable that large numbers of young are present in summer, but these numbers decline in fall and winter. This is corroborated by sampling conducted during February 2009 (Figure 8), which was dominated by bluegill (33.4%), white perch (21.5%), and largemouth bass (7.6%), with gizzard shad only accounting for 6.7 % of the catch (Normandeau 2009).

Although somewhat less productive than other older reservoirs in the region, Monticello Reservoir continues to provide fishermen in the South Carolina Midlands and Upstate with a variety of fishing opportunities. Roving creel surveys in 1997–1998 and 1998–1999, that included interviews of selected anglers, revealed that roughly half (51% in 1997–98, 42% in

1998–99) of all fishing effort in Monticello Reservoir was directed at catfish (Christie and Stroud 1999). Less effort was expended fishing for black crappie (15% in 1997–98, 5% in 1998–99), largemouth bass (12% in 1997–98, 10% in 1998–99), and other species (bluegill, carp, white bass, white perch). The creel surveys indicated that fishing effort (number of hours fished per annum) had increased substantially since the late 1980s. They also showed that fishing pressure (hours fished per acre) was lower on Monticello Reservoir than on other reservoirs in the region (Christie and Stroud 1999).

3.2 BROAD RIVER DOWNSTREAM OF PARR DAM

An ongoing fish community study being conducted by SCDNR Region 3 fisheries staff provides significant data describing the fish community in the Lower Broad River downstream of the Parr Shoals dam. This study has sampled the Lower Broad River fish community since 2009. For the purposes of this review, data from three sample reaches between the Parr Shoals dam and the impoundment of the downstream Columbia Hydroelectric Project will be reported (Figure 9). Study reach one (1) extents from the Project dam to the Palmetto Trail trestle crossing and is delineated into two sub-reaches: the Project tailrace (delineated as 1t on Table 2) and the "bypass" reach located on the western side of the island immediately below the dam (delineated as 1b on Table 2). The next downstream reach extends from the Palmetto Trail trestle crossing to the downstream terminus of Huffman Island and is delineated as reach 2a on Figure 9. The lowermost reach (2b on Figure 9) extends from the downstream terminus of Huffman Island to the downstream terminus of Boatright Island.

Data from the study suggests significantly higher diversity in the downstream riverine reaches, as compared to the two upstream reservoirs (54 species compared to 24-30 in the Parr and Monticello reservoirs) (Table 2). As expected, diversity appears to increase with increased distance from the dam, although redbreast sunfish, whitefin shiner, bluegill and snail bullhead generally dominate from a relative abundance standpoint at all sites (Table 2). Reach 1b, the "bypass" reach, displays the lowest diversity (13 species) and is dominated by Cetrarchids, with bluegill and redbreast sunfish accounting for more than 85% of the total catch in the reach (Figure 10, Table 2). Conversely, the project tailrace (Reach 1t) supports a much greater diversity of fishes, most notably an abundance of riverine suckers (Catostomidae) (Figure 11). The downstream sites (reaches 2a and 2b) support similar fish communities with Centrarchids, Cyprinids, Ictalurids and Percids (*Etheostoma* spp. and *Percina* spp.) being well represented (Table 2, Figure 12, Figure 13).

Finally, it is noteworthy that robust redhorse have been detected in the Project tailrace (Reach 1t) and consultation with SCDNR suggests that significant spawning habitat may exist in the reach (Ron Ahle, SCDNR, Personal Communication).

Bettinger et al. (2003) also sampled a site downstream of the Parr Shoals Dam (just below Bookman Island) as part of a basin-wide aquatic resource inventory. Results from this effort were generally similar to those of the current SCDNR effort, with a total of 34 species documented. Boat electrofishing samples were dominated by redbreast sunfish, redear sunfish, whitefin shiner and sandbar shiner, while redbreast sunfish, margined madtom, Piedmont darter, whitefin shiner and seagreen darter dominated backpack electrofishing samples (Table 3).

3.2.1 DIADROMOUS FISH

American shad (*Alosa sapidissima*), an anadromous species, were collected at the downstream sampling sites, as well as in the Project tailrace (Reach 1t) (Table 2). The source of these fish is likely a combination of recent stocking efforts by the SCDNR and passage at the Columbia Fishway. The Columbia Fishway was constructed in 2006 at the Columbia Hydroelectric Project (FERC No. 1895), located on the Lower Broad River approximately 23 miles downstream of the Parr Shoals Dam. The fishway was designed to provide safe, timely and effective upstream passage for anadromous American shad and blueback herring (*Alosa aestivalis*) to historical spawning and maturation habitats upstream of the Columbia Diversion Dam, including areas of the Lower Broad River downstream of the Parr Shoals Dam. The most recent monitoring data suggests that an estimated 1,730 American shad were passed upstream during the 2013 migration season, which is the highest estimated passage numbers observed since monitoring began in 2007 (Kleinschmidt 2013).

During review of an earlier draft of this report, TWC members requested information summarizing American shad and American eel (*Anguilla rostrata*) studies conducted on the Lower Broad River and funded by the Santee Basin Cooperative Fish Passage Accord (Accord). The Accord is a cooperative program between USFWS, SCDNR, North Carolina Wildlife Resources Commission, SCE&G and Duke Energy Carolinas aimed at restoring diadromous fish

(American shad, blueback herring, and American eels) in the Santee River Basin. Results of Accord-funded studies of American shad and American eels are summarized in Appendix B.

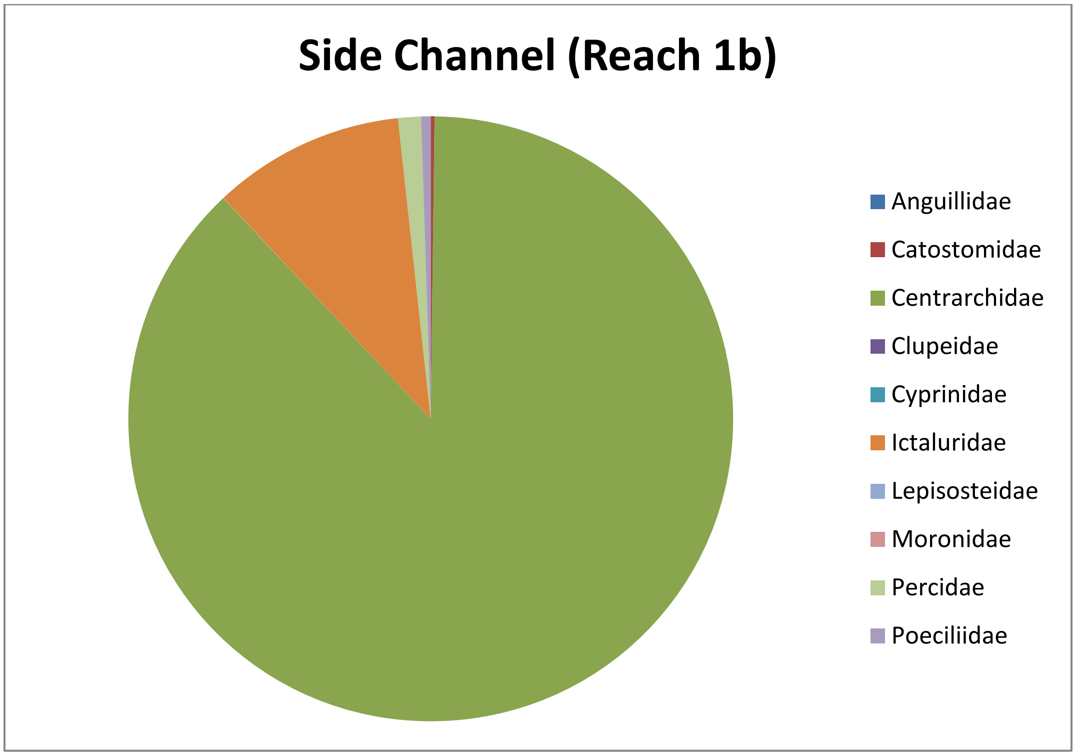


FIGURE 9 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN PARR DAM "BYPASS" REACH (SCDNR SAMPLE REACH 1B), FALL 2009 – SPRING 2013

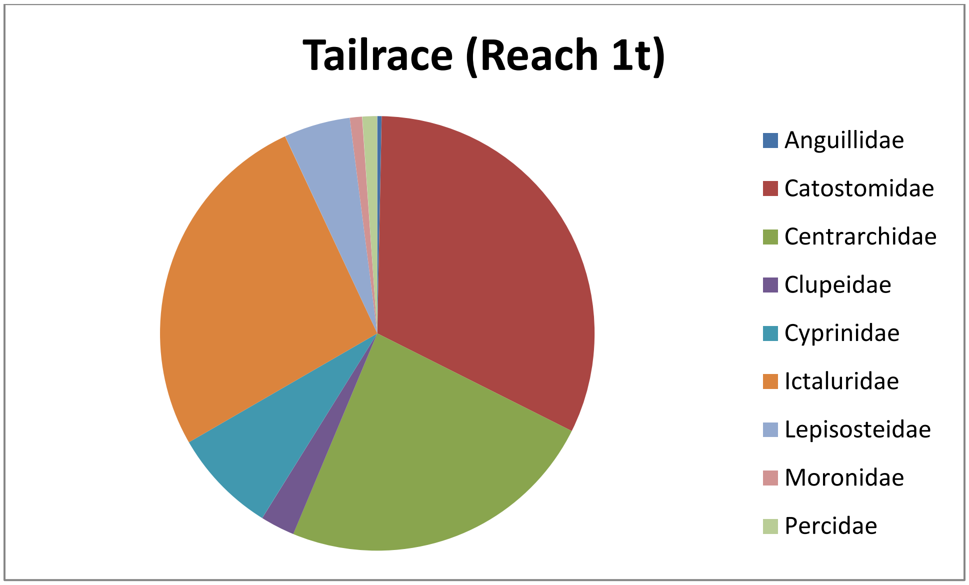


FIGURE 10 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN PARR DAM TAILRACE (SCDNR SAMPLE REACH 1T), FALL 2009 – SPRING 2013

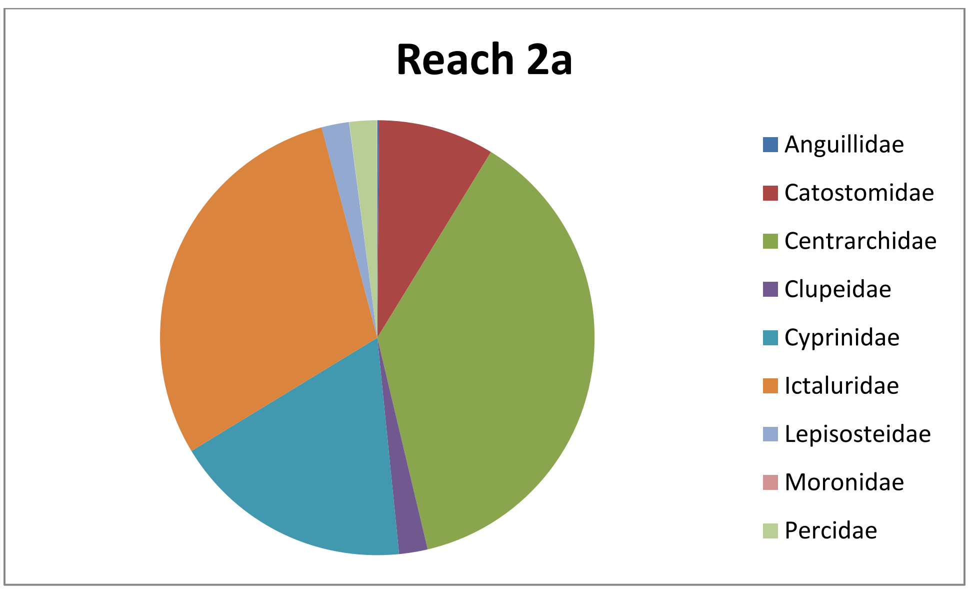


FIGURE 11 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN SCDNR SAMPLE REACH 2A, FALL 2009 – SPRING 2013

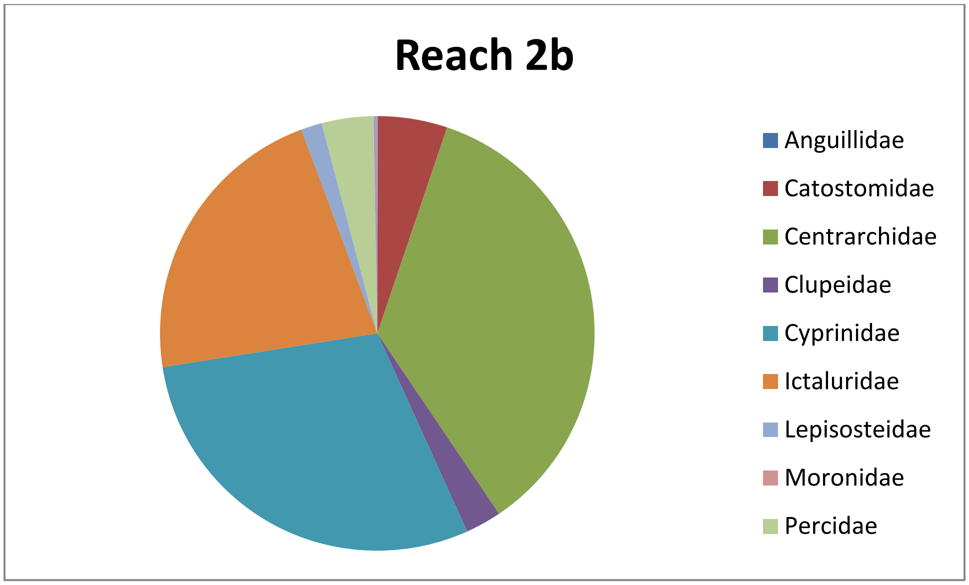


FIGURE 12 RELATIVE ABUNDANCE BY FAMILY OF FISH COLLECTED IN SCDNR SAMPLE REACH 2B, FALL 2009 – SPRING 2013

TABLE 2 PRELIMINARY RESULTS FROM THE LOWER BROAD RIVER FISH COMMUNITY STUDY, FALL 2009 THROUGH SPRING 2013

		TOTAL		PARR BYPASS		PARR TAILRACE		UPPER NATURAL		LOWER NATURAL	
COMMON NAME	SCIENTIFIC NAME	N	RELATIVE ABUNDANCE (RA)	1B	RA	1T	RA	2A	RA	2B	RA
redbreast sunfish	*Lepomis auritus*	5455	30.21%	595	60.59%	505	15.99%	1090	28.65%	1701	28.75%
snail bullhead	*Ameiurus brunneus*	2884	15.97%	81	8.25%	604	19.13%	830	21.81%	1026	17.34%
whitefin shiner	*Cyprinella nivea*	1824	10.10%			134	4.24%	305	8.02%	1042	17.61%
bluegill	*Lepomis macrochirus*	1440	7.97%	253	25.76%	86	2.72%	156	4.10%	138	2.33%
brassy jumprock	*Scartomyzon sp. (1-27-06)*	774	4.29%	1	0.10%	521	16.50%	153	4.02%	90	1.52%
sandbar shiner	*Notropis scepticus*	585	3.24%			18	0.57%	236	6.20%	294	4.97%
largemouth bass	*Micropterus salmoides*	446	2.47%	3	0.31%	93	2.94%	79	2.08%	87	1.47%
margined madtom	*Noturus insignis*	415	2.30%			10	0.32%	208	5.47%	144	2.43%
spottail shiner	*Notropis hudsonius*	414	2.29%			51	1.61%	85	2.23%	181	3.06%
longnose gar	*Lepisosteus osseus*	345	1.91%			156	4.94%	78	2.05%	93	1.57%
notchlip redhorse	*Moxostoma collapsum*	315	1.74%			130	4.12%	78	2.05%	77	1.30%
shorthead redhorse	*Moxostoma macrolepidotum*	294	1.63%			236	7.47%	33	0.87%	16	0.27%
piedmont darter	*Percina crassa*	285	1.58%	3	0.31%	21	0.66%	46	1.21%	180	3.04%
redear sunfish	*Lepomis microlophus*	275	1.52%	9	0.92%	55	1.74%	54	1.42%	47	0.79%
flat bullhead	*Ameiurus platycephalus*	212	1.17%	17	1.73%	19	0.60%	66	1.73%	86	1.45%
channel catfish	*Ictalurus punctatus*	188	1.04%			122	3.86%	16	0.42%	28	0.47%
v-lip redhorse	*Moxostoma pappillosum*	161	0.89%			64	2.03%	41	1.08%	43	0.73%
smallmouth bass	*Micropterus dolomieu*	159	0.88%			11	0.35%	46	1.21%	78	1.32%
bluehead chub	*Nocomis leptocephalus*	145	0.80%					10	0.26%	11	0.19%
threadfin shad	*Dorosoma petenense*	140	0.78%			5	0.16%	7	0.18%	128	2.16%
coastal shiner	*Notropis petersoni*	126	0.70%			23	0.73%	17	0.45%	75	1.27%
gizzard shad	*Dorosoma cepedianum*	114	0.63%			57	1.80%	44	1.16%	5	0.08%
american shad	*Alosa sapidissima*	109	0.60%			19	0.60%	30	0.79%	25	0.42%
northern hogsucker	*Hypentelium nigricans*	102	0.56%			27	0.85%	15	0.39%	50	0.85%
greenfin shiner	*Cyprinella chloristia*	85	0.47%			2	0.06%	18	0.47%	38	0.64%
blue catfish	*Ictalurus furcatus*	67	0.37%			65	2.06%	2	0.05%		
seagreen darter	*Etheostoma thalassinum*	55	0.30%			10	0.32%	31	0.81%	12	0.20%

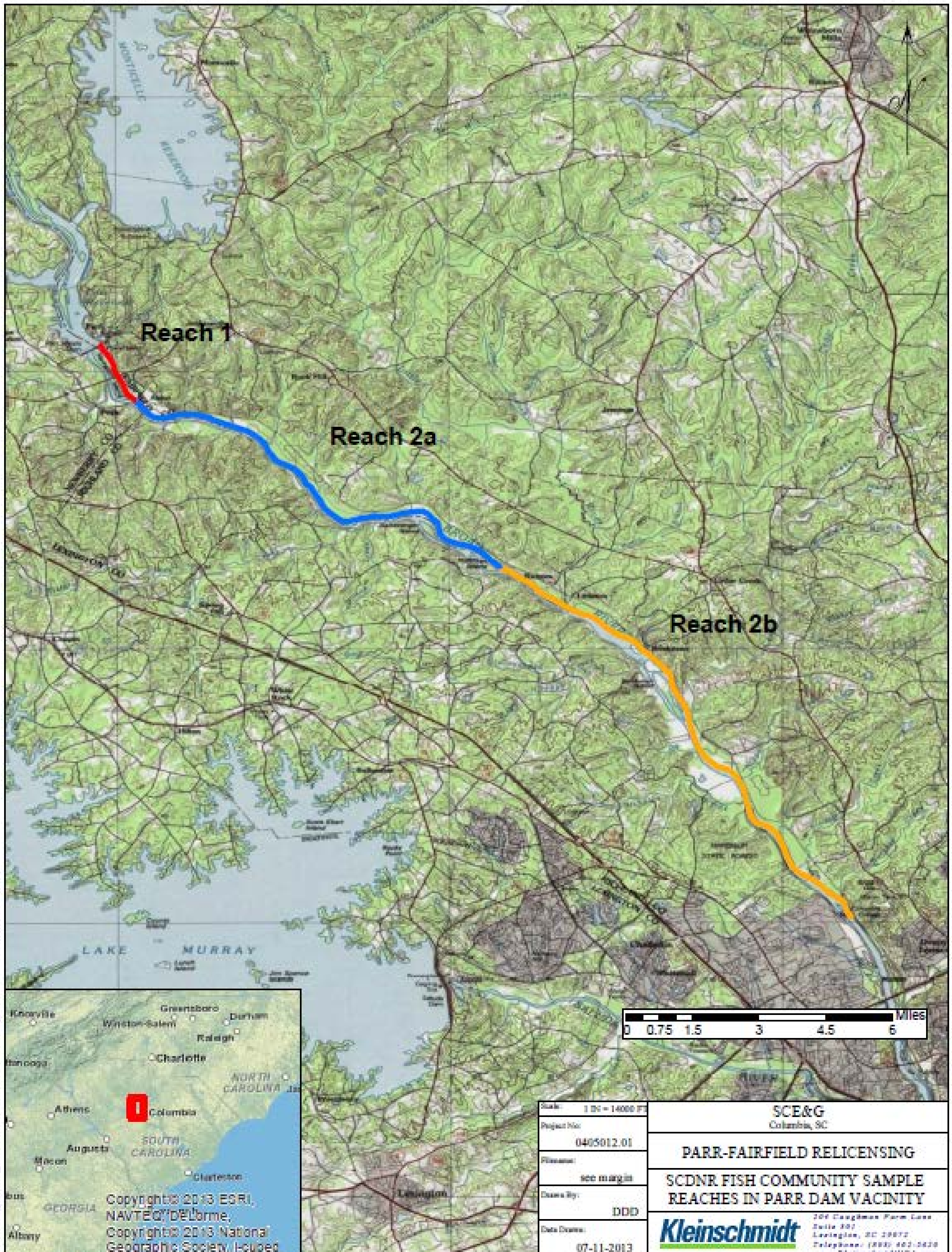
		Total		Parr Bypass		Parr Tailrace		Upper Natural		Lower Natural	
Common Name	**Scientific Name**	**n**	**Relative abundance (RA)**	**1b**	**RA**	**1t**	**RA**	2a	**RA**	**2b**	**RA**
thicklip chub	*Cyprinella labrosa*	51	0.28%							49	0.83%
tessellated darter	*Etheostoma olmstedi*	51	0.28%	9	0.92%	3	0.09%	1	0.03%	34	0.57%
highback chub	*Hybopsis hypsinotus*	46	0.25%					4	0.11%	42	0.71%
mosquitofish	*Gambusia affinis*	43	0.24%	5	0.51%			1	0.03%	17	0.29%
green sunfish	*Lepomis cyanellus*	36	0.20%							33	0.56%
warmouth	*Lepomis gulosus*	32	0.18%	2	0.20%	2	0.06%			4	0.07%
spotted sucker	*Minytrema melanops*	29	0.16%	1	0.10%			1	0.03%	12	0.20%
quillback	*Carpiodes cyprinus*	26	0.14%			22	0.70%			4	0.07%
white perch	*Morone americana*	26	0.14%			26	0.82%				
white catfish	*Ameiurus catus*	19	0.11%	3	0.31%	12	0.38%				
robust redhorse	*Moxostoma robustum ##*	18	0.10%			14	0.44%	4	0.11%		
American eel	*Anguilla rostrata*	17	0.09%			10	0.32%	5	0.13%	2	0.03%
striped jumprock	*Moxostoma rupiscartes*	17	0.09%					2	0.05%	13	0.22%
black crappie	*Pomoxis nigromaculatus*	14	0.08%			3	0.09%	3	0.08%	4	0.07%
swallowtail shiner	*Notropis procne*	14	0.08%			14	0.44%				
carp	*Cyprinus carpio*	11	0.06%			4	0.13%	4	0.11%		
flathead catfish	*Pylodictis olivaris*	9	0.05%			1	0.03%	1	0.03%	5	0.08%
blackbanded darter	*Percina nigrofasciata*	3	0.02%							1	0.02%
grass carp	*Ctenopharyngodon idella*	2	0.01%					2	0.05%		
striped bass	*Morone saxatilis*	2	0.01%			2	0.06%				
tadpole madtom	*Noturus gyrinus*	2	0.01%					2	0.05%		
creek chubsucker	*Erimyzon oblongus*	1	0.01%					1	0.03%		
Santee chub	*Hybopsis zanema*	1	0.01%							1	0.02%
white bass	*Morone chrysops*	1	0.01%			1	0.03%				
yellow perch	*Perca flavescens*	1	0.01%			1	0.03%				

(Source: Ron Ahle, SCDNR Freshwater Fisheries Region 3, data unpublished)

TABLE 3 RELATIVE ABUNDANCE OF FISH SPECIES COLLECTED BY BOAT AND BACKPACK ELECTROFISHING BELOW BOOKMAN ISLAND (SOURCE: BETTINGER ET AL. 2003)

SPECIES	BOAT	BACKPACK
longnose gar	0.8	
gizzard shad	0.1	
threadfin shad	0.4	
greenfin shiner	0.1	0.4
whitefin shiner	6.4	9
common carp	0.1	
eastern silvery minnow	0.1	
thicklip chub		4.3
bluehead chub		1.7
spottail shiner	0.5	0.9
yellowfin shiner	0.2	1.3
sandbar shiner	8.3	3.2
silver redhorse	4.8	
shorthead redhorse	0.1	
striped jumprock	0.2	
brassy jumprock	3.6	
snail bullhead	0.9	7.7
flat bullhead	0.6	1.0
channel catfish	0.2	0.1
margined madtom	0.2	13.6
white perch	0.3	
white bass	0.1	
flier	0.1	
redbreast sunfish	41.8	35.9
pumpkinseed	0.1	
warmouth	0.8	
bluegill	16.2	0.3
redear sunfish	7.5	
largemouth bass	4.2	0.5
black crappie	0.4	
tessellated darter	0.1	1.0
yellow perch	0.8	
seagreen darter		8.3
Piedmont darter	0.1	10.6
	100%	100%

FIGURE 13 SCDNR FISH COMMUNITY SAMPLING SITES IN THE VICINITY OF PARR SHOALS DAM



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Sources: ESRI, Kleinschmidt

4.0 SUMMARY

Parr and Monticello reservoirs support warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina, with recent work having documented 30 species in Parr Reservoir and 24 in Monticello. Although some seasonal variations occur, fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch often being the dominant species. Both reservoirs appear to support relatively high numbers of gizzard shad during the summer months (often numerically dominating the population); however, existing data suggests that these populations decline rapidly during the fall and winter, presumably due to high levels of predation and/or seasonal die-offs. No species that are state or federally listed as threatened or endangered have been documented in Monticello or Parr reservoirs, although robust redhorse, which is considered a species of highest conservation concern by the SCDNR (2005), has been documented in limited numbers in both reservoirs.

The reach of the Broad River downstream of the Parr Dam appears to support a diverse and robust fishery characteristic of large rivers in the Piedmont of South Carolina, although some influence from the Project is evident primarily in the reach extending from the dam to the Palmetto Trail trestle crossing (SCDNR Study Reach 1). The fish community within Reach 1 differs significantly between the Project tailrace (SCDNR Study Reach 1t) and the “bypass” reach located on the western side of the island immediately below the dam (SCDNR Study Reach 1b). The “bypass” reach is characterized by relatively low diversity and is dominated by sunfishes, with redbreast and bluegill account for more than 85% of the catch during recent sampling. Conversely, the tailrace channel side of Reach 1 supports a much more robust fish community and approached what would be expected in a Piedmont river. Most notably, an abundance of riverine suckers (Catostomids) have been documented in the reach, and it is thought to represent a potential spawning area for robust redhorse. Downstream of the Palmetto Trail trestle crossing, the fish communities appear to stabilize, with the two remaining SCDNR sample reaches upstream of the Columbia Hydro Impoundment (Reaches 2a and 2b) having very similar composition at the family level (See Figures 12 and 13). These reaches support a balanced community primarily consisting of Centrarchids, Cyprinids, Ictalurids and Catostomids, with redbreast sunfish, whitefin shiner, bluegill and snail bullhead as dominant species. The diverse fish community occurring in the reach provides an abundance of fish hosts for native freshwater mussels, as is evidenced by a recent survey by Alderman (2012) which found the highest freshwater mussel diversity in the Broad River Sub-basin in North and South Carolina upriver from the Columbia Diversion Dam occurring immediately downstream of Parr Shoals Dam.

No species that are state or federally listed as threatened or endangered have been documented in Monticello or Parr reservoirs or in the downstream reach of the Broad River between Parr Dam and Columbia Hydro Impoundment; however, 16 species that are considered to be priority species in the SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2005) are found in the Project area (Table 4).

TABLE 4 SOUTH CAROLINA CWCP PRIORITY SPECIES

					SCDNR DOWNSTREAM STUDY REACHES			
COMMON NAME	**SCIENTIFIC NAME**	**PRIORITY STATUS**	**PARR**	**MONTICELLO**	**1B**	**1T**	2A	**2B**
American eel	*Anguilla rostrata*	Highest				X	X	X
American shad	*Alosa sapidissima*	Highest				X	X	X
Flat bullhead	*Ameiurus platycephalus*	Moderate	X	X	X	X	X	X
Greenfin shiner	*Cyprinella chloristia*	Moderate				X	X	X
Highfin carpsucker	*Carpiodes velifer*	Highest	X					
Notchlip redhorse	*Moxostoma collapsum*	Moderate	X	X		X	X	X
Piedmont darter	*Percina crassa*	High			X	X	X	X
Quillback	*Carpiodes cyprinus*	High	X	X		X		X
Robust Redhorse	*Moxostoma robustum*	Highest	X			X	X	
Santee Chub	*Hybopsis zanema*	High						X
Seagreen darter	*Etheostoma thalassinum*	High				X	X	X
Snail bullhead	*Ameiurus brunneus*	Moderate		X	X	X	X	X
Striped bass	*Morone saxatilis*	Moderate				X		
Thicklip chub	*Cyprinella labrosa*	Moderate						X
V-lip redhorse	*Moxostoma pappillosum*	Moderate				X	X	X
White catfish	*Ameiurus catus*	Moderate	X	X	X	X		

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APPENDIX A

RELATIVE ABUNDANCE AND CPUE DATA FOR PARR AND MONTICELLO RESERVOIRS, 2007 - 2013

RELATIVE ABUNDANCE OF FISH COLLECTED ON PARR AND MONTICELLO RESERVOIRS, FALL AND SPRING 2007 (SOURCE: NORMANDEAU 2007)

Species	Monticello		Parr	
	# Individuals	Relative Abundance	# Individuals	Relative Abundance
Quillback	1	0.1	3	0.6
Northern Hogsucker	1	0.1	0	0.0
Shorthead Redhorse	10	1.2	29	8.1
Redbreast	3	0.4	0	0.0
Pumpkinseed	12	1.5	8	1.7
Warmouth	6	0.7	0	0.0
Bluegill	267	32.6	34	7.1
Redear	7	0.9	3	0.6
Smallmouth Bass	2	0.2	1	0.2
Largemouth Bass	71	8.7	37	7.8
White Perch	78	9.5	118	24.8
White Bass	2	0.2	0	0.2
Black Crappie	32	3.9	1	0.2
Gizzard Shad	161	19.6	60	12.6
Whitefin Shiner	15	1.8	2	0.4
Golden Shiner	0	0.0	5	1.1
Spottail Shiner	5	0.6	2	0.4
White Catfish	14	1.7	3	0.6
Flat Bullhead	7	0.9	0	0.0
Blue Catfish	90	11.0	34	7.1
Channel Catfish	31	3.6	124	26.1
Yellow Perch	5	0.6	12	2.5

ELECTROFISHING CPUE FOR PARR AND MONTICELLO RESERVOIRS, FALL AND SPRING 2007 (SOURCE: NORMANDEAU 2007)

Species	Monticello Reservoir		Parr Reservoir	
	Fall2006 CPUE	Spring2007 CPUE	Fall2006 CPUE	Spring2007 CPUE
Quillback	0.00	0.00	0.00	3.99
Northern Hogsucker	0.00	3.99	0.00	0.00
Shorthead Redhorse	0.00	19.96	7.98	19.96
Redbreast	7.99	4.00	0.00	0.00
Pumpkinseed	43.91	3.99	19.94	7.98
Warmouth	23.97	0.00	0.00	0.00
Bluegill	806.20	239.38	59.82	75.84
Redear	7.98	7.98	7.97	3.99
Largemouth Bass	31.92	143.74	39.90	35.93
White Perch	0.00	55.90	0.00	0.00
Black Crappie	0.00	0.00	0.00	3.99
Gizzard Shad	0.00	23.94	119.69	63.86
Whitefin Shiner	55.92	3.99	7.97	0.00
Spottail Shiner	3.99	3.99	0.00	7.98
White Catfish	0.00	51.89	0.00	0.00
Flat Bullhead	15.97	0.00	0.00	0.00
Blue Catfish	0.00	0.00	3.99	0.00
Channel Catfish	0.00	31.95	0.00	3.99
Yellow Perch	19.98	0.00	11.96	23.95

RELATIVE ABUNDANCE OF FISH COLLECTED ON PARR AND MONTICELLO RESERVOIRS, SUMMER 2008 (SOURCE: NORMANDEAU 2008)

Common Name	Parr		Monticello	
	Total	Abundance	Total	Abundance
Quillback	2	0.6	0	0
Northern Hogsucker	0	0	1	0.1
Notchlip Redhorse	2	0.6	9	1.2
Shorthead Redhorse	11	3.4	4	0.5
Robust Redhorse	1	0.3	0	0
Redbreast	0	0	3	0.4
Pumpkinseed	3	0.9	6	0.8
Bluegill	47	14.3	181	23.1
Redear	3	0.9	4	0.5
Smallmouth Bass	1	0.3	1	0.1
Largemouth Bass	20	6.1	11	1.4
White Perch	25	7.6	28	3.6
Black Crappie	1	0.3	7	0.9
Gizzard Shad	172	52.4	330	42.2
Whitefin Shiner	0	0	2	0.3
Spottail Shiner	5	1.5	4	0.5
Snail Bullhead	0	0	1	0.1
White Catfish	5	1.5	11	1.4
Yellow Bullhead	0	0	1	0.1
Flat Bullhead	0	0	2	0.3
Blue Catfish	14	4.3	156	19.9
Channel Catfish	12	3.7	20	2.6
Longnose Gar	2	0.6	0	0
Yellow Perch	2	0.6	0	0

ELECTROFISHING CPUE FOR PARR AND MONTICELLO RESERVOIRS, SUMMER 2008 (SOURCE: NORMANDEAU 2008)

Common Name	Parr	Monticello
Northern Hogsucker		3.99
Notchlip Redhorse	3.97	35.88
Shorthead Redhorse		3.99
Redbreast		5.98
Pumpkinseed	11.97	23.92
Bluegill	89.76	143.99
Redear	11.97	7.95
Smallmouth Bass	3.96	3.99
Largemouth Bass	26.44	13.27
White Perch	7.98	33.92
Gizzard Shad	333.05	182.40
Whitefin Shiner		3.98
Spottail Shiner	9.97	7.98
Snail Bullhead		3.97
White Catfish	3.99	14.58
Yellow Bullhead		3.97
Flat Bullhead		7.94
Blue Catfish		3.97
Channel Catfish	15.95	11.96
Yellow Perch	7.98	

RELATIVE ABUNDANCE OF FISH COLLECTED ON PARR AND MONTICELLO RESERVOIRS, WINTER 2009 (SOURCE: NORMANDEAU 2009)

Common Name	Parr		Monticello	
	Total	Abundance	Total	Abundance
Quillback	1	0.8		
Northern Hogsucker			2	0.4
Notchlip Redhorse			8	1.7
Shorthead Redhorse	2	1.5	16	3.5
Redbreast	1	0.8	6	1.3
Pumpkinseed	2	1.5	10	2.2
Bluegill	44	33.6	154	33.4
Redear	1	0.8	2	0.4
Smallmouth Bass	2	1.5	1	0.2
Largemouth Bass	12	9.2	35	7.6
White Perch	2	1.5	99	21.5
Black Crappie			8	1.7
Gizzard Shad	9	6.9	31	6.7
Threadfin Shad	4	3.1		
Whitefin Shiner			16	3.5
Eastern Silvery Minnow	7	5.3	8	1.7
Golden Shiner	3	2.3		
Spottail Shiner	12	9.2	12	2.6
White Catfish	1	0.8	8	1.7
Flat Bullhead			1	0.2
Blue Catfish	11	8.4	14	3
Channel Catfish	12	9.2	26	5.6
Longnose Gar	1	0.8		
Yellow Perch	4	3.1	4	0.9

ELECTROFISHING CPUE FOR PARR AND MONTICELLO RESERVOIRS, WINTER 2009 (SOURCE: NORMANDEAU 2009)

Common Name	Parr	Monticello
Northern Hogsucker		3.99
Notchlip Redhorse		5.98
Shorthead Redhorse	3.96	3.99
Redbreast	3.97	7.95
Pumpkinseed	3.98	13.29
Bluegill	58.17	121.74
Redear	3.99	7.97
Smallmouth Bass	7.94	3.99
Largemouth Bass	13.25	31.81
White Perch	3.99	56.81
Black Crappie		7.97
Gizzard Shad	11.97	16.9
Threadfin Shad	7.97	
Whitefin Shiner		63.79
Eastern Silvery Minnow	27.72	15.95
Spottail Shiner	23.82	15.96
White Catfish	3.99	9.31
Blue Catfish		3.99
Channel Catfish		35.88
Yellow Perch	3.96	5.32

RELATIVE ABUNDANCE OF FISH COLLECTED ON PARR RESERVOIR, SPRING AND FALL 2012 (SOURCE: SCANA 2013)

Species	# Individuals	Relative Abundance
blue catfish	16	10.06
bluegill	20	12.58
channel catfish	39	24.53
flathead catfish	1	0.63
gizzard shad	21	13.21
highfin carpsucker	10	6.29
largemouth bass	4	2.52
notchlip redhorse	2	1.26
redbreast sunfish	1	0.63
redear sunfish	1	0.63
robust redhorse	1	0.63
sandbar shiner	1	0.63
shorthead redhorse	1	1.89
spottail shiner	1	0.63
warmouth	1	0.63
white bass	1	0.63
white catfish	1	0.63
white perch	30	18.87
yellow bullhead	1	0.63
yellow perch	4	0.63

APPENDIX B

SANTEE RIVER ACCORD

AMERICAN EEL AND AMERICAN SHAD SUMMARIES

Introduction

The following is a summary of information gathered as part of the "*Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement*" (Accord). The Accord is a collaborative approach among utilities with licensed hydroelectric projects, including South Carolina Electric & Gas (SCE&G) and Duke Energy Carolinas, LLC (Duke), and federal and state resource agencies, including the South Carolina Department of Natural Resources (SCDNR), the North Carolina Wildlife Resources Commission (NCWRC), and the United States Fish and Wildlife Service (USFWS) to address diadromous fish protection, restoration, and enhancement in the Santee River Basin. The Accord supports the *Santee-Cooper Basin Diadromous Fish Passage Restoration Plan* which was developed by the SCDNR, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the USFWS, and was accepted as a Comprehensive Plan by the Federal Energy Regulatory Commission (FERC).

American Eel Summary

The South Carolina Department of Natural Resources studied American eel abundance and distribution along the spillways of the Lake Wateree Dam on the Wateree River and Columbia Dam on the Broad River. The study occurred from January 1, 2010 through December 31, 2012. The objectives of this study were to quantify the migrational timing and abundance of American eels at various locations along the spillways of the Lake Wateree Dam and the Columbia Dam, evaluate factors that effected this distribution, and identify areas where American eel collection rates could be maximized. Eel ramp traps of a standard design were used and consisted of a ramp covered with a textured surface, attraction flow and covered collection container with aeration or flow-through water supply. Traps were set at several locations across the base of the Lake Wateree Dam and the Columbia Dam. Traps were deployed in early January and monitored biweekly until eels were detected, then weekly until April 1, and then every other day through June. Monitoring then reverted to biweekly for the remainder of the year after catch numbers subsided. The presence and abundance of eels in the vicinity of the Wateree Dam was evaluated by monthly electrofishing efforts from March through June, and then bi-monthly for the remainder of the year. Electrofishing was also conducted below Columbia Dam 2-3 times each year. All eels collected were enumerated, measured and released or retained for further study.

Some of the eels collected were tagged or marked as part of a pilot study to evaluate tagging methods and tag retention for future movement studies or population estimates.

The study results showed that American eels were not abundant below Columbia Dam or Wateree Dam during 2010, 2011 and 2012. Only 25 American eels (13 at Columbia and 12 at Wateree) were collected during the three year study, with 16.5 hours of electrofishing and 4,500 trap days of effort. Although too few eels were collected to thoroughly address the objectives listed above, it was found that eels were collected most frequently during the months of April through June. Eels were most frequently collected near the powerhouse at Wateree, and near the fish passage structure at Columbia. The study also suggested that few eels make it above the Santee-Cooper lakes. During 2012, 13 eels were captured at the Columbia and Wateree sites, while 17,500 eels were captured in the two ramp traps below St. Stephen's.

American Shad Summary

Adult

Each year adult American shad pass through the Santee-Cooper lake system via the St. Stephen fish lift. It is assumed that once fish exit the fish lift, they continue their upriver spawning migrations to the upper Santee, Wateree, and Congaree Rivers. In 2009, ultrasonic telemetry was used to gain a better perspective on the distribution and migration range of American Shad beyond the St. Stephen fish lift. Three hundred ninety six American shad were collected and implanted with ultrasonic transmitters and released above the fish lift to resume their journey upriver. Tagging was distributed to account for the early, mid and latter portions of the shad migration, with personnel downloading locations of transmitted fish weekly from the various receivers located throughout the study area (Figure 1). Several manual tracking trips were also conducted, to account for fish that were located between receivers.

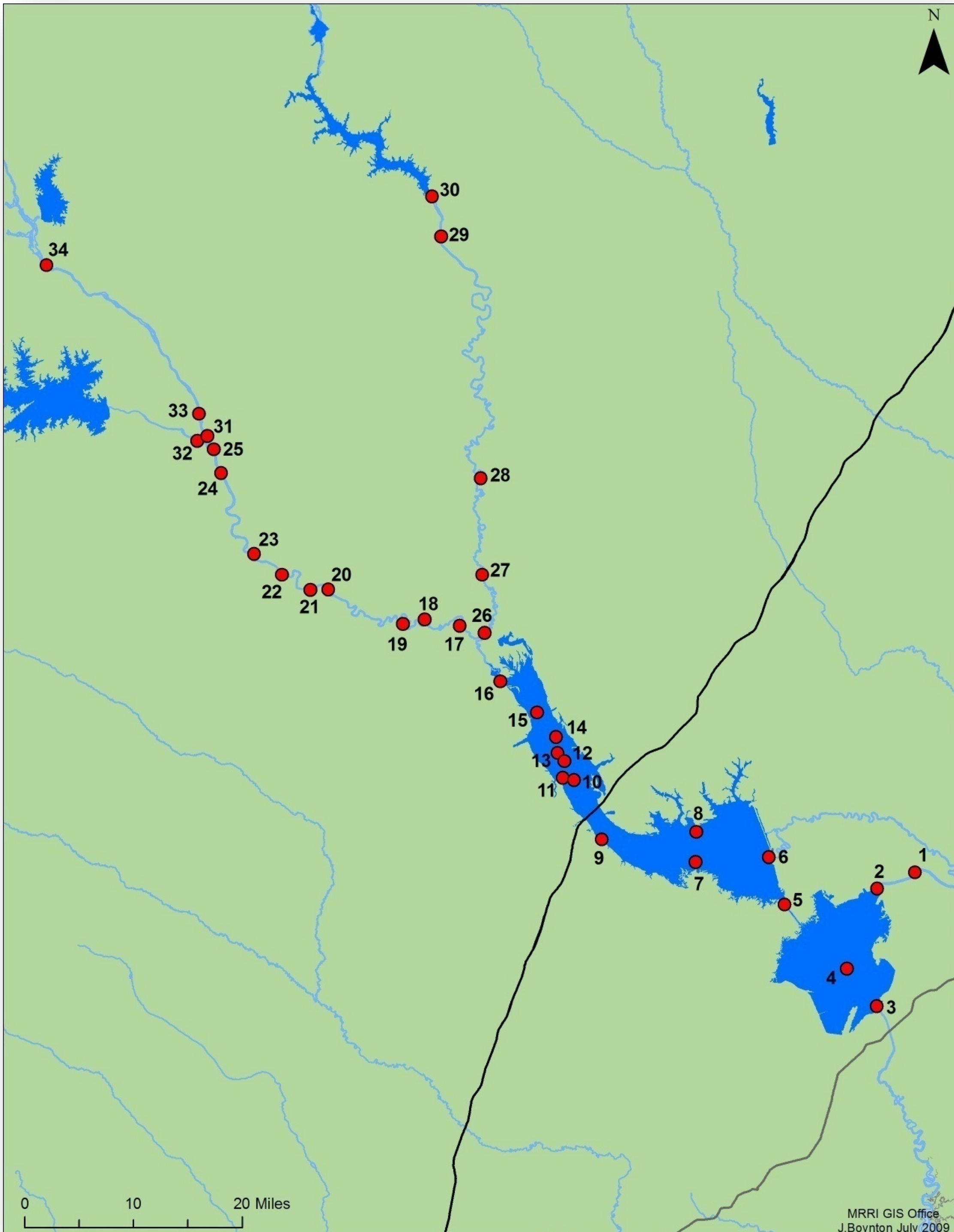

Figure 14 Acoustic Telemetry Receiver Locations in the Santee River Basin, SC

Results from the 2009 Adult American Shad Study indicated that shad were not reaching upper river habitats, but that most shad (67%) were utilizing the area between I-95 and the confluence of the Congaree and Wateree rivers. To determine if this was normal behavior or an anomaly, the study was repeated on a smaller scale in 2010. Two hundred forty seven shad were implanted with transmitters, and identical locations were used for receivers. Tagging was distributed to account for the early, mid and end portions of the shad migration, with personnel downloading locations of transmitted fish weekly from the various receivers. There were also several manual tracking trips conducted to account for fish that were located between receivers.

Of the 247 fish tagged with transmitters, 240 were detected by at least one receiver. 58 American shad were pulled through the turbines or the outmigration bypass system and ended up downstream of the St. Stephen Dam, but two of these fish traveled back upstream through the fish lift and re-entered the lake system. One hundred eighty one fish traveled upstream to Lake Moultrie, with 155 travelling through the Diversion Canal to enter Lake Marion. One hundred nine of the transmitted American shad traveled to the upper portion of Lake Marion, between the I-95 Bridge and Low Falls Landing, on the upper Santee River. This area appears to be where the majority of spawning is taking place. Eighty fish were detected approximately 10 km downstream of the Wateree/Congaree confluence. Fifteen American shad were detected in the lower portion of the Wateree River, and three of these fish continued upstream to the SCE&G Plant. Thirty three American shad were detected in the Congaree River where Hwy 601 crosses the river, and 9 of these fish continued upstream to Congaree National Park. Only two fish traveled far enough upstream to be detected by the receiver in the Congaree River at Rosewood Landing (rkm 77). One tagged American shad successfully traveled through the Columbia Fishway and was detected at the most upstream receiver just below Parr Dam. No American shad were detected in the bypassed reach of the Broad River adjacent to the Columbia Hydro Plant, nor were any American shad detected by receivers in the Saluda River.

Juvenile

As part of the Santee Basin Cooperative Accord, diadromous fish populations in upstream river reaches are being rebuilt through enhancement activities and the construction of permanent passage facilities at dams. Enhancement activities include population augmentation with hatchery-reared American shad fry, as well as re-locations of pre-spawning adults.

As part of an ongoing study, electrofishing is conducted on a weekly basis each year during June through November at several predetermined nursery sites. The study area includes: the Broad River, upstream and downstream of the Columbia Fishway; three sites in the Congaree River between rkm 0-6; four sites in the Upper Santee River between rkm 0-26; three sites in the Wateree River between rkm 39-47; Lake Marion at Harry's Fish Camp, Big Water and Indian Bluff; the Diversion Canal upstream of the Hwy 45 bridge; and Lake Moultrie at Bonneau Beach.

Young-of-year juvenile shad and herring are collected to determine abundance, distribution, growth rates, food habits and out-migration timing. Shad otoliths are also analyzed to determine the relative contribution of naturally produced versus hatchery produced shad juveniles. Each year, American Shad are collected and counted, and the sagittal otoliths are examined to determine if they are from hatchery stock. Results from the study are summarized in Table 1. This study was conducted in 2013 and will continue in 2014 in order to establish trends in abundance and determine overall hatchery contribution to the system.

Table 3 Santee Accord Juvenile American Shad Study Results

YEAR	# AMERICAN SHAD COLLECTED	# AMERICAN SHAD EXAMINED	% HATCHERY STOCK
2010	2,845	2,689	2.8%
2011	3,176	3,167	0.7%
2012	2,277	2198	0.8%

APPENDIX G

MACROINVERTEBRATE AND MUSSEL REPORT

MACROINVERTEBRATE AND MUSSEL REPORT

PARR FAIRFIELD HYDROELECTRIC PROJECT
FERC No. 1894

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

November 2013

Macroinvertebrate and Mussel Report

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project ("Parr Fairfield" or "Project") (FERC No. 1894) is a federally licensed hydroelectric facility owned and operated by South Carolina Electric & Gas Company (SCE&G), a subsidiary of SCANA Corporation. The Parr Fairfield Project consists of two separate developments, including the Parr Hydroelectric Development and the Fairfield Pumped Storage Development. Since 1954, the Project has maintained a Federal Energy Regulatory Commission (FERC) license for operation and is actively seeking renewal for the current license, which expires in June, 2020.

Originating in the Blue Ridge Mountains of North Carolina, the Broad River predominately flows southeasterly into South Carolina to meet the Saluda River, forming the Congaree River and later the Santee River, along its course to the Atlantic Ocean. The Project is located in Fairfield and Newberry Counties, South Carolina, near the town of Jenkinsville. Situated on the Broad River, Parr Shoals Dam creates the 4,400 acre Parr Reservoir, which acts as the lower reservoir for the Fairfield Pumped Storage Development. Lake Monticello, formed by a series of four earthen dams at Frees Creek, is the 6,800 acre upper reservoir of the Fairfield Pumped Storage Development. The Project Boundary Line is depicted in Figure 1-1.

As part of the relicensing process, SCE&G is examining the water quality within the Project area by assessing the macroinvertebrate and mussel populations within the project area waterways, including the Broad River, Parr Reservoir, Parr Shoals Dam tailrace, and Monticello Reservoir. This report includes a compilation of the mussel surveys conducted by the South Carolina Department of Natural Resources (SCDNR) and SCANA Services personnel with Alderman Environmental Services, Inc., and macroinvertebrate studies conducted by SCANA Services personnel with Carnagey Biological Services, LLC.

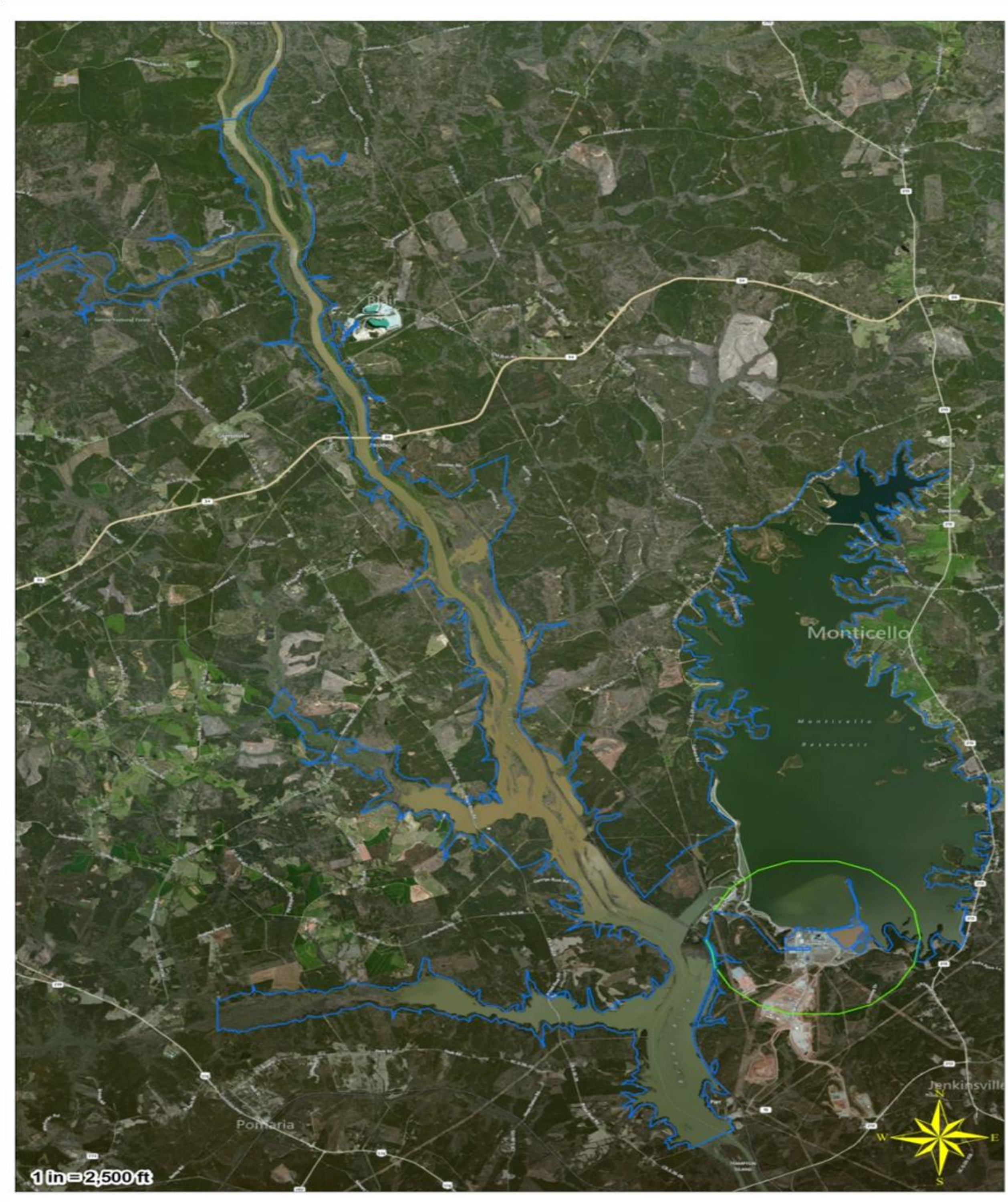


FIGURE 1-1 PARR FAIRFIELD PROJECT BOUNDARY LINE

1.1 GOALS AND OBJECTIVES

The goal of this report is to collect and present existing macroinvertebrate and mussel data for the Parr Reservoir, Lake Monticello, and the downstream reach of the Broad River below the Parr Dam, to assist in describing the past and current water quality of these areas. In addition, this report serves to establish a baseline for the macroinvertebrate and mussel communities found within the Project Area.

1.2 BACKGROUND INFORMATION

Mussel and macroinvertebrate surveys were conducted to evaluate the condition of the waters associated with the Project. Freshwater mussels and benthic organisms commonly serve as indicators, or biological monitors, of water quality. As natural filter feeders, mussels strain out suspended particles and pollutants from the water column and help improve water quality (NRCS, 2007). The presence or absence of certain species can indicate the level of water quality in a specific area.

Macroinvertebrates are also excellent indicators of water quality. As with mussels, the taxonomic composition of the macroinvertebrate community at a specific site can accurately depict the health of that waterbody. Since macroinvertebrates have limited mobility, a site-specific assessment is assured.

2.0 METHODOLOGY

2.1 MUSSELS

2.1.1 SCDNR MUSSEL SURVEY

During 2007, a survey was conducted by the SCDNR to assess the status of freshwater mussels on the Broad River and Parr Reservoir. The team, led by a SCDNR malacologist, surveyed 60 sites along the Broad River, and 5 sites on selected tributaries. The survey sites are depicted on Figure 2-1.

Search methods for this survey differed based on water depth and clarity, and included visual searches, and searches utilizing snorkeling, SCUBA diving, and bathyscopes. Depending on various factors such as suitable habitat present, water clarity and search effectiveness, the amount of time spent searching each site varied. Repeated trips were made to the sites at the Parr Reservoir so that SCUBA could be utilized to examine the deeper areas of the reservoir. Identification of the mussel species collected occurred on site by the survey team.

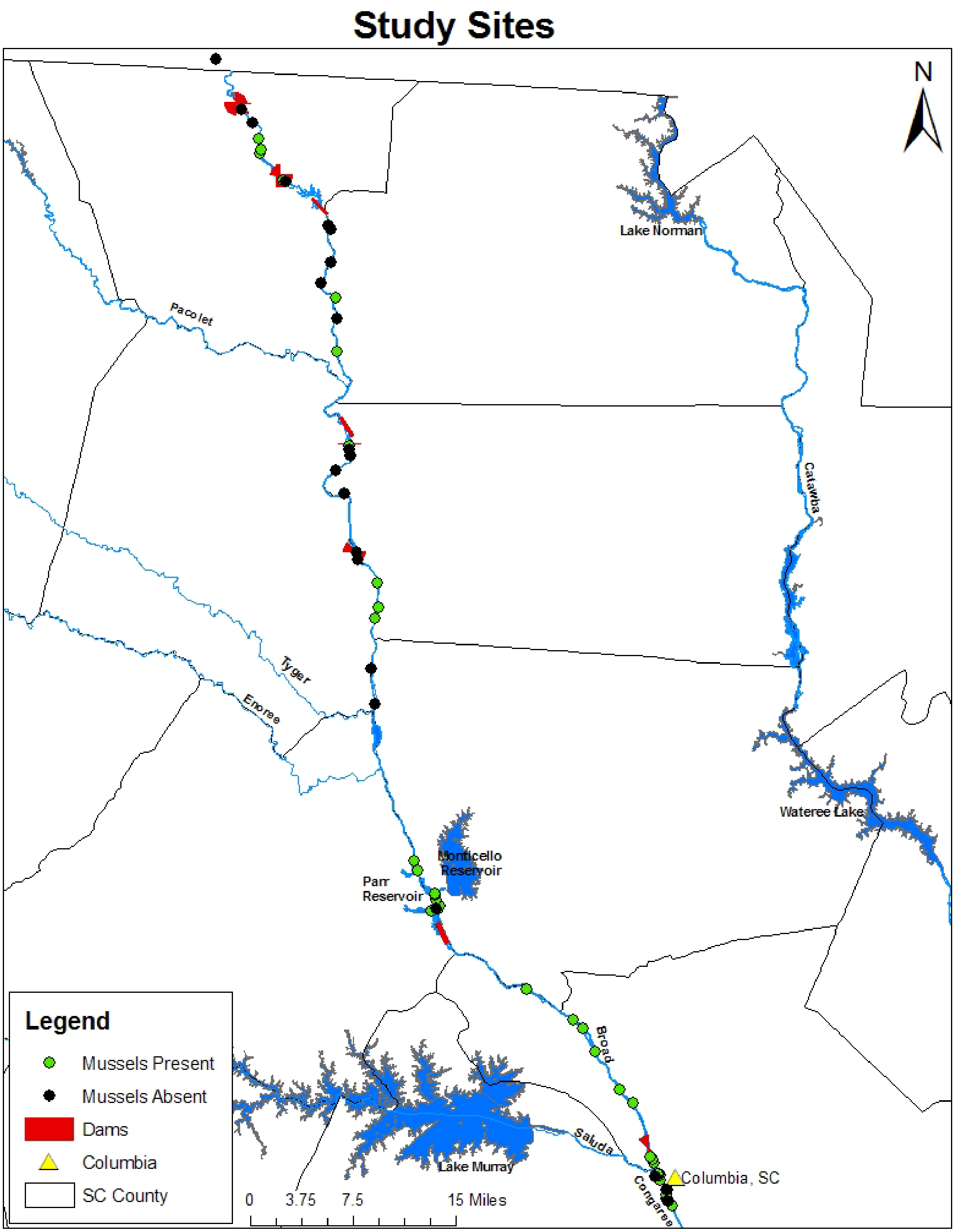


FIGURE 2-1 MUSSEL SURVEY SITES ON THE BROAD RIVER AND PARR RESERVOIR

2.1.2 SCANA Mussel Survey

In 2012, Alderman Environmental Services Inc. was contracted by SCANA Services, Inc. to perform a freshwater mussel survey on the Broad River immediately downstream of the Parr Shoals Dam, as a follow-up to the macroinvertebrate community assessment conducted by Carnagey Biological Services, LLC (see Section 2.2). The survey area included the Broad River east of Hampton Island on the Fairfield/Newberry county line and immediately downstream of the Parr Hydroelectric Development. The exact survey area is displayed in Figure 2-2.

During the study, flows were maintained by SCE&G at low levels to facilitate the surveys. Thirteen areas were surveyed by a team of four malacologists for freshwater mussels using bathyscopes and tactile techniques. Specific sites within the survey areas were selected due to various mussel species' microhabitat needs. The survey was conducted on October 22 and 23, 2012.

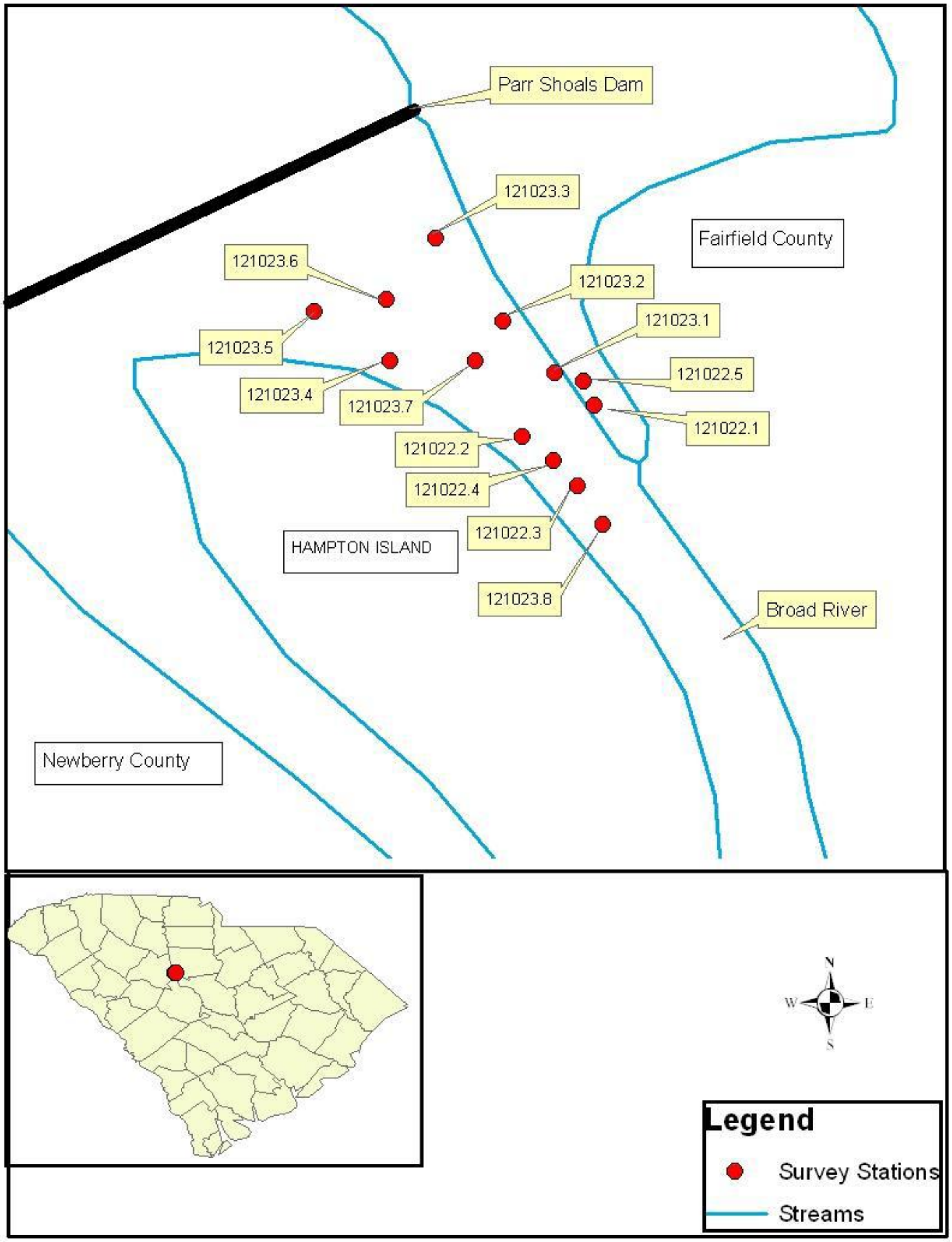


FIGURE 2-2 MUSSEL STUDY AREA AND SURVEY STATIONS

2.2 MACROINVERTEBRATES

In association with the Virgil C. Summer Nuclear Station (VCSNS) expansion, SCE&G conducted baseline studies to examine the macroinvertebrate communities within Parr Reservoir and Lake Monticello. In order to maintain the provisions of the Clean Water Act Section 401 water quality certification issued to the VCSNS Units 2 & 3, SCE&G has continued to monitor these macroinvertebrate populations in Parr Reservoir.

2.2.1 BASELINE STUDIES

In conjunction with the Nuclear Regulatory Commission (NRC) licensing process for the expansion of VCSNS, SCE&G conducted macroinvertebrate community assessments at various locations on Lake Monticello and Parr Reservoir during 2008 and 2009. The objective of these assessments was twofold with the first objective being to determine the condition of the macroinvertebrate community at the new water treatment intake and new raw water intake in Lake Monticello, as well as the condition of the macroinvertebrate community at the new cooling tower blowdown discharge location in Parr Reservoir. The second objective of this study was to document the macroinvertebrate community in and around the VCSNS.

In order to accomplish these objectives, SCANA Services personnel collected petite Ponar macroinvertebrate samples from five locations within Lake Monticello and Parr Reservoir on several different occasions. Samples were collected on June 18, 2008, September 18, 2008, January 22-23, 2009, April 27, 2009, and September 11, 2012. The collected samples were identified and the data analyzed by Carnagey Biological Services, LLC.

Macroinvertebrate sampling was performed at five sites within Parr Reservoir and Lake Monticello. The Parr Reservoir Control site was located upstream of Hellers Creek, approximately 9.0 kilometers above the Parr Shoals Dam. The Parr Reservoir New Blowdown Discharge site was located at the location of the proposed new cooling tower blowdown discharge from the proposed two new nuclear units at the VCSNS, and approximately 1.0 kilometers upstream of the Parr Shoals Dam. The Monticello Reservoir Control was located on the western side of the lake, approximately 5.0 kilometers north of the VCSNS. The Monticello Reservoir New Water Treatment Intake was located at the proposed intake point for the water treatment plant. The Monticello Reservoir Raw Water Intake was located at the proposed intake point for the VCSNS. These five sample sites are shown on Figure 2-3.

Quantitative sampling was performed using a petite Ponar grab sampler, as described in method 10500 (APHA, 1995). Five random replicate (15 X 15 cm) Ponar grab samples of sediment were collected from the lake at each location. Replicates were sieved in the field with a U.S. Standard No. 35 sieve (0.500 mm mesh), then placed individually in plastic bags, preserved with 85% ethanol, and transported to the laboratory for analysis. Upon return to the laboratory, all samples were washed over a U.S. Standard No. 35 sieve and organisms were sorted from the remaining material using forceps and the aid of a stereomicroscope. The organisms were preserved in 70% ethanol, and identified to the lowest positive taxonomic level.

In order to extract the greatest amount of information possible from the data collected, several types of analyses were performed. Bioassessment metrics allow for the comparison of macroinvertebrate communities at the various sampling sites and are based the overall taxonomic composition and the known tolerance levels and life history strategies of the organisms encountered. Changes in taxonomic composition were determined using the metrics outlined in Rapid Bioassessment Protocol III of *Rapid bioassessment protocols for use in streams and rivers* (Plafkin et al. 1989). These metrics include taxa richness, EPT index, Chironomidae taxa and abundance, ratio of EPT and Chronomidae abundance, ratio of scraper/scraper and filtering collectors, percent contribution of dominant taxon, and the North Carolina biotic index (NCBI). Single factor ANOVA analyses were also performed on the data, to detect trends and differences between the two bodies of water, Lake Monticello and Parr Reservoir.

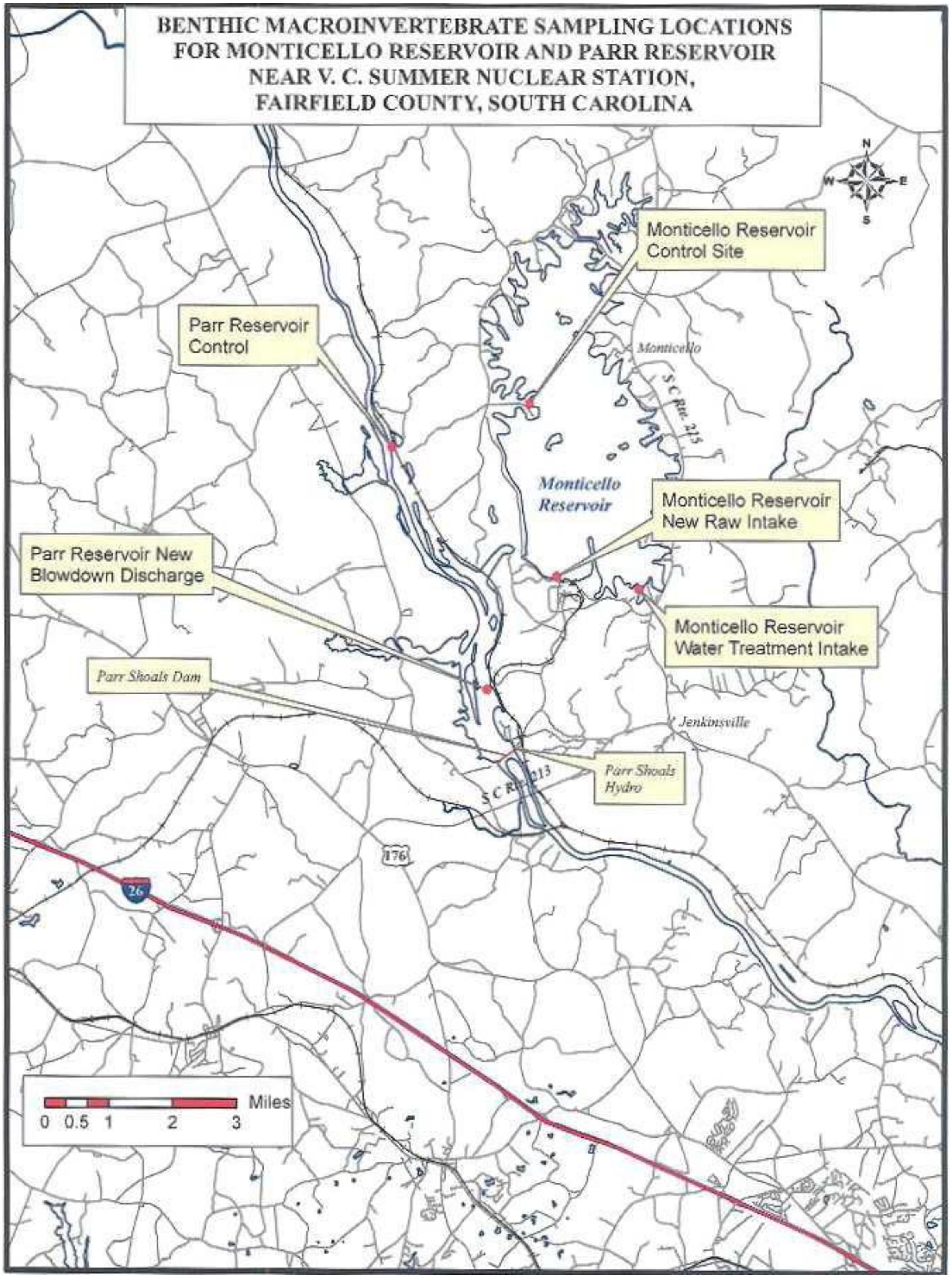


FIGURE 2-3 BASELINE MACROINVERTEBRATE ASSESSMENT SAMPLING LOCATIONS

2.2.2 ONGOING STUDIES

In addition to the baseline studies performed in 2008 and 2009, SCE&G has continued its study of Parr Reservoir with a macroinvertebrate assessment completed on September 11, 2012, to satisfy provisions of the Clean Water Act Section 401 water quality certification issued by the South Carolina Department of Health and Environmental Control (SCDHEC) for the VCSNS expansion. The objective of this and future assessments is to monitor the condition of the macroinvertebrate community in Parr Reservoir and the Broad River immediately below the Parr Shoals Dam to determine if there are any effects due to construction and operation of the cooling tower blowdown discharge diffuser associated with the VCSNS expansion. Samples will continue to be collected on an annual basis between the months of August and October until 5 years after the start-up of the VCSNS Unit 3. Unit 3 is scheduled to come online in 2018.

Collections of macroinvertebrates were made from two sampling transects in Parr Reservoir near the VCSNS and one location below Parr Shoals Dam. Parr Upstream sampling site was located upstream of Hellers Creek, approximately 9.0 kilometers above Parr Shoals Dam. Units 2 & 3 Discharge sampling site was located within the area of the proposed new cooling tower blowdown discharge from the two new nuclear units at the VCSNS, and approximately 1.0 kilometers upstream of the Parr Shoals Dam. Parr Tailrace sampling site is located approximately 75 meters below Parr Shoals Dam. Sampling sites are shown in Figure 2-4.

FIGURE 2-4 ONGOING MACROINVERTEBRATE ASSESSMENT SAMPLING LOCATIONS

Quantitative sampling of the macroinvertebrate communities from the Parr Upstream and Units 2 & 3 Discharge sampling transects was performed using a petite Ponar grab sampler, as described in method 10500 (APHA, 1995). Five random replicate (15 X 15 cm) Ponar grab samples of sediment were collected from the reservoir at each sampling point along the two transects. Replicates were sieved in the field with a U.S. Standard No. 35 sieve (0.500 mm mesh), then placed individually in plastic bags, preserved with 85% ethanol, and transported to the laboratory for analysis.

Due to the rocky substrate at the Parr Tailrace sampling site, dredge samples were not collected. Instead an instream macroinvertebrate community rapid bioassessment was conducted at this location. Macroinvertebrates were qualitatively collected at the Parr Tailrace location from all available habitats (e.g., stream margins, leaf packs, aquatic vegetation, water soaked logs and sand deposits) using a D-frame aquatic dip net and by picking organisms from substrates with forceps. Collections from all habitat types were combined to form one aggregate sample and preserved in the field with 80% ethanol.

Upon return to the laboratory, all petite Ponar samples were washed over a U.S. Standard No. 35 sieve to remove any remaining fine debris. Organisms from all three sample locations were sorted from the remaining material using forceps and the aid of a stereomicroscope. The organisms were retained in 80% ethanol, and identified to the lowest positive taxonomic level.

In order to extract the greatest amount of information possible from the data collected, several types of analyses were performed. Bioassessment metrics allow for the comparison of macroinvertebrate communities at the two transects and are based the overall taxonomic composition and the known tolerance levels and life history strategies of the organisms encountered. Changes in taxonomic composition were determined using the metrics outlined in Rapid Bioassessment Protocol III of *Rapid bioassessment protocols for use in streams and rivers* (Plafkin et al. 1989). These metrics include taxa richness, EPT index, Chironomidae taxa and abundance, ratio of EPT and Chronomidae abundance, ratio of scraper/scraper and filtering collectors, percent contribution of dominant taxon, and the North Carolina biotic index (NCBI). Single factor ANOVA analyses were also performed on the data, to detect trends and differences between the two Parr Reservoir transects. Data from Parr Tailrace was analyzed separately.

SCE&G is also conducting a macroinvertebrate study in the Broad River below the Neal Shoals Dam, located above the Parr Reservoir. The collected samples have been identified and the data analyzed by Carnagey Biological Services, LLC. This study is ongoing, but information collected thus far is presented in Appendix A.

3.0 RESULTS

3.1 MUSSELS

3.1.1 SCDNR MUSSEL SURVEY

The habitat of the surveyed stretch of the Broad River above Parr Dam was turbid, with lower substrate heterogeneity and less stable river bed substrates. Because of this many of the sites surveyed yielded few or no mussel species.

The section of the river from Parr Reservoir down to the Columbia Dam contained dense populations of mussels, although the diversity was low compared to other surveyed areas. The habitat within this area included fairly clear water and very stable substrates of gravel beds and large boulders. Shoals and rapids were also abundantly present in this stretch of the river, which contributed to an increased dissolved oxygen content. Within Parr Reservoir, the habitat is unique due to the water level fluctuations caused by the Fairfield Pumped Storage Development. Because of this, and the riverine characteristic of the reservoir, the species composition of Parr Reservoir is similar to that of the non-impounded sections of the Broad River.

A general inventory of species collected during the study is displayed in Table 3-1.

TABLE 3-1 GENERAL INVENTORY OF MUSSELS IN BROAD RIVER, 2007[A B]

site no.	latitude	longitude	date	person-hours	species	no. live	no. shells	CPUE
Upper Congaree River								
1	33.9688	-81.04007	5/31	0.4	*E. lanceolata* complex	1	0	2.5
					E. roanokensis	1	0	2.5
2	33.97004	-81.03893	5/31	0.5	*E. complanata*	2	0	4.0
					E. lanceolata complex	3	0	6.0
					E. roanokensis	2	0	4.0
					V. delumbis	1	0	2.0
3	33.97513	-81.04359	5/31	0.33	*E. lanceolata* complex	1	0	3.0
					E. roanokensis	5	0	15.0
					L. cariosa	1	0	3.0
4	33.97782	-81.04698	5/16	0.67	*E. roanokensis*	1	0	1.5
5	33.97812	-81.04536	5/16	1.67	*E. complanata*	5	0	3.0
					E. lanceolata complex	1	1	0.6
					E. roanokensis	26	0	15.6
					L. cariosa	2	0	1.2
					V. delumbis	1	0	0.6
6	33.98165	-81.04714	4/25	0.47	*E. complanata*	0	1	0.0
					E. lanceolata complex	1	0	2.1
7	33.98669	-81.04763	5/16	1.25	none	-	-	-
8	33.98708	-81.04551	5/16	3.75	*E. complanata*	9	0	2.4
					E. congaraea	1	0	0.3
					E. lanceolata complex	2	0	0.5
					E. roanokensis	73	0	19.5
					L. cariosa	1	0	0.3
					V. delumbis	1	0	0.3
			5/31	0.83	*E. complanata*	5	0	6.0
					E. lanceolata complex	3	0	3.6
					E. roanokensis	51	0	61.4
					L. cariosa	1	0	1.2
			8/14	1.5	*E. complanata*	1	0	0.7
					E. lanceolata complex	3	0	2.0
					E. roanokensis	12	0	8.0
					L. cariosa	4	0	2.7
					V. delumbis	1	0	1.2
9	33.996	-81.052	5/16	0.67	*E. complanata*	1	0	1.5
					E. lanceolata complex	1	1	1.5
10	33.99732	-81.05421	4/25	0.43	*E. complanata*	0	2	-
					E. lanceolata complex	0	2	-
					E. roanokensis	0	1	-
11	34.00077	-81.06044	4/25	0.17	None	-	-	-
12	34.00301	-81.05532	6/20	1.0	*E. complanata*	1	0	1
					E. roanokensis	1	0	1
13	34.00421	-81.05748	5/15	5.0	*E. complanata*	8	0	1.6
					E. congaraea	3	0	0.6
					E. lanceolata complex	21	1	4.2
					E. roanokensis	22	0	4.4
					L. radiata	2	0	0.4
					L. nasuta	1	0	0.2
					Villosa delumbis	14	1	2.8
Broad River below Parr Reservoir								
18	34.07909	-81.08981	3/27	1.5	*E. complanata*	48	1	32
					E. lanceolata complex	26	0	17.3
					V. delumbis	1	0	0.4
19	34.0934	-81.10606	3/27	1.17	*E. complanata*	27	6	23.1
					E. lanceolata complex	1	14	0.9
					U. carolinanus	10	0	8.5
20	34.13413	-81.13848	3/28	0.5	*E. complanata*	37	0	74
					E. lanceolata complex	14	0	28

21	34.15881	-81.15317	3/28	0.5	*E. complanata*	4	0	8
					E. lanceolata complex	4	0	8
22	34.16693	-81.16542	3/28	0.75	*E. complanata*	44	0	58.7
					E. lanceolata complex	4	0	5.3
					U. carolinanus	1	0	1.3
					V. delumbis	2	0	2.6
23	34.19955	-81.22483	3/28	1.33	*E. complanata*	3	0	2.3
					E. lanceolata complex	8	0	6.0
					U. carolinanus	38	0	28.5
					V. delumbis	7	0	5.3
24	missing	missing	3/29	0.75	*E. complanata*	13	0	17.3
					E. lanceolata complex	24	0	32.0
					V. delumbis	2	0	2.7
25	missing	missing	3/29	1.0	*E. complanata*	63	0	63.0
					E. lanceolata complex	35	0	35.0
					V. delumbis	11	0	11.0
Parr Reservoir								
26	34.28227	-81.34766	8/31	0.75	*E. complanata*	1	0	1.3
					E. lanceolata complex	47	16	62.7
					V. delumbis	3	0	4.0
			9/26	2.17	*E. complanata*	1	0	0.5
					E. lanceolata complex	25	9	11.5
					U. carolinanus	1	0	0.5
					V. delumbis	4	1	1.8
27	34.28503	-81.34099	9/26	2.33	none	0	0	-
28	34.2859	-81.33821	8/31	0.33	*E. lanceolata* complex	1	6	3.0
			9/26	2.0	*E. lanceolata* complex	4	4	2.0
					U. carolinanus	2	0	1.0
					U. imbecilis	0	1	-
					V. delumbis	1	0	0.5
29	34.29477	-81.34232	9/27	2.0	*E. lanceolata* complex	16	7	8.0
					U. carolinanus	2	0	1.0
					V. delumbis	2	0	1.0
30	34.30006	-81.34343	8/31	0.58	*E. complanata*	1	0	1.7
					E. lanceolata complex	18	3	31.0
			9/26	2.0	*E. lanceolata* complex	2	0	1.0
					V. delumbis	16	0	8.0
31	34.32524	-81.36617	9/7	0.5	*E. lanceolata* complex	3	0	6.0
					V. delumbis	1	0	2.0
			9/27	2.0	*E. lanceolata* complex	1	0	0.5
32	34.33614	-81.37004	9/7	0.5	*E. lanceolata* complex	0	2	4.0
Broad River above Parr Reservoir								
33	34.50299	-81.42056	4/26	0.27	none	0	0	-
34	34.54028	-81.42664	4/26	0.67	none	0	0	-
35	34.5933	-81.42075	7/16	1.33	*E. lanceolata* complex	11	0	8.3
					V. delumbis	1	0	0.8
36	34.60525	-81.4172	7/16	0.67	*E. lanceolata* complex	1	0	1.5
37	34.63086	-81.41812	7/16	0.67	*E. lanceolata* complex	1	0	1.5
38	34.65604	-81.44328	7/16	0.5	none	0	0	-
39	34.66316	-81.44566	7/16	0.33	none	0	0	-
40	34.72609	-81.46175	8/16	0.17	none	0	0	-
41	34.75092	-81.47244	8/16	0.5	none	0	0	-

42	34.76659	-81.45328	8/16	0.67	none	0	0	-
43	34.77276	-81.45538	8/16	0.67	none	0	0	-
44	34.77607	-81.45499	8/16	1.0	*E. lanceolata* complex	3	1	3.0
45	34.8766	-81.47118	8/22	1.0	*E. lanceolata* complex	2	0	2.0
46	34.91208	-81.47171	8/22	1.0	none	0	0	0.0
47	34.93425	-81.47374	8/22	1.67	*E. lanceolata* complex	5	1	3.0
48	34.94893	-81.49248	7/19	0.5	none	0	0	-
49	34.97158	-81.48045	7/19	0.33	none	0	0	-
50	35.00663	-81.48038	7/19	0.5	none	0	0	-
51	35.01047	-81.48329	7/19	0.57	none	0	0	-
52	35.02319	-81.21877	7/19	0.67	none	0	0	-
53	35.05651	-81.5395	9/13	0.83	none	0	0	-
54	35.05773	-81.54175	9/13	1.25	*E. lanceolata* complex	1	0	0.8
55	35.08725	-81.57247	9/5	0.5	*E. lanceolata* complex	3	0	6.0
56	35.09025	-81.57183	9/5	1.0	*E. complanata* *E. lanceolata* complex *E. roanokensis*	1 2 1	2 0 0	1.0 2.0 1.0
57	35.10257	-81.57387	9/5	0.83	*E. complanata* complex	0	1	-
58	35.11959	-81.58197	9/5	0.5	none	0	0	-
59	35.1335	-81.59599	9/5	0.33	none	0	0	-
60	35.1869	-81.6302	9/18	1.5	none	0	0	-

Selected tributaries of the Upper Broad								
Guyon Moore Creek	34.98664	-81.47167	10/9	1.0	none	0	0	-
Buffalo Creek	35.1275	-81.55068	10/9	1.33	none	0	0	-
Kings Creek	35.04171	-81.47832	10/9	1.5	none	0	0	-
Thickety Creek	34.92847	-81.52916	10/11	1.0	none	0	0	-
Pacolet River	34.8736	-81.53146	10/11	2.5	none	0	0	-

[a] CPUE= catch per unit effort in live mussels per person hour
[b] Data from SCDNR's 2009 Fish Passage on the Broad River: an assessment of the benefits to freshwater mussels

3.1.2 SCANA Mussel Survey

According to Alderman, the survey reach provides significant freshwater mussel habitat. During the survey, the highest freshwater mussel diversity in the Broad River Subbasin in North and South Carolina upriver from the Columbia Canal Dam was observed. For many of the species, their highest recorded abundances also occur within this specific river reach. Also, this survey found the most upriver occurrence of the yellow lampmussel (*Lampsilis cariosa*) within the Broad River Subbasin to date. Also, it seems the Roakoke slabshell (*Elliptio roanokensis*) juveniles, which require an anadromous fish host, is being recruited to this area of the Broad

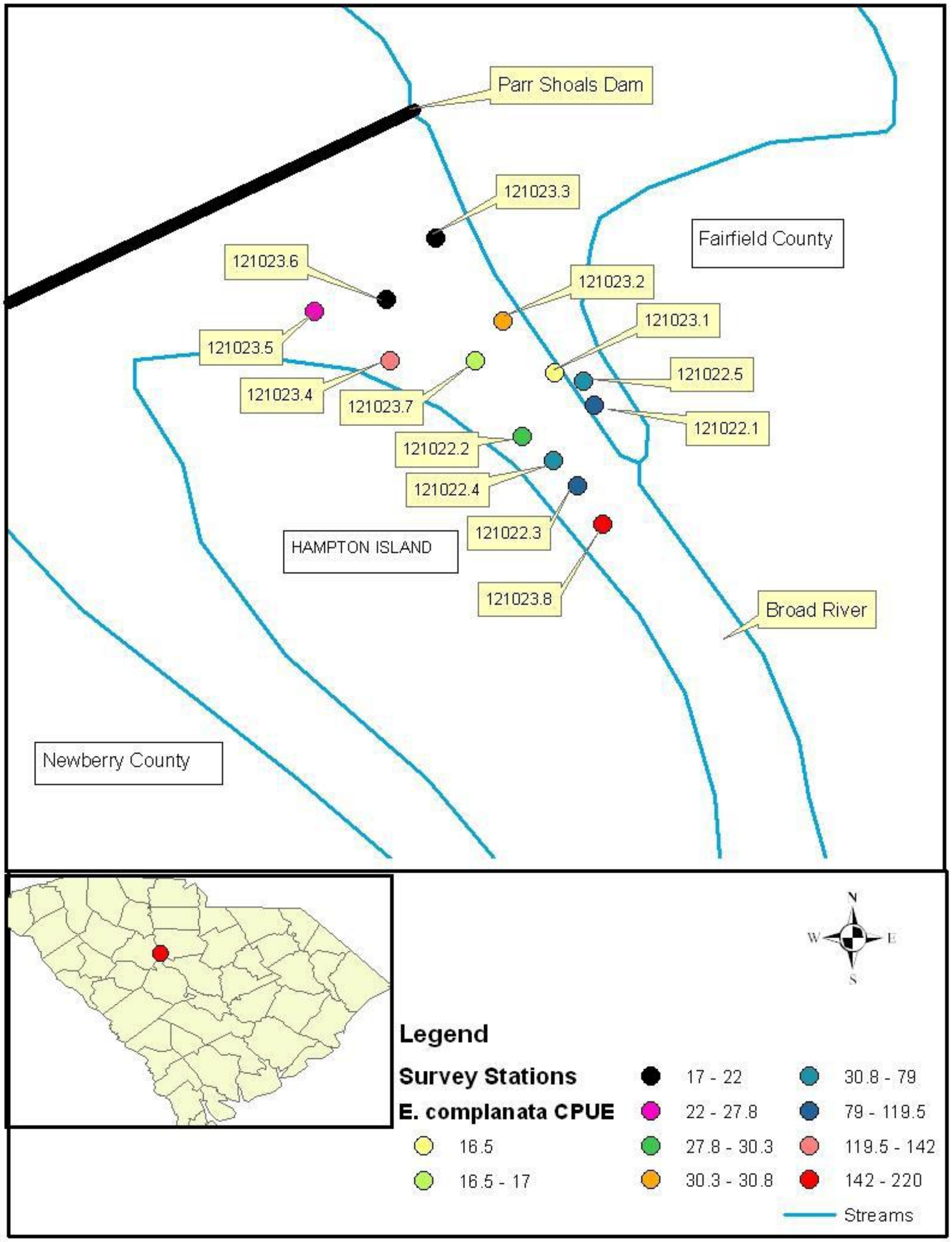
River. This study also found the greatest large river extant eastern creekshell (*Villosa delumbis*) population within the entire Santee Cooper River Basin in North and South Carolina.

Nine freshwater mussel species were documented as existing within the areas surveyed and are listed in Table 3-2.

TABLE 3-2 SCANA SURVEY FRESHWATER MUSSEL INVENTORY

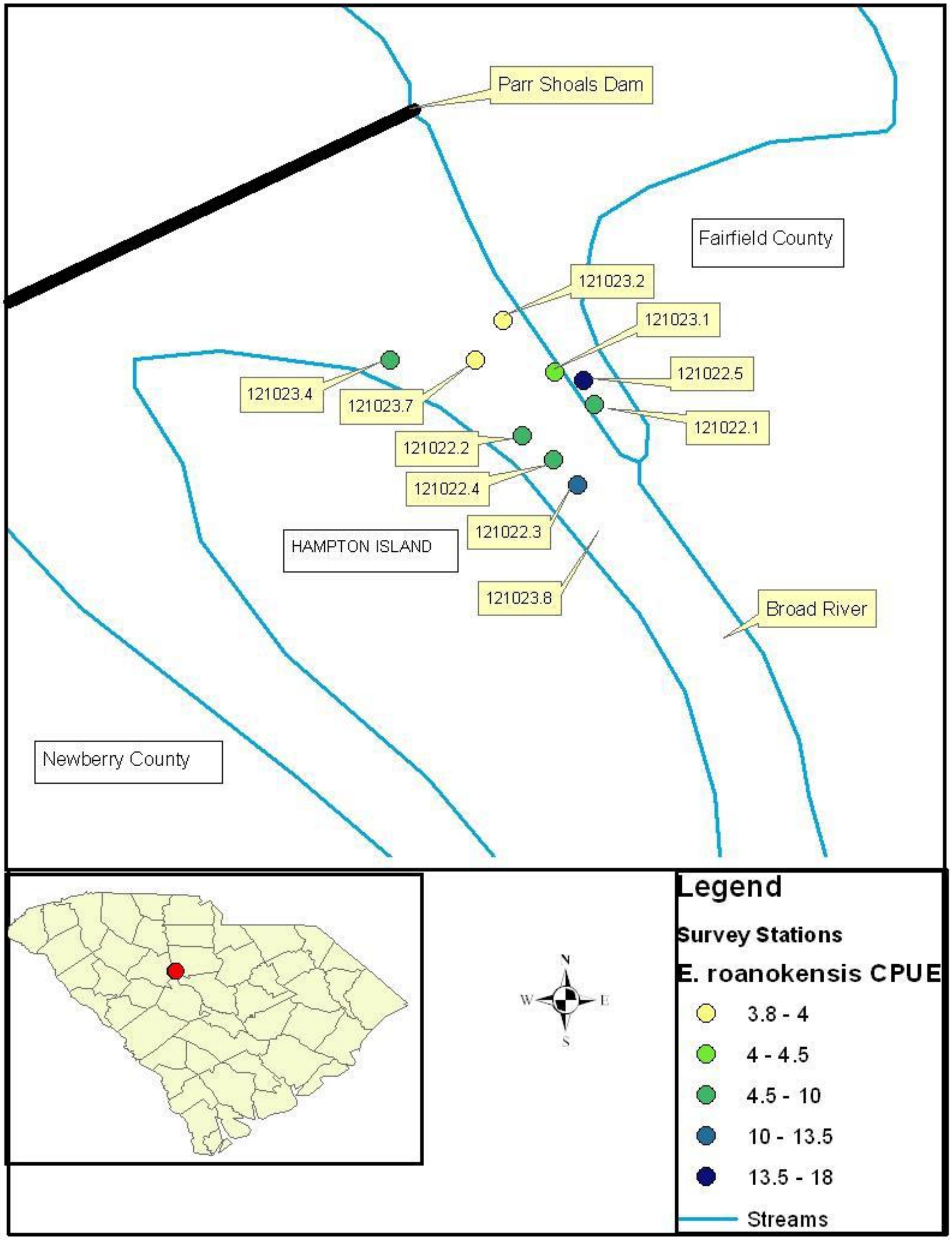
SPECIES DOCUMENTED
Elliptio complanata
E. roanokensis
E. icterina
E. angustata
E. fisheriana
Uniomerus carolinianus
Utterbackia imbecillis
Villosa delumbis
Lampsilis cariosa

The catch-per-unit-effort (CPUE) at each sampling site, for each species, is documented in the figures below.



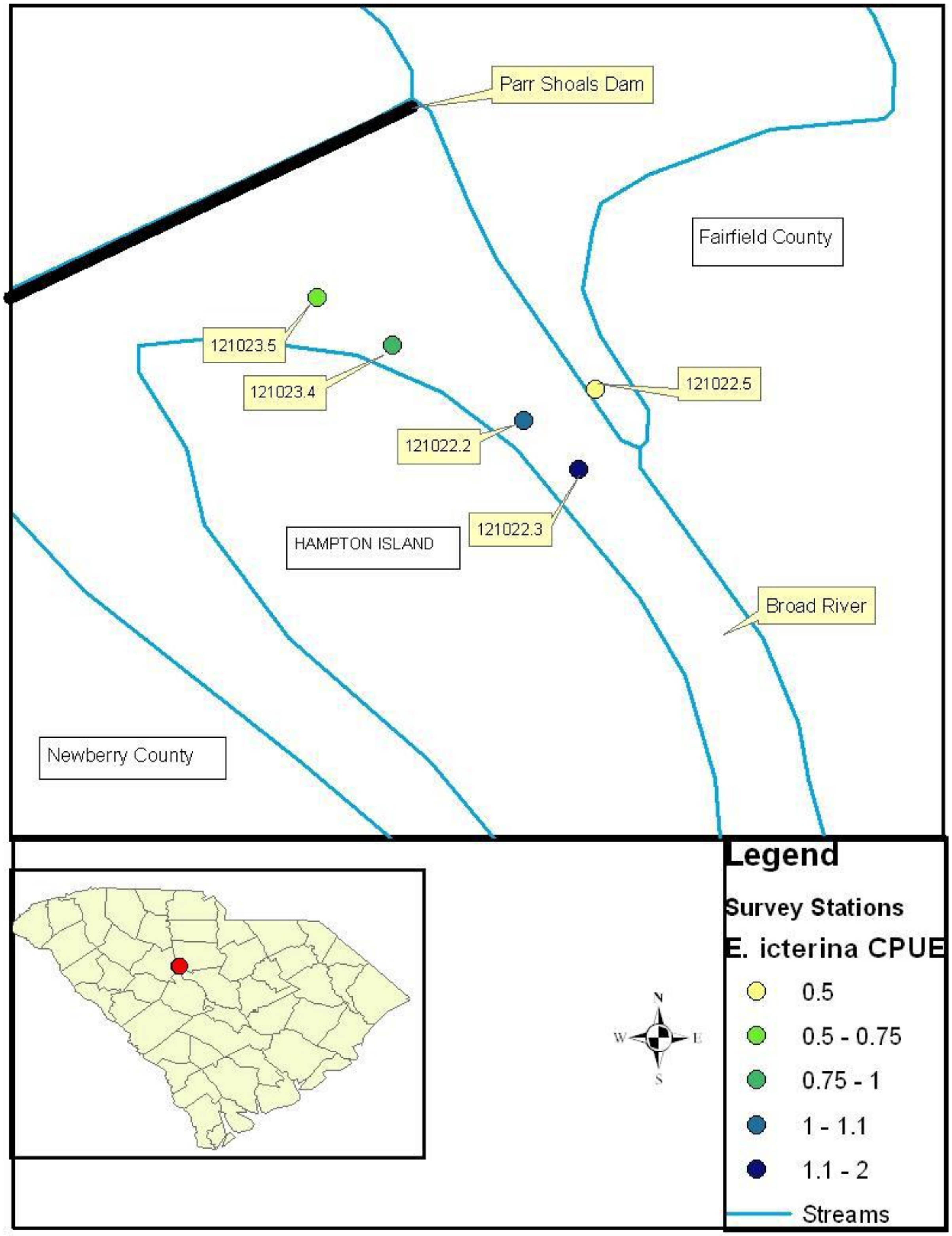
Source: 2012 Alderman Study

FIGURE 3-1 CPUE FOR *ELLIPTIO COMPLANATA*



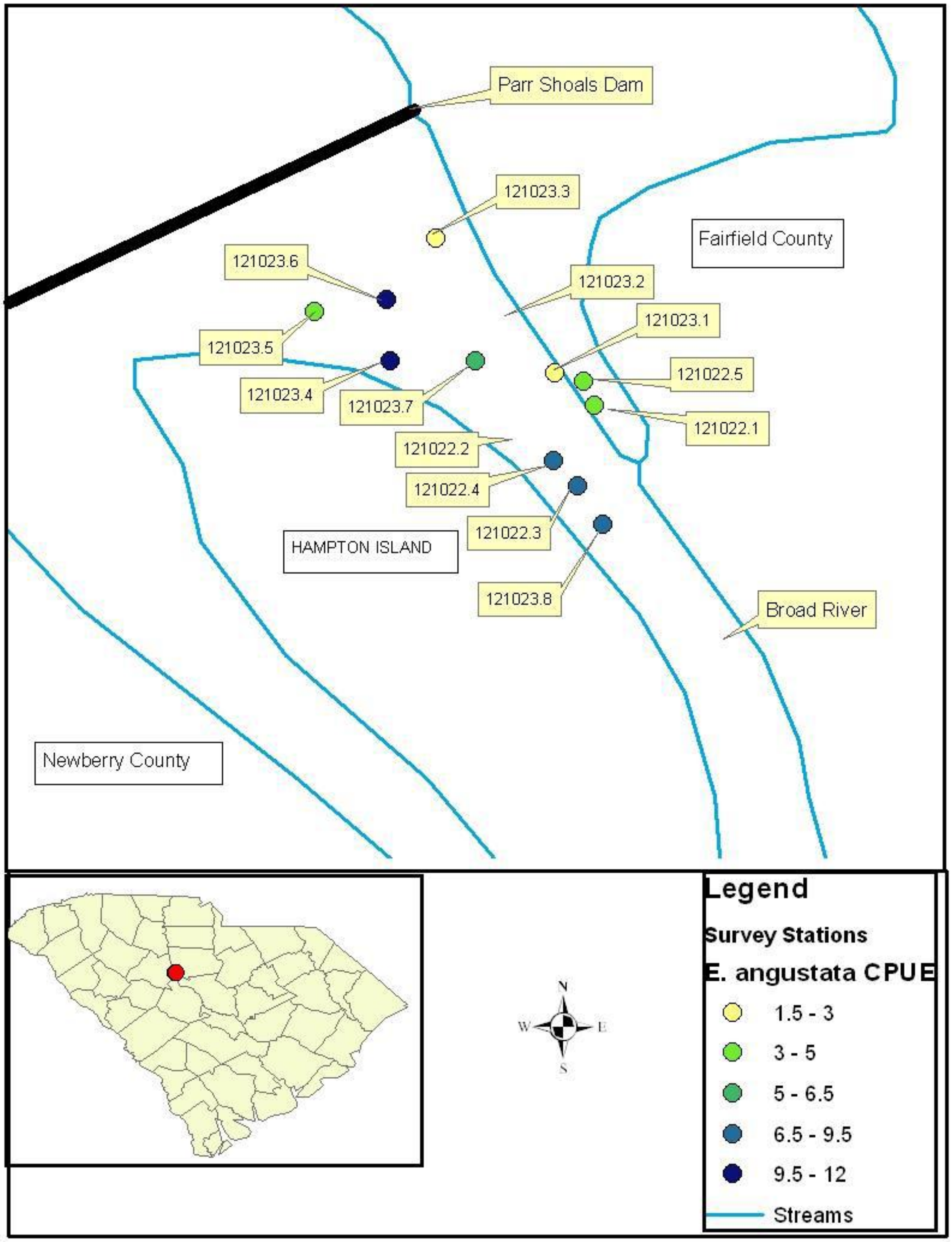
Source: 2012 Alderman Study

FIGURE 3-2 CPUE FOR *ELLIPTIO ROANOKENSIS*



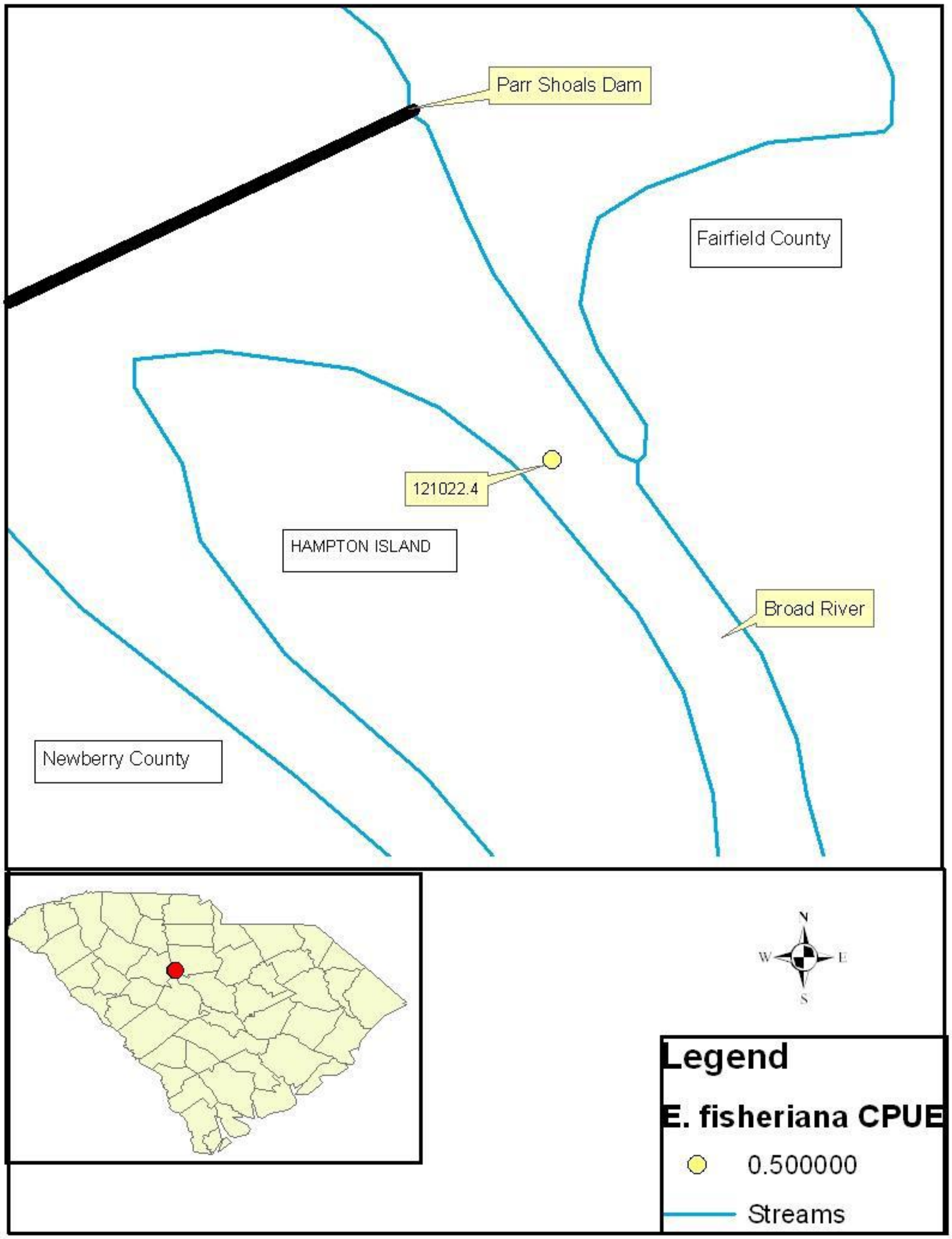
Source: 2012 Alderman Study

FIGURE 3-3 CPUE FOR *ELLIPTIO ICTERINA*



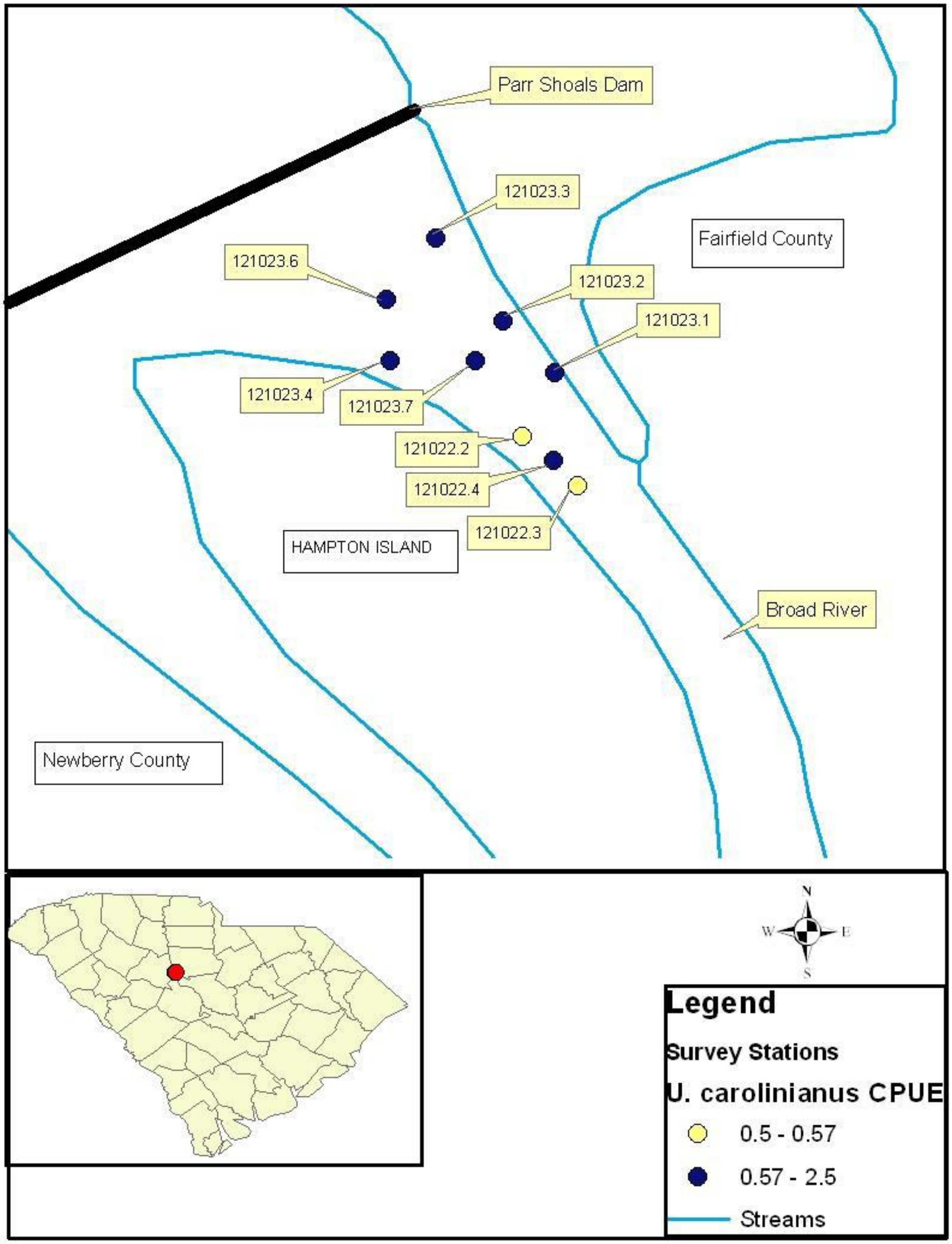
Source: 2012 Alderman Study

FIGURE 3-4 CPUE FOR *ELLIPTIO ANGUSTATA*



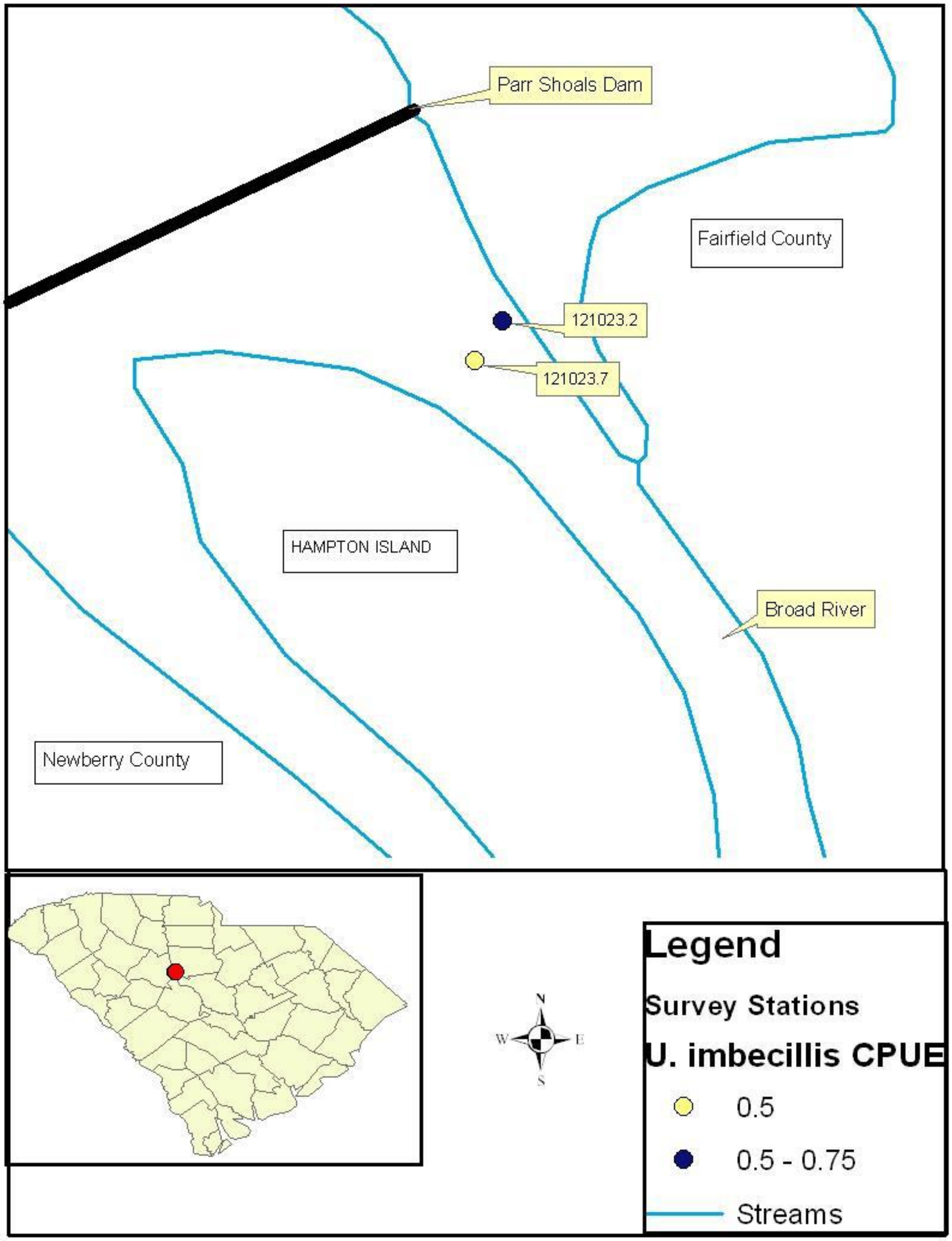
Source: 2012 Alderman Study

FIGURE 3-5 CPUE FOR *ELLIPTIO FISHERIANA*



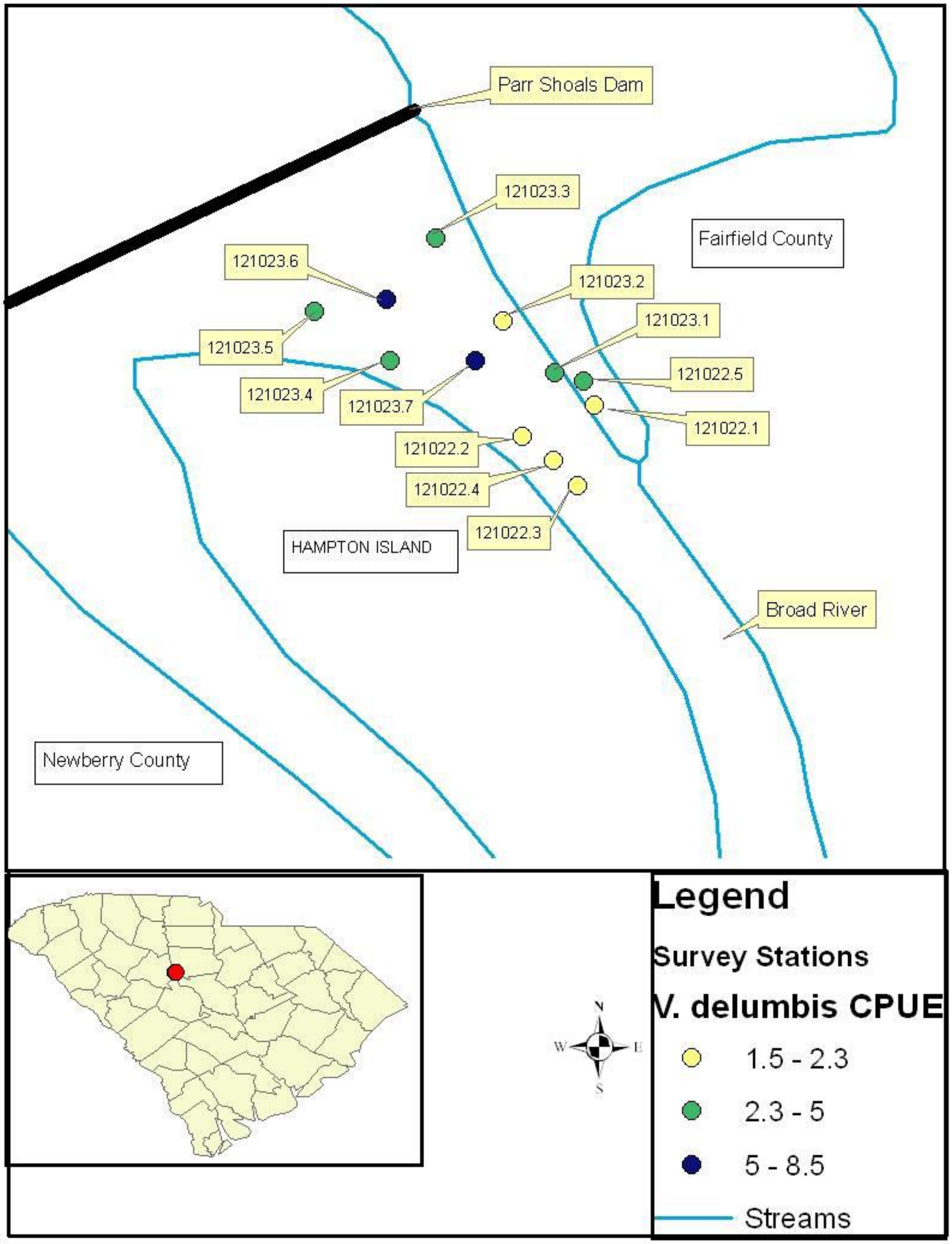
Source: 2012 Alderman Study

FIGURE 3-6 CPUE FOR *UNIOMERUS CAROLINIANUS*



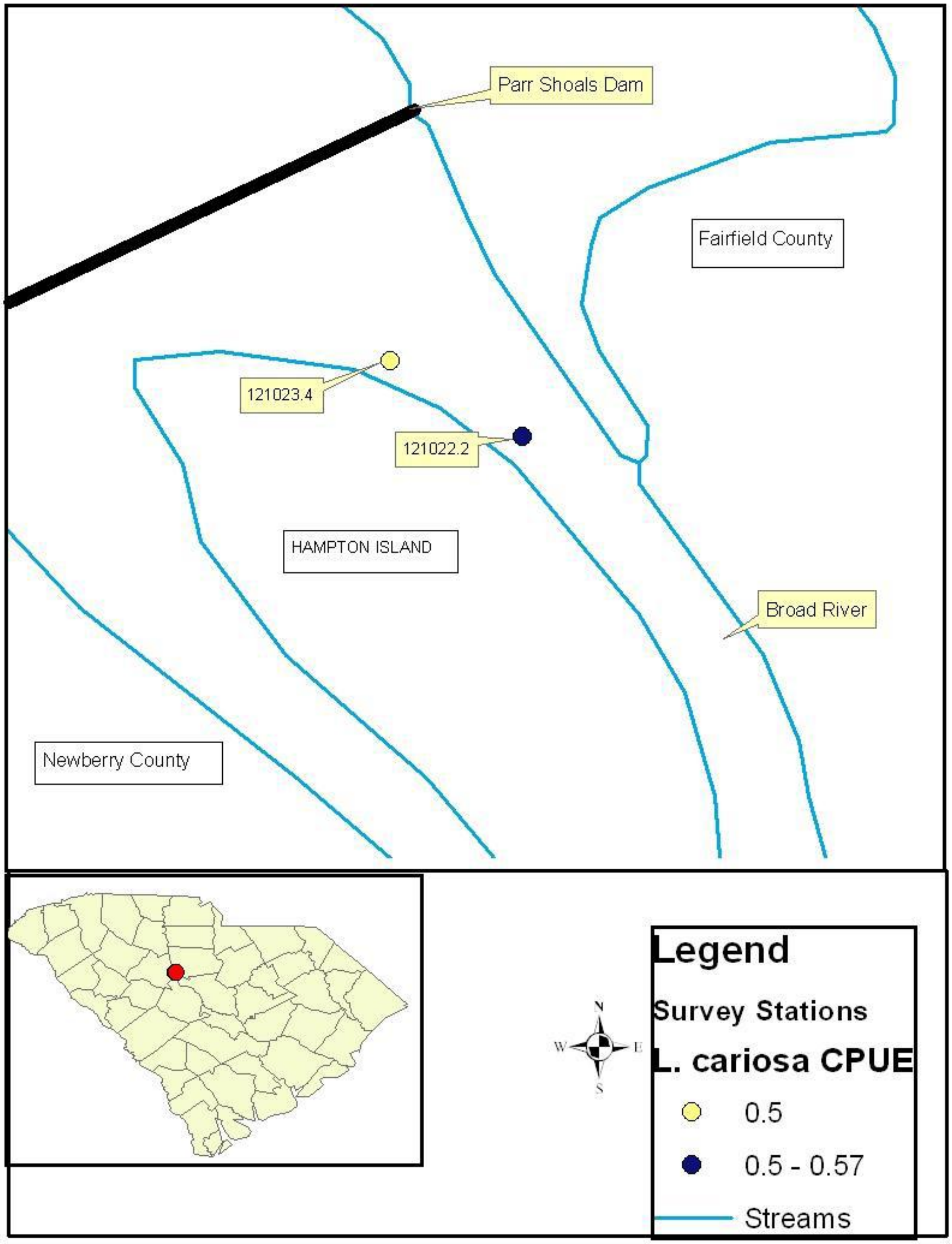
Source: 2012 Alderman Study

FIGURE 3-7 CPUE FOR *UTTERBACKIA IMBECILLIS*



Source: 2012 Alderman Study

FIGURE 3-8 CPUE FOR *VILLOSA DELUMBIS*



Source: 2012 Alderman Study

FIGURE 3-9 CPUE FOR *LAMPSILIS CARIOSA*

3.2 MACROINVERTEBRATES

3.2.1 BASELINE STUDIES

3.2.1.1 PARR RESERVOIR

The macroinvertebrate community in Parr Reservoir was sampled on June 18, 2008, September 18, 2008, January 22-23, 2009 and April 27, 2009. The number of specimens collected and the number of taxa represented from each sample date are shown in Table 3-3.

TABLE 3-3 TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN PARR RESERVOIR

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	400	26
September 18, 2008	321	13
January 22-23, 2009	254	19
April 27, 2009	201	12

The number of specimens collected, their NCBI tolerance values, bioassessment metrics, and functional feeding groups for each sample date are included in Table 3-4 through Table 3-11.

The bioassessment metrics conducted by Carnagey on June 18, 2008 indicated some differences between the two sampling locations on Parr Reservoir. The control location was dominated by scrapers in two of the replicates and by collector-filterers in three of the replicates. The blowdown discharge location was dominated by collector-filterers in all five replicates.

On September 18, 2008, bioassessment metrics indicated that the Parr Reservoir control point and the discharge were similar. The EPT index values for the blowdown discharge point were somewhat higher than at the control. The control had three replicates at 0 and two replicates with indices of 1, while the blowdown discharge point had three replicates with a value of 1 and two replicates with values of 2. All five replicates at the Parr Reservoir control were collector-filterers. At the blowdown discharge point, two replicates were majority collector-filterers, two scrapers and one predator. The blowdown discharge also showed a correspondingly higher EPT abundance.

On January 22-23, 2009, the bioassessment metrics indicated very few differences between sampling locations. The control was dominated by predators in three of the replicates and by collector-filterers in two replicates (Table 3-4). The blowdown discharge point was dominated by collector-filterers in four replicates and predators in one.

The bioassessment metrics from the April 27, 2009 survey indicated very few differences between sample locations. The control was dominated by scrapers in four of the replicates and by collector-filterers in one replicate. The blowdown discharge location was dominated by scrapers in all five replicates.

TABLE 3-4 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR JUNE 18, 2008[A]

				Control					New Blowdown Discharge				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Annelida													
Hirudinea													
Rhynchobdellida													
Glossiphoniidae													
1	Helobdella stagnalis	8.63	P										8
Oligochaeta													
Lumbriculida													
Lumbriculidae													
2	Lumbriculidae Genus species	7.03	SC			1			1				3
Tubificida													
Tubificidae													
3	Tubifex tubifex	10.00	SC	14	2	1		8	1	6	7	9	3
Arthropoda													
Crustacea													
Amphipoda													
Talitridae													
4	Hyalella azteca	7.75	OM										1
Isopoda													
Asellidae													
5	Caecidotea sp.	9.11	SC										2

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Hexapoda													
Diptera													
Ceratopogonidae													
6	Bezzia/Palpomyia sp.	6.86	P	2									2
Chironomidae													
7	Ablabesmyia annulata	2.04	P						1				
8	Ablabesmyia mallochi	7.19	P										1
9	Chironomus sp.	9.63	CG						7	6	10	6	5
10	Clinotanypus sp.		P										
11	Cryptochironomus sp.	6.40	P		1				1				1
12	Cryptotendipes sp.	6.19	CG										
13	Dicrotendipes sp.	8.10	CG										
14	Fissimentum sp. A		CG	2									
15	Microtendipes sp.	5.53	CF	3			2						
16	Paracladopelma undine	4.93	CG	2									1
17	Polypedilum halterale gr.	7.31	SH								1		
18	Procladius sp.	9.10	P						4	2			7
19	Rheotanytarsus exiguus gr.	5.89	CF						1				1
20	Tanytarsus sp.	6.76	CF										
21	Tribelos sp.	6.31	CG		1		1	1					

				Control					New Blowdown Discharge				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Ephemeroptera													
Ephemeridae													
22	Hexagenia limbata	4.90	CG						3				1
Odonata													
Gomphidae													
23	Gomphus sp.	5.80	P						1				
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
24	Corbicula fluminea	6.12	CF	5	4	3	5	3	72	31	18	13	97
Gastropoda													
Limnophila													
Physidae													
25	Physa sp.	8.84	SC										1
Planorbidae													
26	Promenetus exacuous		SC						2	1			1

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-5 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR JUNE 18, 2008[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
Taxa Richness	6	4	3	3	3	11	5	4	3	16
Number of Specimens	28	8	5	8	12	94	46	36	28	135
EPT Index	0	0	0	0	0	0	0	0	0	1
EPT Abundance	0	0	0	0	0	0	0	0	0	1
Chironomidae Taxa	3	2	0	2	1	5	3	3	3	7
Chironomidae Abundance	7	2	0	3	1	82	43	35	28	116
EPT/Chironomidae Abundance	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	0.01
North Carolina Biotic Index	8.15	6.85	7.08	6.04	7.81	6.66	5.84	6.11	5.84	6.35
SCDHEC Bioclassification	1.0	1.5	1.5	2.0	1.0	1.5	2.0	2.0	2.0	2.0
Percent Collector-Filterers	28.57	50.00	60.00	87.50	25.00	77.66	67.39	50.00	46.43	74.07
Percent Collector-Gatherers	14.29	12.50	0.00	12.50	8.33	3.19	13.04	19.44	32.14	4.44
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48
Percent Predators	7.14	12.50	0.00	0.00	0.00	9.57	15.22	30.56	21.43	4.44
Percent Scrapers	50.00	25.00	40.00	0.00	66.67	9.57	4.35	0.00	0.00	9.63
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.93
Scraper/Scraper & Collector-Filterers	1.75	0.50	0.67	0.00	2.67	0.12	0.06	0.00	0.00	0.13
Percent Dominant Taxon	50.00	50.00	60.00	62.50	66.67	76.60	67.39	50.00	46.43	71.85
Number Of Dominant Taxa	6	4	3	3	3	2	3	3	3	3

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-6 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR SEPTEMBER 18, 2008[A]

				Control					New Blowdown Discharge				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Annelida													
Hirudinidae													
1	Hirudinea Genus species		P	1					6	3	14	14	4
Oligochaeta													
Lumbriculida													
Lumbriculidae													
2	Lumbriculidae Genus species	7.13	SC			1							
Tubificida													
Tubificidae													
3	Tubifex tubifex	10.10	SC			2	5	7		11	7	6	17
Arthropoda													
Hexapoda													
Coleoptera													
Elmidae													
4	Dubiraphia sp.	6.03	CG					1					
Diptera													
Athericidae													
5	Atherix sp.	2.20	P			1							
Ceratopogonidae													
6	Culicoides sp.	7.80	P					1					
Chironomidae													
7	Clinotanypus sp.		P	5	1	4	4	3		2		1	1
8	Procladius sp.	9.20	P								1	1	1
9	Rheotanytarsus exiguus gr.	5.99	CF								1		1
Ephemeroptera													
Ephemerellidae													
10	Ephemerella sp.	2.14	CG	1					3	5	2	2	5
Odonata													
Gomphidae													
11	Gomphus sp.	5.90	P					1					
Trichoptera													
Leptoceridae													
12	Oecetis inconspicua complex	1.95	P					1			2		1
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
13	Corbicula fluminea	6.22	CF	36	21	8	33	9	5	8	17	18	16

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-7 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR SEPTEMBER 18, 2008[A]

Metric	Station									
	Control					New Blowdown Discharge				
	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2	Rep 1	Rep 2
Taxa Richness	4	2	5	3	7	3	5	7	6	8
Number of Specimens	43	22	16	42	23	14	29	44	42	46
EPT Index	1	0	0	0	1	1	1	2	1	2
EPT Abundance	1	0	0	0	1	3	5	4	2	6
Chironomidae Taxa	1	1	1	1	1	0	1	2	2	3
Chironomidae Abundance	5	1	4	4	3	0	2	2	2	3
EPT/Chironomidae Abundance	0.20	0.00	0.00	0.00	0.33	-	2.50	2.00	1.00	2.00
North Carolina Biotic Index	5.85	6.22	6.35	7.12	7.06	4.18	7.88	6.58	6.92	7.18
SCDHEC Bioclassification	2.0	2.0	2.0	1.5	1.5	3.0	1.0	1.5	1.5	1.5
Percent Collector-Filterers	83.72	95.45	50.00	78.57	39.13	35.71	27.59	40.91	42.86	36.96
Percent Collector-Gatherers	2.33	0.00	0.00	0.00	4.35	21.43	17.24	4.55	4.76	10.87
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	13.95	4.55	31.25	9.52	26.09	42.86	17.24	38.64	38.10	15.22
Percent Scrapers	0.00	0.00	18.75	11.90	30.43	0.00	37.93	15.91	14.29	36.96
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.00	0.38	0.15	0.78	0.00	1.38	0.39	0.33	1.00
Percent Dominant Taxon	83.72	95.45	50.00	78.57	39.13	42.86	37.93	38.64	42.86	36.96
Number Of Dominant Taxa	2	1	5	3	3	3	5	3	3	4

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-8 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR JANUARY 22-23, 2009[a]

				Control					New Blowdown Discharge				
Seq	**Taxon**	**TV**	**FG**	**Rep. 1**	**Rep. 2**	**Rep. 3**	**Rep. 4**	**Rep. 5**	**Rep. 1**	**Rep. 2**	**Rep. 3**	**Rep. 4**	**Rep. 5**
Annelida													
Hirudinea													
1	Hirudinea Genus species		P							5	11		
Oligochaeta													
Tubificida													
Naididae													
2	Branchiura sowerbyi	8.38	SC	1					3			2	
3	Limnodrilus hoffmeisteri	9.57	SC	6	1	3	1	6	5	2	1	5	
4	Tubifex tubifex	10.10	SC	4	1	2	1	2	3		1	4	
Arthropoda													
Insecta													
Coleoptera													
Elmidae													
5	Macronychus glabratus	4.68	CG					1					
Diptera													
Ceratopogonidae													
6	Bezzia/Palpomyia sp.	6.96	P				2						
7	Culicoides sp.	7.80	P				2						
Chaoboridae													
8	Chaoborus sp.	8.60	P	1									
Chironomidae													
9	Chironomus sp.	9.73	CG		2	4	4	1		5	1		
10	Clinotanypus sp.		P	8		1	7	12			2		
11	Cryptochironomus sp.	6.50	P						1			1	
12	Polypedilum illinoense gr.	9.10	SH						1				
13	Procladius sp.	9.20	P	3		4	4	2					
Ephemeroptera													
Ephemeridae													
14	Hexagenia sp.	5.00	CG					1	2				
Odonata													
Gomphidae													
15	Stylurus plagiatus		P			1	1						
Trichoptera													
Hydroptilidae													
16	Hydroptilidae Genus species		0		2		1						
Leptoceridae													
17	Oecetis sp.	4.80	P								2		
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
18	Corbicula fluminea	6.22	CF	2	2	1	13	17	12	39	4	12	1
Sphaeriidae													
19	Sphaeriidae Genus species		CF			2							

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-9 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR JANUARY 22-23, 2009[A]

Metric	Station									
	Control					New Blowdown Discharge				
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	7	5	8	10	8	7	4	7	5	1
Number of Specimens	25	8	18	36	42	27	51	22	24	1
EPT Index	0	1	0	1	1	1	0	1	0	0
EPT Abundance	0	2	0	1	1	2	0	2	0	0
Chironomidae Taxa	2	1	3	3	3	2	1	2	1	0
Chironomidae Abundance	11	2	9	15	15	2	5	3	1	0
EPT/Chironomidae Abundance	0.00	1.00	0.00	0.07	0.07	1.00	0.00	0.67	0.00	-
North Carolina Biotic Index	9.15	8.91	9.26	7.67	7.20	7.59	7.21	7.55	7.56	6.22
SCDHEC Bioclassification	1.0	1.0	1.0	1.0	1.5	1.0	1.5	1.0	1.0	2.0
Percent Collector-Filterers	8.00	50.00	16.67	38.89	40.48	44.44	76.47	18.18	50.00	100.00
Percent Collector-Gatherers	0.00	25.00	22.22	11.11	7.14	7.41	9.80	4.55	0.00	0.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	48.00	0.00	33.33	44.44	33.33	3.70	9.80	68.18	4.17	0.00
Percent Scrapers	44.00	25.00	27.78	5.56	19.05	40.74	3.92	9.09	45.83	0.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	3.70	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	5.50	0.50	1.67	0.14	0.47	0.92	0.05	0.50	0.92	0.00
Percent Dominant Taxon	32.00	25.00	22.22	36.11	40.48	44.44	76.47	50.00	50.00	100.00
Number Of Dominant Taxa	5	5	8	6	3	5	3	4	4	1

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-10 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE TWO PARR RESERVOIR SAMPLE LOCATIONS FOR APRIL 27, 2009[A]

				Control					New Blowdown Discharge				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Annelida													
Oligochaeta													
Tubificida													
Naididae													
1	Limnodrilus hoffmeisteri	9.47	SC				2	1		3	6		4
2	Naididae Genus species		SC	5	13	16	10	11	4	13	12	15	8
Arthropoda													
Insecta													
Diptera													
Ceratopogonidae													
3	Bezzia/Palpomyia sp.	6.86	P		1		2	1					
Chironomidae													
4	Chironomus sp.	9.63	CG		1				1	1			2
5	Clinotanypus sp.		P			1	1						
6	Cryptochironomus sp.	6.40	P	1									
7	Harnischia sp.	9.07	CG		2								
8	Polypedilum halterale gr.	7.31	SH				1						
9	Procladius sp.	9.10	P		1			1					
10	Thienemannimyia gr.	8.42	P			1							

				Control					New Blowdown Discharge				
Seq	**Taxon**	**TV**	**FG**	**Rep. 1**	**Rep. 2**	**Rep. 3**	**Rep. 4**	**Rep. 5**	**Rep. 1**	**Rep. 2**	**Rep. 3**	**Rep. 4**	**Rep. 5**
Mollusca													
Bivalvia													
Unionoida													
Corbiculidae													
18	Corbicula fluminea	6.22	CF	2	2	1	13	17	12	39	4	12	1
Sphaeriidae													
19	Sphaeriidae Genus species		CF			2							

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

TABLE 3-11 BIOASSESSMENT METRICS FOR PARR RESERVOIR FOR APRIL 27, 2009[A]

	Station									
	Control					New Blowdown Discharge				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	3	6	5	6	5	3	5	3	2	4
Number of Specimens	12	25	24	21	25	8	22	21	18	25
EPT Index	0	0	1	0	0	0	1	0	0	0
EPT Abundance	0	0	1	0	0	0	1	0	0	0
Chironomidae Taxa	1	3	2	2	1	1	1	0	0	1
Chironomidae Abundance	1	4	2	2	1	1	1	0	0	2
EPT/Chironomidae Abundance	0.00	0.00	0.50	0.00	0.00	0.00	1.00	-	-	0.00
North Carolina Biotic Index	6.19	7.57	6.34	7.00	6.66	7.00	7.66	7.80	6.12	7.09
SCDHEC Bioclassification	2.0	1.0	2.0	1.5	1.5	1.5	1.0	1.0	2.0	1.5
Percent Collector-Filterers	50.00	28.00	20.83	23.81	44.00	37.50	18.18	14.29	16.67	44.00
Percent Collector-Gatherers	0.00	12.00	4.17	0.00	0.00	12.50	9.09	0.00	0.00	8.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	8.33	8.00	8.33	14.29	8.00	0.00	0.00	0.00	0.00	0.00
Percent Scrapers	41.67	52.00	66.67	57.14	48.00	50.00	72.73	85.71	83.33	48.00
Percent Shredders	0.00	0.00	0.00	4.76	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.83	1.86	3.20	2.40	1.09	1.33	4.00	6.00	5.00	1.09
Percent Dominant Taxon	50.00	52.00	66.67	47.62	44.00	50.00	59.09	57.14	83.33	44.00
Number Of Dominant Taxa	3	3	2	4	2	3	3	3	2	4

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site. These results are shown in Table 3-12, Table 3-13, Table 3-14 and Table 3-15.

One-way ANOVA results from June 18, 2008 show significant differences in bioassessment metrics in SCDHEC bioclassification (p-value = 0.0482), and NCBI rating (p-value = 0.0333) at the Parr Reservoir blowdown discharge point. All other metrics show no significant difference. One-way ANOVA results from September 18, 2008 show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.0194), EPT Index values (p-value = 0.0187), EPT abundance (p-value = 0.0005) at the Parr Reservoir control point. All other metrics show no significant difference.

One-way ANOVA results from January 22-23, 2009 show significant differences in bioassessment metrics in NCBI (p-value = 0.0429), and percentage of dominant taxon (p-value = 0.0065) at the Parr Reservoir control point. All other metrics show no significant difference.

One-way ANOVA results from April 27, 2009 show no significant differences in bioassessment metrics between the points. The control point was dominated by scrapers in four of the five replicates and collector-filterers in one. The blowdown discharge point was dominated by scrapers in all five replicates.

TABLE 3-12 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, JUNE 18, 2008[A]

ANOVA for Taxa Richness						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.1079	1	0.1079	2.6291	0.1436	5.3177
Within Stations	0.3282	8	0.0410			
Total	0.4361	9				

ANOVA for EPT Abundance						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.0091	1	0.0091	1.0000	0.3466	5.3177
Within Stations	0.0725	8	0.0091			
Total	0.0816	9				

ANOVA for Total Abundance						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	1.2609	1	1.2609	17.2042	0.0032	5.3177
Within Stations	0.5863	8	0.0733			
Total	1.8473	9				

ANOVA for NCBI						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.0081	1	0.0081	6.5873	0.0333	5.3177
Within Stations	0.0098	8	0.0012			
Total	0.0178	9				

ANOVA for percentage of the dominant taxon						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.0019	1	0.0019	0.3031	0.5970	5.3177
Within Stations	0.0496	8	0.0062			
Total	0.0515	9				

ANOVA for SCDHEC Bioclassification						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.0186	1	0.0186	5.4249	0.0482	5.3177
Within Stations	0.0274	8	0.0034			
Total	0.0460	9				

ANOVA for EPT Index						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-crit*
Between Stations	0.0091	1	0.0091	1.0000	0.3466	5.3177
Within Stations	0.0725	8	0.0091			
Total	0.0816	9				

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-13 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, SEPTEMBER 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0388	1	0.0388	1.7165	0.2265	5.3177
Within Stations	0.1810	8	0.0226			
Total	0.2199	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.7836	1	0.7836	32.4438	0.0005	5.3177
Within Stations	0.1932	8	0.0242			
Total	0.9769	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0132	1	0.0132	0.3441	0.5736	5.3177
Within Stations	0.3058	8	0.0382			
Total	0.3189	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0001	1	0.0001	0.0109	0.9194	5.3177
Within Stations	0.0372	8	0.0046			
Total	0.0372	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1150	1	0.1150	8.5067	0.0194	5.3177
Within Stations	0.1081	8	0.0135			
Total	0.2231	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0017	1	0.0017	0.2415	0.6364	5.3177
Within Stations	0.0563	8	0.0070			
Total	0.0580	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1576	1	0.1576	8.6368	0.0187	5.3177
Within Stations	0.1460	8	0.0182			
Total	0.3035	9				

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-14 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, JANUARY 22-23, 2009[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.1096	1	0.1096	3.0905	0.1168	5.3177
Within Stations	0.2836	8	0.0355			
Total	0.3932	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0016	1	0.0016	0.0278	0.8717	5.3177
Within Stations	0.4491	8	0.0561			
Total	0.4507	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0392	1	0.0392	0.2113	0.6580	5.3177
Within Stations	1.4827	8	0.1853			
Total	1.5219	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0087	1	0.0087	5.7831	0.0429	5.3177
Within Stations	0.0120	8	0.0015			
Total	0.0206	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.2188	1	0.2188	13.3530	0.0065	5.3177
Within Stations	0.1311	8	0.0164			
Total	0.3500	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0031	1	0.0031	0.7516	0.4112	5.3177
Within Stations	0.0330	8	0.0041			
Total	0.0361	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0091	1	0.0091	0.3333	0.5796	5.3177
Within Stations	0.2175	8	0.0272			
Total	0.2265	9				

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-15 RESULTS OF THE SINGLE FACTOR ANOVA FOR PARR RESERVOIR, APRIL 27, 2009[A]

ANOVA for Taxa Richness

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0476	1	0.0476	4.1768	0.0752	5.3177
Within Stations	0.0912	8	0.0114			
Total	0.1389	9				

ANOVA for EPT Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0000	1	0.0000	0.0000	1.0000	5.3177
Within Stations	0.1450	8	0.0181			
Total	0.1450	9				

ANOVA for Total Abundance

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0110	1	0.0110	0.4410	0.5253	5.3177
Within Stations	0.2001	8	0.0250			
Total	0.2111	9				

ANOVA for NCBI

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0011	1	0.0011	0.9349	0.3619	5.3177
Within Stations	0.0090	8	0.0011			
Total	0.0101	9				

ANOVA for percentage of the dominant taxon

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0052	1	0.0052	0.6939	0.4290	5.3177
Within Stations	0.0598	8	0.0075			
Total	0.0650	9				

ANOVA for SCDHEC Bioclassification

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0031	1	0.0031	0.5690	0.4723	5.3177
Within Stations	0.0436	8	0.0054			
Total	0.0467	9				

ANOVA for EPT Index

Source of Variation	SS	df	MS	F	P-value	F-crit
Between Stations	0.0000	1	0.0000	0.0000	1.0000	5.3177
Within Stations	0.1450	8	0.0181			
Total	0.1450	9				

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

3.2.1.2 LAKE MONTICELLO

The macroinvertebrate community in Lake Monticello was sampled on June 18, 2008, September 18, 2008, January 22-23, 2009 and April 27, 2009. The number of specimens collected and the number of taxa represented from each sample date are shown in Table 3-16.

TABLE 3-16 TOTAL MACROINVERTEBRATE SPECIMENS AND TAXA REPRESENTED IN LAKE MONTICELLO

SAMPLE DATE	TOTAL # OF SPECIMENS	TOTAL # OF TAXA
June 18, 2008	341	27
September 18, 2008	262	24
January 22-23, 2009	277	16
April 27, 2009	405	24

The number of specimens collected, their NCBI tolerance values, functional feeding groups and bioassessment metrics for each sample date are included in Table 3-17 through Table 3-24.

The bioassessment metrics from June 18, 2008 indicate few differences between the sample locations. The control sample point was predominately collector-filters, but did include one replicate with a majority of scrapers. The control SCDHEC bioclassification values were the same as the other two stations when replicates were averaged. The Raw Intake point had all “fair” bioclassification ratings and had a majority (4 out of 5) of collector feeders. The Water Treatment Intake point had three “fair” and two “good-fair” bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in all five replicates.

According to the bioassessment metrics from September 18, 2008 the control sample point feeding types showed mixed dominant feeders. Collector-filters and scrapers were the largest ratio in two replicates each, and predators were majority of one. The control SCDHEC bioclassification values were the lowest of the three stations. The Raw Intake point received two “fair” and three “good-fair” bioclassification ratings. The Raw intake point contained a majority (4 out of 5) of predator feeders. Parallel to the previous sample date, the Water Treatment Intake point had three “fair” and two “good-fair” bioclassification ratings. The Treatment Intake point was also dominated by collector-filterers in three replicates, and predators in two.

On January 22-23, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

According to the bioassessment metrics from April 27, 2009 the control sample point was predominately collector/filters, but did include one replicate with a majority of collector/gatherers (Table). The control SCDHEC bioclassification values were slightly lower than the other two stations. The Raw intake point contained a majority of collector/filterer feeders. The raw water intake point was the only location in which any EPT taxa were collected. The Water Treatment Intake point feeding type majority was collector/filterers. The Treatment Intake point was also dominated by collector-filterers.

TABLE 3-17 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR JUNE 18, 2008[A]

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
Rhynchobdellida																		
Glossiphoniidae																		
1	Helobdella stagnalis	8.63	P	2														1
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Lumbriculidae Genus species	7.03	SC					2										
Tubificida																		
Tubificidae																		
3	Tubifex tubifex	10.00	SC		18	8	2	4										1
Arthropoda																		
Crustacea																		
Cladocera																		
Daphnidae																		
4	Daphnia sp.		CF												1		1	
Cyclopoida																		
Cyclopidae																		
5	Eucyclops agilis		OM		1				2	1				2	3			
Ostracoda																		
6	Ostracoda Genus species		CF												1			

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Hexapoda																		
Diptera																		
Ceratopogonidae																		
7	Bezzia/Palpomyia sp.	6.86	P												1	1		
Chaoboridae																		
8	Chaoborus sp.	8.50	P														2	
Chironomidae																		
9	Ablabesmyia annulata	2.04	P				1						1				1	
10	Chironomus sp.	9.63	CG					1	2		1	1			2	3	3	2
11	Clinotanypus sp.		P	2	1				2	2	1	1	1		1		1	1
12	Cryptochironomus sp.	6.40	P		5			1		1				4	1		1	1
13	Cryptotendipes sp.	6.19	CG		1							1	1					
14	Dicrotendipes sp.	8.10	CG		1													
15	Fissimentum sp. A		CG	1		1	2							1				
16	Microtendipes sp.	5.53	CF		1		1				1						1	1
17	Paracladopelma undine	4.93	CG												7			1
18	Polypedilum halterale gr.	7.31	SH		1	3									1		1	
19	Procladius sp.	9.10	P	3	3	1		1	2						4	1		4
20	Pseudochironomus sp.	5.36	CG		2													
21	Rheotanytarsus exiguus gr.	5.89	CF												1		1	
22	Tanytarsus sp.	6.76	CF		4	1								4			1	

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Ephemeroptera																		
Ephemeridae																		
23	Hexagenia limbata	4.90	CG	4			2		5	3	2	2	4	2	7	5	5	1
Trichoptera																		
Hydroptilidae																		
24	Orthotrichia sp.	8.29	SC			1												
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
25	Corbicula fluminea	6.12	CF	20	18	19	5	4	5	5	5	10	9	7	10	5		5
Unionidae																		
26	Elliptio complanata complex	5.14	CF		7	1				1					1			
Nematoda																		
27	Nematoda Genus species	6.02	OM												1			

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-18 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR JUNE 18, 2008[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	6	13	8	6	6	6	5	5	5	6	6	15	5	11	10
Number of Specimens	32	63	35	13	13	13	10	15	16	20	18	42	15	18	18
EPT Index	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1
EPT Abundance	4	0	1	2	0	3	2	2	4	2	5	7	5	5	1
Chironomidae Taxa	3	9	4	3	3	2	3	3	3	3	3	7	2	8	6
Chironomidae Abundance	6	19	6	4	3	3	3	3	3	9	6	17	4	10	10
EPT/Chironomidae Abundance	0.67	0.00	0.17	0.50	0.00	1.00	0.67	0.67	1.33	0.22	0.83	0.41	1.25	0.50	0.10
North Carolina Biotic Index	6.58	7.46	7.12	5.83	8.05	5.58	6.40	6.30	5.16	6.27	6.47	6.36	7.08	6.62	7.36
SCDHEC Bioclassification	1.5	1.3	1.5	2.2	1.0	2.5	2.0	2.0	2.8	2.0	1.8	2.0	1.5	1.5	1.5
Percent Collector-Filterers	62.50	47.62	60.00	46.15	30.77	46.15	60.00	66.67	56.25	55.00	27.78	33.33	33.33	22.22	33.33
Percent Collector-Gatherers	15.63	6.35	2.86	30.77	7.69	23.08	30.00	26.67	31.25	15.00	38.89	38.10	53.33	44.44	22.22
Percent Omnivores	0.00	1.59	0.00	0.00	0.00	7.69	0.00	0.00	0.00	10.00	11.11	9.52	0.00	0.00	0.00
Percent Predators	21.88	14.29	2.86	7.69	15.38	23.08	10.00	6.67	12.50	20.00	22.22	16.67	13.33	27.78	38.89
Percent Scrapers	0.00	28.57	25.71	15.38	46.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.56
Percent Shredders	0.00	1.59	8.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38	0.00	5.56	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.60	0.43	0.33	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17
Percent Dominant Taxon	62.50	28.57	54.29	38.46	30.77	38.46	50.00	66.67	56.25	35.00	27.778	23.81	33.333	27.778	27.778
Number Of Dominant Taxa	5	5	3	6	6	6	5	5	5	6	6	5	5	11	10

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-19 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR SEPTEMBER 18, 2008[A]

				Control					New Water Treatment Intake					New Raw Intake				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P	1				14					2	11	7	14	8	8
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Lumbriculidae Genus species	7.13	SC		2	13	1	5										1
Tubificida																		
Tubificidae																		
3	Limnodrilus sp.	9.60	SC					1										
4	Tubifex tubifex	10.10	SC	1	1		2											
Arthropoda																		
Arachnoidea																		
Acariformes																		
Arrenuridae																		
5	Arrenurus sp.	5.63	P					1										
Hexapoda																		
Diptera																		
Chironomidae																		
6	Ablabesmyia peleensis	9.77	P				1	1								1		
7	Clinotanypus sp.		P		1			4		1		2	4	2	2			1
8	Cryptochironomus sp.	6.50	P			1		1								1		
Chironomidae cont.																		
9	Fissimentum sp. A		CG		1													
10	Parachironomus sp.	9.52	P			1												
11	Polypedilum halterale gr.	7.41	SH			2												
12	Procladius sp.	9.20	P									1		1				
13	Pseudochironomus sp.	5.46	CG					2										
14	Rheotanytarsus exiguus gr.	5.99	CF	1	1	2		1										
15	Tanytarsus sp.	6.86	CF					3										
Ephemeroptera																		
Ephemerellidae																		
16	Ephemerella sp.													2	2	7	5	15
Odonata																		
Gomphidae																		
17	Gomphus sp.	5.90	P	1														
Libellulidae																		
18	Macromia taeniolata	6.26	P									7						
Trichoptera																		
Leptoceridae																		
19	Oecetis inconspicua complex	1.95	P					1										
Polycentropodidae																		
20	Cyrnellus fraternus	7.44	CF					2										

				Control					New Water Treatment Intake					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
21	Corbicula fluminea	6.22	CF	12	4	6		15	2	2	3	7	4					
Unionidae																		
22	Elliptio lanceolata complex	5.20	CF	1														
Gastropoda														5	3	2	3	6
Limnophila																		
Physidae																		
23	Physa sp.	8.94	SC										1					
Mesogastropoda																		
Viviparidae																		
24	Bellamya japonica		SC	1		1		8								2		

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-20 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR SEPTEMBER 18, 2008[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Taxa Richness	7	6	7	3	14	1	2	1	4	4	5	4	6	3	5
Number of Specimens	18	10	26	4	59	2	3	3	17	11	21	14	27	16	31
EPT Index	0	0	0	0	2	0	0	0	0	0	1	1	1	1	1
EPT Abundance	0	0	0	0	3	0	0	0	0	0	2	2	7	5	15
Chironomidae Taxa	1	3	4	1	6	0	1	0	2	1	2	1	2	0	1
Chironomidae Abundance	1	3	6	1	12	0	1	0	3	4	3	2	2	0	1
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.25	-	0.00	-	0.00	0.00	0.67	1.00	3.50	-	15.00
North Carolina Biotic Index	6.39	6.98	7.02	9.00	6.52	6.22	6.22	6.22	6.66	6.90	6.00	5.20	5.41	4.18	3.37
SCDHEC Bioclassification	2.0	1.5	1.5	1.0	1.7	2.0	2.0	2.0	1.5	1.5	2.0	2.7	2.5	3.0	3.0
Percent Collector-Filterers	77.78	50.00	30.77	0.00	35.59	100.00	66.67	100.00	41.18	36.36	23.81	21.43	7.41	18.75	19.35
Percent Collector-Gatherers	0.00	10.00	0.00	0.00	3.39	0.00	0.00	0.00	0.00	0.00	9.52	14.29	25.93	31.25	48.39
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	11.11	10.00	7.69	25.00	37.29	0.00	33.33	0.00	58.82	54.55	66.67	64.29	59.26	50.00	29.03
Percent Scrapers	11.11	30.00	53.85	75.00	23.73	0.00	0.00	0.00	0.00	9.09	0.00	0.00	7.41	0.00	3.23
Percent Shredders	0.00	0.00	7.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.14	0.60	1.75	-	0.67	0.00	0.00	0.00	0.00	0.25	0.00	0.00	1.00	0.00	0.17
Percent Dominant Taxon	66.67	40.00	50.00	50.00	25.42	100.00	66.67	100.00	41.18	36.36	52.381	50	51.852	50	48.387
Number Of Dominant Taxa	7	6	4	3	6	1	2	1	4	4	4	4	4	3	3

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-21 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR JANUARY 22-23, 2009[A]

				Control					New Water Treatment					New Raw Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P	1									1	1		2		1
Oligochaeta																		
Lumbriculida																		
Lumbriculidae																		
2	Eclipidrilus lacustris	7.13	SC	1												1		
Tubificida																		
Naididae																		
3	Branchiura sowerbyi	8.38	SC								2	1	1	1	2	5	3	
4	Limnodrilus hoffmeisteri	9.57	SC	15	4	2		3					1		1		1	
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
5	Ablabesmyia mallochi	7.29	P	1														
6	Chironomus sp.	9.73	CG			1		2							1	2		1
7	Cladotanytarsus sp.	4.19	CG					2										
8	Clinotanypus sp.		P							6	3		2	1		1		
9	Cryptochironomus sp.	6.50	P	4													1	
10	Dicrotendipes neomodestus	8.20	CG															1
11	Procladius sp.	9.20	P	2									1	1				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Chironomidae cont.																		
12	Rheotanytarsus exiguus gr.	5.99	CF				4						1			4	1	
13	Tanytarsus sp.	6.86	CF										2				1	1
Ephemeroptera																		
Ephemeridae																		
14	Hexagenia sp.	5.00	CG											2		6	6	6
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
15	Corbicula fluminea	6.22	CF	76	12	13	2	2	3	7	3	2	11	5	9	6	2	3
Gastropoda																		
Limnophila																		
Physidae																		
16	Physa sp.	8.94	SC	3											1			

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-22 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR JANUARY 22-23, 2009[A]

	Station														
	Control					New Water Treatment Intake					New Raw Intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	8	2	3	2	4	1	2	3	2	8	6	5	8	7	6
Number of Specimens	103	16	16	6	9	3	13	8	3	20	11	14	27	15	13
EPT Index	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
EPT Abundance	0	0	0	0	0	0	0	0	0	0	2	0	6	6	6
Chironomidae Taxa	3	0	1	1	2	0	1	1	0	4	2	1	3	3	3
Chironomidae Abundance	7	0	1	4	4	0	6	3	0	6	2	1	7	3	3
EPT/Chironomidae Abundance	0.00	-	0.00	0.00	0.00	-	0.00	0.00	-	0.00	1.00	0.00	0.86	2.00	2.00
North Carolina Biotic Index	7.86	6.99	6.79	6.05	8.14	6.22	6.22	6.76	7.30	6.81	6.87	7.90	6.69	6.84	6.49
SCDHEC Bioclassification	1.0	1.5	1.5	2.0	1.0	2.0	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.5	1.7
Percent Collector-Filterers	73.79	75.00	81.25	100.00	22.22	100.00	53.85	37.50	66.67	70.00	45.45	64.29	37.04	26.67	30.77
Percent Collector-Gatherers	0.00	0.00	6.25	0.00	44.44	0.00	0.00	0.00	0.00	0.00	18.18	7.14	29.63	40.00	61.54
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	7.77	0.00	0.00	0.00	0.00	0.00	46.15	37.50	0.00	20.00	27.27	0.00	11.11	6.67	7.69
Percent Scrapers	18.45	25.00	12.50	0.00	33.33	0.00	0.00	25.00	33.33	10.00	9.09	28.57	22.22	26.67	0.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.25	0.33	0.15	0.00	1.50	0.00	0.00	0.67	0.50	0.14	0.20	0.44	0.60	1.00	0.00
Percent Dominant Taxon	73.79	75.00	81.25	66.67	33.33	100.00	53.85	37.50	66.67	55.00	45.45	64.29	22.22	40.00	46.15
Number Of Dominant Taxa	2	2	3	2	4	1	2	3	2	8	6	5	6	7	6

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-23 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE THREE LAKE MONTICELLO SAMPLE LOCATIONS FOR APRIL 27, 2009[A]

				Control					New Water Treatment Intake					Raw Water Intake				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species		P													1	1	
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC						1		1	1	1	1	1	1		1
3	Limnodrilus hoffmeisteri	9.47	SC			1					4							
4	Limnodrilus sp.	9.50	SC				1											
5	Naididae Genus species		SC	1			1	2	3		5	2					1	
Arthropoda																		
Copepoda																		
6	Copepoda Genus species		OM						1									
Insecta																		
Diptera																		
Chironomidae																		
7	Ablabesmyia annulata	2.04	P												1	2		
8	Chironomus sp.	9.63	CG		2	3	5	2		1		1	1					
9	Cladopelma sp.	3.49	CG						1	3	2		2		1			
10	Cladotanytarsus sp.	4.09	CG	2	1	18	3	5	10	8	14		8					
11	Clinotanypus sp.		P								1							

				Control					New Water Treatment Intake					Raw Water Intake				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Chironomidae cont.																		
12	Cryptochironomus sp.	6.40	P			2					1							
13	Dicrotendipes sp.	8.10	CG		1						1							
14	Nanocladius sp.	7.07	CG								1							
15	Orthocladius sp.	5.94	SH		2													
16	Phaenopsectra obediens gr.	6.50	SC											1				
17	Polypedilum halterale gr.	7.31	SH	1		2			9	3	15	1	8	1		1	2	1
18	Procladius sp.	9.10	P						1						1			
19	Rheotanytarsus exiguus gr.	5.89	CF		1				2		1		4					
20	Tanytarsus sp.	6.76	CF						2		1							
Ephemeroptera																		
Ephemeridae																		
21	Hexagenia limbata	4.90	CG											1	9	3	5	5
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	15	14	18	9	11	19	12	19	10	12	6	11	10	14	4
Unionidae																		
23	Pyganodon cataracta		CF											1				
Gastropoda																		
Limnophila																		
Physidae																		
24	Physa sp.	8.84	SC						1			1						

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

TABLE 3-24 BIOASSESSMENT METRICS FOR LAKE MONTICELLO FOR APRIL 27, 2009[A]

	Station														
	Control					New Water Treatment Intake					Raw Water intake				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	4	6	6	5	4	11	5	13	6	7	6	6	6	5	4
Number of Specimens	19	21	44	19	20	50	27	66	16	36	11	24	18	23	11
EPT Index	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
EPT Abundance	0	0	0	0	0	0	0	0	0	0	1	9	3	5	5
Chironomidae Taxa	2	5	4	2	2	6	4	9	2	5	2	3	2	1	1
Chironomidae Abundance	3	7	25	8	7	25	15	37	2	23	2	3	3	2	1
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	3	1	3	5
North Carolina Biotic Index	6.05	6.32	5.93	6.90	5.94	5.74	5.78	6.24	6.80	6.11	6.48	5.81	5.85	5.94	6.08
SCDHEC Bioclassification	2.0	2.0	2.0	1.5	2.0	2.3	2.3	2.0	1.5	2.0	1.8	2.2	2.0	2.0	2.0
Percent Collector-Filterers	78.95	71.43	40.91	47.37	55.00	2.00	0.00	3.03	6.25	2.78	9.09	8.33	16.67	0.00	9.09
Percent Collector-Gatherers	10.53	19.05	47.73	42.11	35.00	62.00	59.26	59.09	87.50	58.33	72.73	45.83	61.11	73.91	45.45
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	0.00	0.00	4.55	0.00	0.00	6.00	0.00	3.03	6.25	0.00	0.00	4.17	0.00	0.00	0.00
Percent Scrapers	5.26	0.00	2.27	10.53	10.00	6.00	11.11	6.06	0.00	5.56	18.18	41.67	22.22	26.09	45.45
Percent Shredders	5.26	9.52	4.55	0.00	0.00	24.00	29.63	22.73	0.00	33.33	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.07	0.00	0.06	0.22	0.18	3.00	-	2.00	0.00	2.00	2.00	5.00	1.33	-	5.00
Percent Dominant Taxon	78.95	66.67	40.91	47.37	55.00	38.00	44.44	28.79	62.50	33.33	54.55	45.83	55.56	60.87	45.45
Number Of Dominant Taxa	4	3	3	5	4	4	4	5	6	5	6	2	6	3	4

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site on Lake Monticello. These results are shown in Table 3-25, Table 3-26, Table 3-27 and Table 3-28.

The three Lake Monticello sample points (control, new water treatment intake, and new raw intake) from June 18, 2008 indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Percentage of dominant taxon (p-value = 0.01879), EPT abundance (p-value = 0.04360), NCBI values (p-value = 0.04624), and SCDHEC bioclassification values (p-value = 0.01450) indicate significant difference between the stations. All other metrics show no significant difference.

The September 18, 2008 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. Taxa richness (p=0.01234), total abundance (p-value = 0.04412), EPT Index value (p-value=0.00676), EPT abundance (p-value = 0.00050), NCBI values (p-value = 0.00361), and SCDHEC bioclassification values (p-value = 0.00172) indicate significant difference between the stations. All other metrics show no significant difference.

The January 22-23, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison. EPT Index value (p-value=0.00041), and EPT abundance (p-value = 0.00097) indicate significant difference between the stations. All other metrics show no significant difference.

The April 27, 2009 sample points indicate a few significant differences in bioassessment metrics through one-way ANOVA comparison (Table). Taxa richness (p-value = 0.04737), EPT Index value, EPT abundance (p-value = 0.00001), and SCDHEC bioclassification values (p-value = 0.04309) indicate significant difference between the stations. All other metrics show no significant difference.

TABLE 3-25 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, JUNE 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.08822	2	0.04411	2.69272	0.10814	3.88529
Within Stations	0.19658	12	0.01638			
Total	0.2848	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.43168	2	0.21584	4.11342	0.0436	3.88529
Within Stations	0.62967	12	0.05247			
Total	1.06135	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.1528	2	0.0764	1.88877	0.19358	3.88529
Within Stations	0.48538	12	0.04045			
Total	0.63818	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0106	2	0.0053	4.01487	0.04624	3.88529
Within Stations	0.01585	12	0.00132			
Total	0.02645	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.13756	2	0.06878	5.6369	0.01879	3.88529
Within Stations	0.14643	12	0.0122			
Total	0.28399	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.03764	2	0.01882	6.15018	0.0145	3.88529
Within Stations	0.03673	12	0.00306			
Total	0.07437	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.04833	2	0.02417	2.66667	0.1101	3.88529
Within Stations	0.10874	12	0.00906			
Total	0.15707	14				

[a] Data from Carnagey's June 2008 Macroinvertebrate Assessment

TABLE 3-26 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, SEPTEMBER 18, 2008[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.38943	2	0.19471	6.48194	0.01234	3.88529
Within Stations	0.36047	12	0.03004			
Total	0.7499	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.7058	2	0.8529	15.327	0.0005	3.8853
Within Stations	0.6678	12	0.0557			
Total	2.3735	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.8222	2	0.4111	4.0934	0.0441	3.8853
Within Stations	1.2051	12	0.1004			
Total	2.0273	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.061	2	0.0305	9.3186	0.0036	3.8853
Within Stations	0.0393	12	0.0033			
Total	0.1002	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0585	2	0.0293	1.352	0.2954	3.8853
Within Stations	0.2597	12	0.0216			
Total	0.3182	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.0661	2	0.033	11.335	0.0017	3.8853
Within Stations	0.035	12	0.0029			
Total	0.101	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.2367	2	0.1183	7.7972	0.0068	3.8853
Within Stations	0.1821	12	0.0152			
Total	0.4188	14				

[a] Data from Carnagey's September 2008 Macroinvertebrate Assessment

TABLE 3-27 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, JANUARY 22-23, 2009[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.24645	2	0.12322	3.58529	0.06016	3.88529
Within Stations	0.41243	12	0.03437			
Total	0.65887	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.20995	2	0.60498	13.0738	0.00097	3.88529
Within Stations	0.55529	12	0.04627			
Total	1.76524	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.33227	2	0.16613	1.52273	0.25743	3.88529
Within Stations	1.30922	12	0.1091			
Total	1.64148	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00177	2	0.00089	0.7502	0.49318	3.88529
Within Stations	0.01419	12	0.00118			
Total	0.01596	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.09522	2	0.04761	1.92634	0.18814	3.88529
Within Stations	0.29659	12	0.02472			
Total	0.39181	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00842	2	0.00421	1.27477	0.31477	3.88529
Within Stations	0.03965	12	0.0033			
Total	0.04807	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.19332	2	0.09666	16	0.00041	3.88529
Within Stations	0.0725	12	0.00604			
Total	0.26582	14				

[a] Data from Carnagey's January 2009 Macroinvertebrate Assessment

TABLE 3-28 RESULTS OF THE SINGLE FACTOR ANOVA FOR LAKE MONTICELLO, APRIL 27, 2009[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.09011	2	0.04506	3.9747	0.04737	3.88529
Within Stations	0.13603	12	0.01134			
Total	0.22614	14				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	1.59565	2	0.79783	35.3732	0.00001	3.88529
Within Stations	0.27065	12	0.02255			
Total	1.86631	14				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.24547	2	0.12273	3.65038	0.05776	3.88529
Within Stations	0.40347	12	0.03362			
Total	0.64893	14				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.00034	2	0.00017	0.3393	0.71889	3.88529
Within Stations	0.00601	12	0.0005			
Total	0.00635	14				

ANOVA for Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.05831	2	0.02915	2.78199	0.10171	3.88529
Within Stations	0.12575	12	0.01048			
Total	0.18406	14				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.01936	2	0.00968	4.13354	0.04309	3.88529
Within Stations	0.02811	12	0.00234			
Total	0.04747	14				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Stations	0.30206	2	0.15103	65535	-	3.88529
Within Stations	0	12	0			
Total	0.30206	14				

[a] Data from Carnagey's April 2009 Macroinvertebrate Assessment

3.2.2 ONGOING STUDIES

3.2.2.1 PARR RESERVOIR

On September 11-12, 2012, 1051 specimens were collected from the three sample locations on Parr Reservoir, representing 51 taxa. The number of specimens collected, their NCBI tolerance values, functional feeding groups, and bioassessment metrics are displayed in Table 3-29 through Table 3-35.

The bioassessment metrics indicated that Parr Reservoir upstream and the discharge were similar. The Parr Reservoir upstream location had much lower taxa richness than the discharge location. Bioassessment metrics for Parr Tailrace downstream of Parr Reservoir were also calculated using instream benthic macroinvertebrate community rapid bioassessment. Due to the different bioassessment sampling protocol, and environment, the metrics were not compared to those at the upstream and discharge locations.

TABLE 3-29 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV) AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE PARR UPSTREAM REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species	5.00	P															
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC								1	1						
3	Dero sp.		SC															
4	Limnodrilus sp.	9.50	SC															
5	Naididae Genus species		SC			3			2		1		1	1				1
6	Pristina osborni		SC															
7	Spirosperma ferox	5.40	SC							1		1						
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
8	Ablabesmyia peleensis	9.67	P															
9	Chironomus sp.	9.63	CG															
10	Cladopelma sp.	4.09	CG															
11	Cladotanytarsus sp. B		CG										1					

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Chironomidae cont.																		
12	Clinotanypus sp.		P															
13	Cryptochironomus sp.	6.40	P	1		1	1			1	1					2		
14	Polypedilum halterale gp.	7.30	SH													1		
15	Procladius sp.	9.10	P															
16	Tanytarsus sp.	6.76	CF															
Ephemeroptera																		
Ephemeridae																		
17	Hexagenia limbata	4.90	CG									1						
Odonata																		
Gomphidae																		
18	Gomphus sp.	5.80	P															
Trichoptera																		
Hydroptilidae																		
19	Hydroptila sp.	6.22	SC															
Malacostraca																		
Cladocera																		
Sididae																		
20	Sida sp.		CF															
Cyclopoida																		
Cyclopidae																		
21	Eucyclops sp.		OM															

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	**Taxon**	**TV**	**FG**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**	**Rep 1**	**Rep 2**	**Rep 3**	**Rep 4**	**Rep 5**
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	30	17	20	20	20	60	21	54	67	67	2	10	11	3	1

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-30 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV) AND FUNCTIONAL FEEDING GROUPS (FG) FOR THE UNITS 2 & 3 DISCHARGE REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

				Sample Point 1					Sample Point 2					Sample Point 3				
Seq	Taxon	TV	FG	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Annelida																		
Hirudinea																		
1	Hirudinea Genus species	5.00	P	10	1	16	24	8	2	2			5					
Oligochaeta																		
Tubificida																		
Naididae																		
2	Branchiura sowerbyi	8.28	SC			5	4	2		1			1		1		5	
3	Dero sp.		SC	1	1	1	2											
4	Limnodrilus sp.	9.50	SC		2	1	3	2	1						1			
5	Naididae Genus species		SC	6	7	3	8	18		1	3		5		5		3	3
6	Pristina osborni		SC						1			1	1				1	
7	Spirosperma ferox	5.40	SC													1	1	
Arthropoda																		
Insecta																		
Diptera																		
Chironomidae																		
8	Ablabesmyia peleensis	9.67	P												1		1	
9	Chironomus sp.	9.63	CG												1			1
10	Cladopelma sp.	4.09	CG			2	1	2										
11	Cladotanytarsus sp. B		CG			1												
Chironomidae cont.																		
12	Clinotanypus sp.		P					1						1	1			1
13	Cryptochironomus sp.	6.40	P	1	1	1	1								2		2	1
14	Polypedilum halterale gp.	7.30	SH		1													
15	Procladius sp.	9.10	P	1		1				1								
16	Tanytarsus sp.	6.76	CF	1														
Ephemeroptera																		
Ephemeridae																		
17	Hexagenia limbata	4.90	CG											1	1			
Odonata																		
Gomphidae																		
18	Gomphus sp.	5.80	P			1												
Trichoptera																		
Hydroptilidae																		
19	Hydroptila sp.	6.22	SC														2	
Malacostraca																		
Cladocera																		
Sididae																		
20	Sida sp.		CF			2												
Cyclopoida																		
Cyclopidae																		
21	Eucyclops sp.		OM				1								1			
Mollusca																		
Bivalvia																		
Unionoida																		
Corbiculidae																		
22	Corbicula fluminea	6.12	CF	19	17	4	20	22	1	13	2	5	8	2	8	7	4	2

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-31 MACROINVERTEBRATES, THEIR NCBI TOLERANCE VALUES (TV), FUNCTIONAL FEEDING GROUPS (FG), AND RELATIVE ABUNDANCE FOR PARR TAILRACE AT PARR RESERVOIR, SEPTEMBER 12, 2012[A]

Seq	Taxon	TV	FG	No. of Individuals	Relative Abundance
Annelida					
Hirudinea					
1	Hirudinea Genus species	5.00	P	3	0.01
Rhynchobdellida					
Glossiphoniidae					
2	Helobdella sp.	9.00	P	2	0.01
Oligochaeta					
Tubificida					
Naididae					
3	Stylaria lacustris	9.40	SC	1	0.00
Arthropoda					
Insecta					
Diptera					
Chironomidae					
4	Ablabesmyia peleensis	9.67	P	1	0.00
5	Nanocladius crassicornis/cf. rectinervis	7.07	CG	8	0.03
6	Orthocladius robacki		SH	1	0.00
7	Parachironomus carinatus	9.42	P	1	0.00
8	Polypedilum flavum	4.90	SH	2	0.01
9	Rheocricotopus robacki	7.28	CG	3	0.01
Simuliidae					
10	Simulium luggeri		CF	52	0.18
Ephemeroptera					
Baetidae					
11	Baetis intercalaris	4.99	CG	3	0.01
Heptageniidae					
12	Maccaffertium integrum	5.80	SC	2	0.01
13	Maccaffertium modestum	5.50	SC	26	0.09
Isonychiidae					
14	Isonychia sp.	3.45	CF	2	0.01
Leptohyphidae					
15	Tricorythodes sp.	5.06	CG	24	0.08

Seq	Taxon	TV	FG	No. of Individuals	Relative Abundance
	Megaloptera				
	Corydalidae				
16	Corydalus cornutus	5.16	P	11	0.04
	Odonata				
	Coenagrionidae				
17	Argia moesta	8.17	P	11	0.04
	Libellulidae				
18	Neurocordulia virginiensis	2.05	P	3	0.01
	Trichoptera				
	Hydropsychidae				
19	Cheumatopsyche sp.	6.22	CF	12	0.04
20	Hydropsyche bidens		CF	20	0.07
21	Macrostemum carolina	3.52	CF	27	0.10
	Hydroptilidae				
22	Hydroptila sp.	6.22	SC	7	0.02
	Lepidostomatidae				
23	Lepidostoma sp.	0.90	SH	1	0.00
	Leptoceridae				
24	Ceraclea nepha/protonepha	2.01	CG	18	0.06
25	Oecetis persimilis	4.70	P	7	0.02
26	Triaenodes injustus	2.47	SH	1	0.00
	Philopotamidae				
27	Chimarra sp.	2.76	CF	2	0.01
	Polycentropodidae				
28	Neureclipsis crepuscularis	4.19	CF	1	0.00
	Malacostraca				
	Amphipoda				
	Gammaridae				
29	Gammarus sp.	9.10	OM	2	0.01
	Mollusca				
	Bivalvia				
	Unionoida				
	Corbiculidae				
30	Corbicula fluminea	6.12	CF	5	0.02
	Gastropoda				
	Mesogastropoda				
	Hydrobiidae				
31	Somatogyrus virginicus	6.40	SC	8	0.03
	Pleuroceridae				
32	Goniobasis catenaria catenaria		SC	12	0.04
	Platyhelminthes				
	Turbellaria				
	Tricladida				
	Planariidae				
33	Dugesia tigrina	7.50	OM	5	0.02

Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-32 BIOASSESSMENT METRICS FOR THE PARR UPSTREAM REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

	Parr Upstream														
	Sample Point 1					Sample Point 2					Sample Point 3				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	2	1	3	2	1	2	3	4	4	3	2	1	3	1	2
Number of Specimens	31	17	24	21	20	62	23	57	70	69	3	10	14	3	2
EPT Index	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
EPT Abundance	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Chironomidae Taxa	1	0	1	1	0	0	1	1	0	1	0	0	2	0	0
Chironomidae Abundance	1	0	1	1	0	0	1	1	0	1	0	0	3	0	0
EPT/Chironomidae Abundance	0.00	-	0.00	0.00	-	-	0.00	0.00	-	0.00	-	-	0.00	-	-
North Carolina Biotic Index	6.15	6.12	6.15	6.15	6.12	6.12	6.08	6.32	6.14	6.12	6.12	6.12	6.24	6.12	6.12
SCDHEC Bioclassification	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Percent Collector-Filterers	96.77	100.00	83.33	95.24	100.00	96.77	91.30	94.74	95.71	97.10	66.67	100.00	78.57	100.00	50.00
Percent Collector-Gatherers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	1.45	0.00	0.00	0.00	0.00	0.00
Percent Omnivores	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Predators	3.23	0.00	4.17	4.76	0.00	0.00	4.35	1.75	0.00	0.00	0.00	0.00	14.29	0.00	0.00
Percent Scrapers	0.00	0.00	12.50	0.00	0.00	3.23	4.35	3.51	2.86	1.45	33.33	0.00	0.00	0.00	50.00
Percent Shredders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.14	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.00	0.00	0.15	0.00	0.00	0.03	0.05	0.04	0.03	0.01	0.50	0.00	0.00	0.00	1.00
Percent Dominant Taxon	96.77	100.00	83.33	95.24	100.00	96.77	91.30	94.74	95.71	97.10	66.67	100.00	78.57	100.00	50.00
Number Of Dominant Taxa	1	1	2	1	1	1	1	1	1	1	2	1	3	1	2

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-33 BIOASSESSMENT METRICS FOR THE UNITS 2 & 3 DISCHARGE REPLICATES IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

	Units 2 & 3 Discharge														
	Sample Point 1					Sample Point 2					Sample Point 3				
Metric	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
Taxa Richness	7	7	12	9	7	4	5	2	2	5	3	10	2	8	5
Number of Specimens	39	30	38	64	55	5	18	5	6	20	4	22	8	19	8
EPT Index	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0
EPT Abundance	0	0	0	0	0	0	0	0	0	0	1	1	0	2	0
Chironomidae Taxa	3	2	4	2	2	0	1	0	0	0	1	4	0	2	3
Chironomidae Abundance	3	2	5	2	3	0	1	0	0	0	1	5	0	3	3
EPT/Chironomidae Abundance	0.00	0.00	0.00	0.00	0.00	-	0.00	-	-	-	1.00	0.20	-	0.67	0.00
North Carolina Biotic Index	5.80	6.39	6.10	6.25	6.13	6.87	6.43	6.12	6.12	5.95	5.51	7.42	5.94	7.09	7.38
SCDHEC Bioclassification	2.2	2.0	2.0	2.0	2.0	1.5	2.0	2.0	2.0	2.0	2.5	1.5	2.0	1.5	1.5
Percent Collector-Filterers	51.28	56.67	15.79	31.25	40.00	20.00	72.22	40.00	83.33	40.00	50.00	36.36	87.50	21.05	25.00
Percent Collector-Gatherers	0.00	0.00	7.89	1.56	3.64	0.00	0.00	0.00	0.00	0.00	25.00	9.09	0.00	0.00	12.50
Percent Omnivores	0.00	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	0.00	0.00
Percent Predators	30.77	6.67	50.00	39.06	16.36	40.00	16.67	0.00	0.00	25.00	25.00	18.18	0.00	15.79	25.00
Percent Scrapers	17.95	33.33	26.32	26.56	40.00	40.00	11.11	60.00	16.67	35.00	0.00	31.82	12.50	63.16	37.50
Percent Shredders	0.00	3.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper/Scraper & Collector-Filterers	0.35	0.59	1.67	0.85	1.00	2.00	0.15	1.50	0.20	0.88	0.00	0.88	0.14	3.00	1.50
Percent Dominant Taxon	48.72	56.67	42.11	37.50	40.00	40.00	72.22	60.00	83.33	40.00	50.00	36.36	87.50	26.32	37.50
Number Of Dominant Taxa	3	3	6	4	3	4	5	2	2	5	3	3	2	8	5

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-34 BIOASSESSMENT METRICS FOR THE COMBINED DATA COLLECTED AT THE PARR UPSTREAM AND UNITS 2 & 3 DISCHARGE LOCATIONS IN PARR RESERVOIR, SEPTEMBER 11, 2012[A]

Metric	Parr Upstream	Units 2 & 3 Discharge
Taxa Richness	8	22
Number of Specimens	426	341
EPT Index	1	2
EPT Abundance	1	4
Chironomidae Taxa	3	9
Chironomidae Abundance	9	28
EPT/Chironomidae	0.11	0.14
North Carolina Biotic Index	6.25	7.08
SCDHEC Bioclassification	2.0	1.5
Percent Collector-Filterers	94.60	40.18
Percent Collector-Gatherers	0.47	2.93
Percent Omnivores	0.00	0.59
Percent Predators	1.64	25.51
Percent Scrapers	3.05	30.50
Percent Shredders	0.23	0.29
Scraper/Collector-Filterers	0.03	0.76
Percent Dominant Taxon	94.60	39.30
Number Of Dominant Taxa	1	4

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

TABLE 3-35 BIOASSESSMENT METRICS FOR PARR TAILRACE DOWNSTREAM OF PARR RESERVOIR, SEPTEMBER 12, 2012[A]

Metric	Parr Tailrace
Taxa Richness	8
Number of Specimens	426
EPT Index	1
EPT Abundance	1
Chironomidae Taxa	3
Chironomidae Abundance	9
EPT/Chironomidae Abundance	0.11
North Carolina Biotic Index	6.25
SCDHEC Bioclassification	2.0
Percent Collector-Filterers	94.60
Percent Collector-Gatherers	0.47
Percent Omnivores	0.00
Percent Predators	1.64
Percent Scrapers	3.05
Percent Shredders	0.23
Scraper/Collector-Filterers	0.03
Percent Dominant Taxon	94.60
Number Of Dominant Taxa	1

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

Single factor ANOVA analyses were also completed at each site on Parr Reservoir. These results are shown in Table 3-36.

One-way ANOVA results show significant differences in bioassessment metrics in taxa richness (p-value = 0.00009), and percentage of dominant taxon (p-value = 0.000001) at the Parr Reservoir upstream location. At the Parr Reservoir discharge point, ANOVA results show significant differences in bioassessment metrics in percentage of dominant taxon (p-value = 0.03499), EPT Index values (p-value = 0.00592), EPT abundance (p-value = 0.00010). All other metrics show no significant difference.

TABLE 3-36 RESULTS OF THE SINGLE FACTOR ANOVA ON PARR RESERVOIR, 11 SEPTEMBER 2012[A]

ANOVA for Taxa Richness

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for EPT Index

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for Total Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for EPT Abundance

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for the Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for NCBI

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for the Percentage of the Dominant Taxon

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

ANOVA for SCDHEC Bioclassification

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Transects	1.81337	6	0.30223	13.9683	0.000001	2.50819
Within Transects	0.51928	24	0.02164			
Total	2.33265	30				

[a] Data from Carnagey's September 2012 Macroinvertebrate Assessment

4.0 DISCUSSION AND CONCLUSIONS

The Parr Fairfield Project operations do not appear to affect the overall water quality of the Parr Reservoir, Lake Monticello, and the Broad River below Parr Shoals Dam, according to mussel and macroinvertebrate studies. The data presented within the report depicts an overall healthy water system, providing suitable habitat for a variety of aquatic species. Ongoing monitoring efforts within the Project area will examine the macroinvertebrate community for any changes in water quality.

4.1 MUSSELS

The two freshwater mussel surveys conducted in 2007 and 2012 covered a large portion of the Broad River and Parr Reservoir, well documenting the mussel species in and around the Project area. Because of these studies, a current and comprehensive inventory of the freshwater mussels within the Project area exists.

The 2012 study revealed that the area of the Broad River immediately downstream of the Parr Shoals Dam provides a significant freshwater mussel habitat. Species were documented never before been seen in that area of the Broad River, while diversity at the study site was the greatest recorded in the Broad River Subbasin in North and South Carolina upriver from the Columbia Canal Dam (Alderman, 2012).

The 2007 study covered an expansive area, documenting the mussel species above and below Parr Shoals Dam, as well as within Parr Reservoir. The reservoir was determined to have the same diversity as the unimpounded sections of the river below Parr Shoals Dam. The stretch of the Broad River between Parr Shoals Dam and Columbia Dam was found to provide an excellent habitat for mussels.

4.2 MACROINVERTEBRATES

Baseline studies performed in 2008 and 2009 provide an inventory of macroinvertebrate species within the Project area. Monitoring efforts resumed in 2012 and will continue throughout the construction of the VCSNS expansion, and for five years after construction is complete.

Data collection and comparison of macroinvertebrate biometrics indicate neither spatial nor temporal significant difference within the Project Vicinity. The latest data concludes a SCDHEC score of “good-fair” and NCBI score of “good” immediately downstream of the Project location at the Parr Tailrace.

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APPENDIX A

NEAL SHOALS MACROINVERTEBRATE ASSESSMENT

MEMORANDUM

To: Alan Stuart, Kleinschmidt Associates
From: Daniel Carnagey, Carnagey Biological Services, LLC
Date: 21 June 2012
Subject: Preliminary Conclusions From the Neal Shoals Macroinvertebrate Assessment, 24-25 Apr 2012

Based on the collections made below Neal Shoals Dam, and a previous study made at Parr Reservoir (Parr) in 2008 and 2009, a number of conclusions may be drawn. However, a number of items should be noted. First, neither the North Carolina Biotic Index (NCBI), nor the SCDHEC Bioclassification index SCDHEC BI)are robust if the number of specimens collected is under 100. Their robustness is also compromised if a large number of the specimens collected are without a tolerance value. Second, because there is not a control station, nor data from before the sand release, comparisons are somewhat difficult. Finally, the Parr collections were nor made using the Rapid Bioassessment Protocol, but were petite Ponar Dredge samples. This means that they were collected from a somewhat different habitat (sediment from deeper and more open water) and that each repetition at a given stations has generally has a lower number of specimens and taxa richness.

The bioassessment metrics for the Neal Shoals collection are listed below in Table 1. Note that the NCBI and the SCDHEC BI values are suspect at Stations 2E and 2W for the reasons listed above. Otherwise all stations are quite similar in NCBI and SCDHEC BI scores.

Because most of the Parr replicates had less than 100 specimens, all the replicates at each station during each sampling event were combined. The combined data is in Table 2 and the bioassessment metrics are in Table 3. When compared to the Neal Shoals collections, the Parr samples are much poorer in nearly all metrics. In general, NCBI and SCDHEC BI were higher at Neal Shoals than at Parr. In addition, EPT indices and abundance was much higher at all Neal Shoals stations than at Parr. This is due, at least in part, to the collection methods.

In conclusion, the Neal Shoals samples showed significantly better results than the previous Parr samples. The Parr samples also indicate that the taxa richness in Neal Shoals seems to be what would be expected given the sampling constraints discussed in the Memo dated 18 June 2012.

Table 1. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	31.00	38.00	16.00	16.00	42.00	16.00
Number of Specimens	194.00	127.00	73.00	119.00	106.00	106.00
EPT Index	13.00	13.00	8.00	3.00	13.00	9.00
EPT Abundance	88.00	59.00	21.00	15.00	50.00	63.00
Chironomidae Taxa	12.00	9.00	3.00	1.00	8.00	2.00
Chironomidae Abundance	82.00	21.00	3.00	1.00	25.00	19.00
EPT/Chironomidae Abundance	1.07	2.81	7.00	15.00	2.00	3.32
NCBI	6.18	6.33	5.72	7.20	6.34	5.68
SCDHEC Bioclassification	2.50	2.50	2.80	1.50	2.50	2.80
%C-F	13.92	14.17	0.00	0.00	12.26	0.94
%C-G	11.34	6.30	5.48	10.08	30.19	17.92
%OM	1.55	0.79	5.48	1.68	6.60	0.00
%P	14.95	21.26	50.68	47.90	20.75	36.79
%SC	26.29	49.61	36.99	39.50	16.98	26.42
%SH	31.96	7.87	1.37	0.84	13.21	17.92
SC/C-F	1.89	3.50	-	-	1.38	28.00
SH/Total	0.32	0.08	0.01	0.01	0.13	0.18
%Dom Taxon	24.74	11.81	36.99	37.82	16.04	20.75
# Dom Taxa	7.00	6.00	5.00	7.00	5.00	7.00

Table 2. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for Broad River petite Ponar stations near the Parr Reservoir operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY.

				Sep-08		Jun-08		Jan-09		Apr-09	
Seq	**Taxon**	**TV**	**FG**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**
Annelida											
Hirudinea											
1	Hirudinea Genus species		P	1	41				16		
Rhynchobdellida											
Glossiphoniidae											
2	Helobdella stagnalis	8.63	P				8				
Oligochaeta											
Lumbriculida											
Lumbriculidae											
3	Lumbriculidae Genus species	7.03	SC	1		1	4				
Tubificida											
Naididae											
4	Branchiura sowerbyi	8.28	SC					1	5		
5	Limnodrilus hoffmeisteri	9.47	SC					17	13	3	13
6	Naididae Genus species		SC							55	52
7	Tubifex tubifex	10	SC	14	41	25	26	10	8		
Arthropoda											
Insecta											
Coleoptera											
Elmidae											
8	Dubiraphia sp.	5.93	CG	1							
9	Macronychus glabratus	4.58	CG					1			

Table 2. Continued.

				Sep-08	Jun-08	Jan-09	Apr-09

Seq	Taxon	TV	FG	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Diptera											
Athericidae											
10	Atherix sp.	2.1	P	1							
Ceratopogonidae											
11	Bezzia/Palpomyia sp.	6.86	P			2	2	2		4	
12	Culicoides sp.	7.7	P	1				2			
Chaoboridae											
13	Chaoborus sp.	8.5	P					1			
Chironomidae											
14	Ablabesmyia annulata	2.04	P				1				
15	Ablabesmyia mallochi	7.19	P				1				
16	Chironomus sp.	9.63	CG				34	11	6	1	4
17	Clinotanypus sp.		P	17	4			28	2	2	
18	Cryptochironomus sp.	6.4	P			1	2		2	1	
19	Cryptotendipes sp.	6.19	CG								
20	Dicrotendipes sp.	8.1	CG								
21	Fissimentum sp. A		CG			2					
22	Harnischia sp.	9.07	CG							2	
23	Microtendipes sp.	5.53	CF			5					
24	Paracladopelma undine	4.93	CG			2	1				
25	Polypedilum halterale gr.	7.31	SH				1			1	
26	Polypedilum illinoense gr.	9	SH						1		
27	Procladius sp.	9.1	P		3		13	13		2	
28	Rheotanytarsus exiguus gr.	5.89	CF		2		2				

Table 2. Continued.

Seq	Taxon	TV	FG	Sep-08		Jun-08		Jan-09		Apr-09	
				Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Chironomidae cont.											
29	Tanytarsus sp.	6.76	CF								
30	Thienemannimyia gr.	8.42	P							1	
31	Tribelos sp.	6.31	CG			3					
Ephemeroptera											
Ephemerellidae											
32	Ephemerella sp.	2.04	CG	1	17						
Ephemeridae											
33	Hexagenia limbata	4.9	CG				4			1	1
34	Hexagenia sp.	4.9	CG					1	2		
Odonata											
Gomphidae											
35	Gomphus sp.	5.8	P	1			1				
36	Stylurus plagiatus		P					2			
Trichoptera											
Hydroptilidae											
37	Hydroptilidae Genus species		0					3			
Leptoceridae											
38	Oecetis inconspicua complex	1.85	P	1	3						
39	Oecetis sp.	4.7	P						2		
Malacostraca											
Amphipoda											
Talitridae											
40	Hyalella azteca	7.75	OM				1				

Table 2. Continued.

				Sep-08		Jun-08		Jan-09		Apr-09	
Seq	**Taxon**	**TV**	**FG**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**	**Control**	**New Blowdown Discharge**
Isopoda											
Asellidae											
41	Caecidotea sp.	9.11	SC				2				
Mollusca											
Bivalvia											
Unionoida											
Corbiculidae											
42	Corbicula fluminea	6.12	CF	107	64	20	231	35	68	34	24
Sphaeriidae											
43	Sphaeriidae Genus species		CF					2			
Gastropoda											
Limnophila											
Physidae											
44	Physa sp.	8.84	SC				1				
Planorbidae											
45	Promenetus exacuous		SC				4				
TOTAL				146	175	61	339	129	125	107	94

Table 3. Bioassessment metrics for the Broad River rapid bioassessment stations near Parr reservoir operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY.

	Sep-08		Jun-08		Jan-09		Apr-09	
	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge	Control	New Blowdown Discharge
Taxa Richness	11	8	9	19	15	11	12	5
Number of Specimens	146	175	61	339	129	125	107	94
EPT Index	2	2	0	1	2	2	1	1
EPT Abundance	2	20	0	4	4	4	1	1
Chironomidae Taxa	1	3	5	8	3	4	7	1
Chironomidae Abundance	17	9	13	55	52	11	10	4
EPT/Chironomidae Abundance	0.12	2.22	0.00	0.07	0.08	0.36	0.10	0.25
NCBI	7.17	5.96	7.40	8.04	8.64	8.02	7.17	7.90
SCDHEC Bioclassification	1.5	2	1.5	1	1	1	1.5	1
%C-F	73.29	37.71	40.98	68.73	28.68	54.40	31.78	25.53
%C-G	1.37	9.71	11.48	11.50	10.08	6.40	3.74	5.32
%OM	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00
%P	15.07	29.14	4.92	8.26	37.21	17.60	9.35	0.00
%SC	10.27	23.43	42.62	10.91	21.71	20.80	54.21	69.15
%SH	0.00	0.00	0.00	0.29	0.00	0.80	0.93	0.00
SC/C-F	0.14	0.62	1.04	0.16	0.76	0.38	1.71	2.71
%Dom Taxon	73.29	36.57	40.98	68.14	27.13	54.40	51.40	55.32
# Dom Taxa	3	4	3	3	6	4	2	3

MEMORANDUM

To: Alan Stuart, Kleinschmidt Associates
From: Daniel Carnagey, Carnagey Biological Services, LLC
Date: 17 May 2013
Subject: Neal Shoals Macroinvertebrate Assessment of 10-11 April 2013

On 10-11 April 2013, personnel from CARNAGEY BIOLOGICAL SERVICES, LLC (SCDHEC Laboratory Certification No. 32010) and Kleinschmidt Associates conducted an instream benthic macroinvertebrate community rapid bioassessment on the Broad River, downstream of the Neal Shoals Dam operated by South Carolina Electric & Gas Company (SCE&G).

One sample was collected from each bank in each of the three segments specified in the study plan. Sampling lasted for 30 minutes on each bank. Sampling consisted of using a D-ring dip net to sample habitat along the bank, as well as examining submerged logs and rocks for invertebrates. The water depth did not allow for sampling at any distance from the bank.

RESULTS

A total of 905 specimens representing 86 taxa were collected from the six stations during this assessment. Bioassessment metrics for the 2013 collection are listed in Table 1. The number of specimens collected, their NCBI tolerance values, functional feeding groups, and relative abundance at each station are presented in Table 3. Tables 2 and 4 are the values for the Spring 2012 collections. Both have been corrected for the season (spring) and use the most up to date available tolerance values from SCDHEC (2012).

Comparison to Spring 2012 Assessment

With the exception of Segment 2, taxa richness and EPT index values were similar for the two years. In Segment 2, both were much higher in 2013. Spring 2013 EPT abundance was higher in Segments 2 and 3, and were very similar to 2012 in Segment 1. The 2013 North Carolina Biotic Index (NCBI) and SCDHEC bioclassifications scores were numerically better at all stations than in 2012.

Comparison to the 2008 and 2009 collections made in Parr Reservoir

As noted in a previous memo (21 June 2012), the Parr Reservoir metrics were much poorer in nearly all metrics than the Spring 2012 Neal Shoals collection. This is also true for the Spring 2013 collection. That memo should be referenced for the Parr Reservoir data and a short discussion of the difficulties in comparing these studies.

Conclusion

In conclusion, while the collections made in Spring 2012 and Spring 2013 were similar, the 2013 collections had better scores at all stations. This was especially true in Segment 2. The difference in EPT taxa between the two collections is the largest cause of this difference. Both of the Neal Shoals collections have shown much better metric scores than previous studies in Parr Reservoir.

Table 1. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 10-11 April 2013.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	24	36	40	39	39	33
Number of Specimens	118	113	173	146	175	180
EPT Index	13	13	20	14	13	11
EPT Abundance	88	58	143	75	122	123
Chironomidae Taxa	7	13	9	10	15	13
Chironomidae Abundance	24	36	15	52	36	36
EPT/Chironomidae Abundance	3.67	1.61	9.53	1.44	3.39	3.42
NCBI	5.03	6.22	5.41	6.28	5.69	5.67
SCDHEC Bioclassification	3.7	2.7	4.2	2.8	3.2	3.0
%C-F	24.58	39.82	38.73	8.90	8.57	43.33
%C-G	19.49	9.73	5.78	30.82	52.57	10.56
%OM	0.00	2.65	0.00	1.37	0.57	0.00
%P	31.36	24.78	16.18	17.81	15.43	11.11
%SC	10.17	7.96	37.57	34.25	13.14	27.78
%SH	14.41	15.04	1.73	6.85	9.71	7.22
SC/C-F	0.41	0.20	0.97	3.85	1.53	0.64
SH/Total	0.14	0.15	0.02	0.07	0.10	0.07
%Dom Taxon	24.58	20.35	19.08	21.23	17.14	17.78
# Dom Taxa	8	5	5	3	5	6

Table 2. Bioassessment metrics for the six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

	Sta. 1E	Sta. 1W	Sta. 2E	Sta. 2W	Sta. 3E	Sta. 3W
Taxa Richness	31	38	16	16	42	16
Number of Specimens	194	127	73	119	106	106
EPT Index	13	13	8	3	13	9
EPT Abundance	88	59	21	15	50	63
Chironomidae Taxa	12	9	3	1	8	2
Chironomidae Abundance	82	21	3	1	25	19
EPT/Chironomidae Abundance	1.07	2.81	7.00	15.00	2.00	3.32
NCBI	6.49	6.47	6.00	7.50	6.81	5.98
SCDHEC Bioclassification	2.2	2.3	2.3	1.2	2.0	2.3
%C-F	13.92	14.17	0.00	0.00	12.26	0.94
%C-G	11.34	6.30	5.48	10.08	30.19	17.92
%OM	1.55	0.79	5.48	1.68	6.60	0.00
%P	14.95	21.26	50.68	47.90	20.75	36.79
%SC	26.29	49.61	36.99	39.50	16.98	26.42
%SH	31.96	7.87	1.37	0.84	13.21	17.92
SC/C-F	1.89	3.50	-	-	1.38	28.00
SH/Total	0.32	0.08	0.01	0.01	0.13	0.18
%Dom Taxon	24.74	11.81	36.99	37.82	16.04	20.75
# Dom Taxa	7	6	5	7	5	7

Table 3. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 10-11 April 2013.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Annelida															
Hirudinea															
Rhynchobdellida															
Glossiphoniidae															
1	Helobdella sp.	9.30	P						1.00						0.01
Oligochaeta															
Haplotaxida															
Lumbricidae															
2	Lumbricidae Genus species		SC			1						0.01			
Lumbriculida															
Lumbriculidae															
3	Eclipidrilus lacustris	7.33	SC			1						0.01			
Tubificida															
Naididae															
4	Branchiura sowerbyi	8.58	SC				2						0.01		
5	Dero sp.		SC		1	1	1	2	1.00		0.01	0.01	0.01	0.01	0.01
6	Limnodrilus sp.	9.80	SC				1						0.01		
7	Stylaria lacustris	9.70	SC						1.00						0.01
Arthropoda															
Arachnoidea															
Acariformes															
Hydrachnidae															
8	Hydrachna sp.	5.83	P	2						0.02					

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Insecta															
Coleoptera															
Elmidae															
9	Ancyronyx variegatus	6.79	CG			1		2	4.00			0.01		0.01	0.02
10	Dubiraphia quadrinotata	6.23	CG					1						0.01	
11	Macronychus glabratus	4.88	CG			1		4	2.00			0.01		0.02	0.01
Gyrinidae															
12	Dineutus discolor	5.84	P		1						0.01				
Haliplidae															
13	Peltodytes bradleyi	9.03	SH				1						0.01		
14	Peltodytes duodecimpunctatus	9.03	SH				1						0.01		
Noteridae															
15	Hydrocanthus atripennis	7.44	P	1						0.01					
Diptera															
Chironomidae															
16	Ablabesmyia mallochi	7.49	P		2	2	3	1			0.02	0.01	0.02	0.01	
17	Ablabesmyia peleensis	9.97	P		5	2		1	1.00		0.04	0.01		0.01	0.01
18	Brillia flavifrons	5.50	SH					1						0.01	
19	Chironomus sp.	9.93	CG					1	1.00					0.01	0.01
20	Corynoneura sp.		CG			2	2		2.00			0.01	0.01		0.01
21	Cricotopus sp.		SH		2			1	1.00		0.02			0.01	0.01
22	Dicrotendipes neomodestus	8.40	CG	1				2		0.01				0.01	
23	Eukiefferiella brehmi gr.	3.00	CG	2	3	1	2			0.02	0.03	0.01	0.01		
24	Hydrobaenus sp.	9.84	SC	3	1		1	1		0.03	0.01		0.01	0.01	
25	Nanocladius distinctus	7.37	CG		2				2.00		0.02				0.01
26	Omisus sp.		CG					3						0.02	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Chironomidae cont.															
27	Orthocladius sp.		SH	8	6	1	5	2	2.00	0.07	0.05	0.01	0.03	0.01	0.01
28	Paralauterborniella nigrohalterale	5.07	CG			1						0.01			
29	Parametriocnemus sp.	3.95	CG	1					5.00	0.01					0.03
30	Polypedilum flavum	5.20	SH	8	2	1	1	2	10.00	0.07	0.02	0.01	0.01	0.01	0.06
31	Polypedilum halterale gr.	7.60	SH		3		1	7			0.03		0.01	0.04	
32	Polypedilum illinoense gr.	9.30	SH		2			2			0.02			0.01	
33	Rheocricotopus robacki	7.58	CG		2				2.00		0.02				0.01
34	Rheotanytarsus exiguus gr.	6.19	CF		2	2			7.00		0.02	0.01			0.04
35	Stictochironomus sp.	6.82	CG				31	6	1.00				0.21	0.03	0.01
36	Tanytarsus sp.	7.06	CF				2	2	1.00				0.01	0.01	0.01
37	Zavrelimyia sp.		P	1	4	3	4	4	1.00	0.01	0.04	0.02	0.03	0.02	0.01
Simuliidae															
38	Simulium slossanae		CF	2				1		0.02				0.01	
Tipulidae															
39	Tipula sp.	7.63	SH					1						0.01	
Ephemeroptera															
Baetidae															
40	Baetis intercalaris	5.29	CG	3	1					0.03	0.01				
41	Plauditus puntiventris	4.30	CG					30						0.17	
Caenidae															
42	Caenis sp.	7.71	CG		1		4	22			0.01		0.03	0.13	
Ephemerellidae															
43	Dannella simplex	3.91	CG	6	1	1	1	4		0.05	0.01	0.01	0.01	0.02	
44	Ephemerella sp.	2.34	CG	10	1	1		15		0.08	0.01	0.01		0.09	
45	Eurylophella funeralis	2.35	CG			1	5					0.01	0.03		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
	Ephemeridae														
46	Hexagenia limbata	5.20	CG			1						0.01			
	Heptageniidae														
47	Maccaffertium integrum	6.10	SC	2	3	25	24	10	27.00	0.02	0.03	0.14	0.16	0.06	0.15
48	Maccaffertium modestum	5.80	SC	6	3	33	20	8	14.00	0.05	0.03	0.19	0.14	0.05	0.08
49	Stenacron interpunctatum	7.17	SC			1	1	2				0.01	0.01	0.01	
	Isonychiidae														
50	Isonychia sp.	3.75	CF	2	5	19	1	5	24.00	0.02	0.04	0.11	0.01	0.03	0.13
	Leptophlebiidae														
51	Leptophlebia sp.	6.53	CG					2						0.01	
	Odonata														
	Aeshnidae														
52	Boyeria vinosa	6.19	P					1						0.01	
	Calopterygidae														
53	Calopteryx sp.	8.08	P					1						0.01	
	Coenagrionidae														
54	Argia moesta	8.47	P				2						0.01		
55	Argia tibialis	8.47	P			3	2					0.02	0.01		
56	Enallagma sp.	9.21	P		1	1	2				0.01	0.01	0.01		
	Gomphidae														
57	Erptogomphus designatus		P		1		1				0.01		0.01		
58	Gomphus sp.	6.10	P		1		1	1	1.00		0.01		0.01	0.01	0.01
	Libellulidae														
59	Epicordulia princeps	5.90	P			2	1					0.01	0.01		
60	Macromia taeniolata	6.46	P		2		1		2.00		0.02		0.01		0.01

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Plecoptera															
Nemouridae															
61	Amphinemura sp.	3.63	SH					1						0.01	
Perlidae															
62	Agnetina sp.	0.30	P	1						0.01					
63	Neoperla sp.	1.79	P			3	1					0.02	0.01		
64	Paragnetina fumosa	3.66	P			1						0.01			
65	Perlesta sp.	5.00	P	29	7	9	6	18	12.00	0.25	0.06	0.05	0.04	0.10	0.07
Perlodidae															
66	Isoperla bilineata	5.74	P	3	3	1			2.00	0.03	0.03	0.01			0.01
Pteronarcyidae															
67	Pteronarcys sp.	1.97	SH	1						0.01					
Trichoptera															
Hydropsychidae															
68	Cheumatopsyche sp.	6.52	CF	18	23	29	6	4	32.00	0.15	0.20	0.17	0.04	0.02	0.18
69	Hydropsyche incommoda	5.07	CF	6	7	1			4.00	0.05	0.06	0.01			0.02
70	Hydropsyche simulans/rossi		CF	1		3	2	1	2.00	0.01		0.02	0.01	0.01	0.01
71	Hydropsyche venularis	5.26	CF						4.00						0.02
Hydroptilidae															
72	Hydroptila sp.	6.52	SC			1						0.01			
Leptoceridae															
73	Nectopsyche exquisita	4.40	SH		2						0.02				
74	Oecetis persimilis	5.00	P		1	1	2				0.01	0.01	0.01		
Limnephilidae															
75	Pycnopsyche sp.	2.82	SH			1	1					0.01	0.01		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3.   Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
	Philopotamidae														
76	Chimarra sp.	3.06	CF			3			1.00			0.02			0.01
	Polycentropodidae														
77	Neureclipsis crepuscularis	4.49	CF			8	1		1.00			0.05	0.01		0.01
	Malacostraca														
	Amphipoda														
	Gammaridae														
78	Gammarus sp.	9.40	OM		1						0.01				
	Talitridae														
79	Hyalella azteca	8.05	OM				1						0.01		
	Decapoda														
	Cambaridae														
80	Cambaridae Genus species	7.80	OM					1						0.01	
Mollusca															
	Bivalvia														
	Unionoida														
	Corbiculidae														
81	Corbicula fluminea	6.42	CF		8	2	1	2	2.00		0.07	0.01	0.01	0.01	0.01
	Gastropoda														
	Limnophila														
	Lymnaeidae														
82	Lymnaea columella		SC	1						0.01					
	Physidae														
83	Physa sp.	9.14	SC			1						0.01			
	Planorbidae														
84	Helisoma anceps	6.53	SC			1						0.01			

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Mesogastropoda															
Pleuroceridae															
85	Goniobasis catenaria catenaria		SC		1				7.00		0.01				0.04
Platyhelminthes															
Turbellaria															
Tricladida															
Planariidae															
86	Dugesia tigrina	7.80	OM		2		1				0.02		0.01		

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Macroinvertebrates, their NCBI tolerance values (TV), functional feeding groups (FG), and relative abundance for six Broad River rapid bioassessment stations downstream from the Neal Shoals Dam operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY, 24-25 April 2012.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Annelida															
Hirudinea															
1	Hirudinea Genus species	5.30	P				1						0.01		
Rhynchobdellida															
Glossiphoniidae															
2	Helobdella sp.	9.30	P		1						0.01				
Oligochaeta															
Haplotaxida															
Lumbricidae															
3	Lumbricidae Genus species		SC					2						0.02	
Lumbriculida															
Lumbriculidae															
4	Eclipidrilus lacustris	7.33	SC		1						0.01				
5	Lumbriculus variegatus	7.33	SC		4			1			0.04			0.01	
Tubificida															
Naididae															
6	Branchiura sowerbyi	8.58	SC		1						0.01				
7	Pristina jenkinae		SC					1	1					0.01	0.01
8	Pristina osborni		SC		2						0.02				
9	Slavina appendiculata	7.36	CG	1						0.01					

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Arthropoda															
Insecta															
Coleoptera															
Dytiscidae															
10	Neoporus clypealis	8.92	P					1						0.01	
11	Neoporus dilatatus	8.92	P					6						0.06	
12	Neoporus striatopunctatus	8.92	P					1						0.01	
Elmidae															
13	Ancyronyx variegatus	6.79	CG				7						0.06		
14	Macronychus glabratus	4.88	CG		1	1	5	5	3		0.01	0.01	0.04	0.05	0.03
15	Stenelmis sp.	5.40	SC	2						0.01					
Haliplidae															
16	Peltodytes bradleyi	9.03	SH					1						0.01	
17	Peltodytes duodecimpunctatus	9.03	SH					1						0.01	
Hydrophilidae															
18	Sperchopsis tessellatus	6.43	CG					1						0.01	
Noteridae															
19	Hydrocanthus atripennis	7.44	P			1		1	1			0.01		0.01	0.01
Diptera															
Ceratopogonidae															
20	Bezzia/Palpomyia sp.	7.16	P		1			1			0.01			0.01	
Chironomidae															
21	Ablabesmyia mallochi	7.49	P	5	7			3		0.03	0.06			0.03	
22	Chironomus sp.	9.93	CG					1						0.01	
23	Corynoneura sp.		CG	3		1		2		0.02		0.01		0.02	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
	Chironomidae cont.														
24	Cricotopus sp.		SH	1						0.01					
25	Dicrotendipes neomodestus	8.40	CG	1						0.01					
26	Dicrotendipes sp.	8.40	CG			1						0.01			
27	Orthocladius sp.		SH	48	6			11		0.26	0.05			0.10	
28	Paratanytarsus sp.	8.75	CF		1						0.01				
29	Polypedilum fallax gr.	6.69	SH				1	1	16				0.01	0.01	0.15
30	Polypedilum flavum	5.20	SH	1	1					0.01	0.01				
31	Polypedilum illinoense gr.	9.30	SH	11	1	1			3	0.06	0.01	0.01			0.03
32	Polypedilum scalaenum gr.	8.70	SH	1						0.01					
33	Procladius sp.	9.40	P					2						0.02	
34	Pseudochironomus sp.	5.66	CG		1						0.01				
35	Tanytarsus sp.	7.06	CF	3	1			4		0.02	0.01			0.04	
36	Thienemanniella similis	6.20	CG	5						0.03					
37	Thienemanniella xena	6.20	CG	1	1			1		0.01	0.01			0.01	
38	Thienemannimyia gr.		P	2	2					0.01	0.02				
	Ephemeroptera														
	Baetidae														
39	Baetis intercalaris	5.29	CG	2	1	1		4	14	0.01	0.01	0.01		0.04	0.13
40	Heterocloeon sp.	3.78	SC	1		1		1	2	0.01		0.01		0.01	0.02
41	Procloeon sp.	5.30	OM	2	1	4	2	6		0.01	0.01	0.05	0.02	0.06	
	Caenidae														
42	Caenis sp.	7.71	CG		3			17			0.03			0.16	
	Ephemerellidae														
43	Dannella simplex	3.91	CG					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
	Heptageniidae														
44	Maccaffertium integrum	6.10	SC	18	13	7	12	6	8	0.10	0.11	0.10	0.10	0.06	0.08
45	Maccaffertium modestum	5.80	SC	4	10	2	1	3	1	0.02	0.09	0.03	0.01	0.03	0.01
46	Stenacron interpunctatum	7.17	SC	1	3	2				0.01	0.03	0.03			
	Isonychiidae														
47	Isonychia sp.	3.75	CF	1				3		0.01				0.03	
	Leptohyphidae														
48	Tricorythodes sp.	5.36	CG	3	1					0.02	0.01				
	Leptophlebiidae														
49	Leptophlebia sp.	6.53	CG						2						0.02
	Heteroptera														
	Gerridae														
50	Rheumatobates sp.		P		7	27	45		13		0.06	0.37	0.38		0.12
	Mesoveliidae														
51	Mesovelia mulsanti		P					1						0.01	
	Nepidae														
52	Ranatra nigra	8.10	P					1						0.01	
	Megaloptera														
	Corydalidae														
53	Corydalus cornutus	5.46	P		1						0.01				
	Odonata														
	Aeshnidae														
54	Boyeria vinosa	6.19	P					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
	Coenagrionidae														
55	Argia apicalis	8.47	P				4						0.03		
56	Argia tibialis	8.47	P				5						0.04		
	Gomphidae														
57	Gomphus consanguis	6.10	P			6		1				0.08		0.01	
58	Gomphus sp.	6.10	P				2						0.02		
	Libellulidae														
59	Macromia illinoense	6.46	P		1						0.01				
	Plecoptera														
	Perlidae														
60	Acroneuria sp.		P		2						0.02				
61	Neoperla sp.	1.79	P		1				3		0.01				0.03
62	Perlesta sp.	5.00	P	20	4	3		2	22	0.11	0.04	0.04		0.02	0.21
	Trichoptera														
	Hydropsychidae														
63	Cheumatopsyche sp.	6.52	CF	12	3			1	1	0.07	0.03			0.01	0.01
64	Hydropsyche sp.		CF					4						0.04	
	Hydroptilidae														
65	Hydroptila sp.	6.52	SC	16	15	1		1	10	0.09	0.13	0.01		0.01	0.09
	Leptoceridae														
66	Ceraclea tarsipunctata	2.31	CG	6						0.03					
67	Oecetis persimilis	5.00	P	2						0.01					
68	Triaenodes sp.	4.76	SH		2						0.02				
	Polycentropodidae														
69	Polycentropus sp.	3.83	P					1						0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Malacostraca															
Amphipoda															
Gammaridae															
70	Gammarus sp.	9.40	OM	1						0.01					
Talitridae															
71	Hyalella azteca	8.05	OM					1						0.01	
Cladocera															
Sididae															
72	Sida sp.		CF	1						0.01					
Isopoda															
Asellidae															
73	Caecidotea sp.	9.40	SC		3		10	1			0.03		0.08	0.01	
Mollusca															
Bivalvia															
Unionoida															
Corbiculidae															
74	Corbicula fluminea	6.42	CF	10	13			1							
Gastropoda															
Limnophila															
Physidae															
75	Physa sp.	9.14	SC	9	5		9	1	6	0.05	0.04		0.08	0.01	0.06
Planorbidae															
76	Helisoma anceps	6.53	SC				7						0.06		
77	Menetus dilatatus	8.53	SC		1		7	1			0.01		0.06	0.01	

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Continued.

				No. of Individuals						Relative Abundance					
Seq	**Taxon**	**TV**	**FG**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**	**Sta. 1 E**	**Sta. 1 W**	**Sta. 2 E**	**Sta. 2 W**	**Sta. 3 E**	**Sta. 3 W**
Mesogastropoda															
Pleuroceridae															
78	Goniobasis catenaria catenaria		SC		3	14	1				0.03	0.19	0.01		
Viviparidae															
79	Campeloma decisum	6.75	SC		2						0.02				

* Functional feeding groups: CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

APPENDIX B

MACROINVERTEBRATE ASSESSMENT OF THE BROAD RIVER NEAR THE PARR HYDROELECTRIC PROJECT, 2014

MACROINVERTEBRATE ASSESSMENT OF THE BROAD RIVER NEAR THE PARR HYDROELECTRIC PROJECT OPERATED BY SOUTH CAROLINA ELECTRIC AND GAS COMPANY (SCE&G), NEWBERRY AND RICHLAND COUNTIES, SOUTH CAROLINA

AUGUST 2014

Submitted To:

KLEINSCHMIDT ASSOCIATES
Lexington, South Carolina

Submitted by:

CARNAGEY BIOLOGICAL SERVICES, LLC
636 Westwood Drive
Lexington, South Carolina
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SCDHEC Laboratory Certification No. 32572

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I. SUMMARY

On 28 and 29 August 2014, CARNAGEY BIOLOGICAL SERVICES, LLC (SCDHEC Laboratory Certification Number 32572) conducted a benthic macroinvertebrate community assessment on the Broad River, near the Parr Hydroelectric Project, operated by SOUTH CAROLINA ELECTRIC & GAS COMPANY. The objective of this proposed study is to determine the condition of the macroinvertebrate community in the Broad River adjacent to Parr Reservoir, utilizing the Multi-habitat Rapid Bioassessment Protocol.

Results of the benthic macroinvertebrate assessment indicated the river's macroinvertebrate community was healthy at all three stations. All three stations had SCDHEC ratings of "good" which indicates that the river is fully supporting of aquatic life. The NCBI rating for Stations 2 and 3 was "excellent", while Station 1 had a value of "good". All three stations shared similar taxa richness, EPT indices, and number of Chironomidae taxa.

The water chemistry data measured in conjunction with the macroinvertebrate assessment showed similar temperature, pH, dissolved oxygen, and conductivity at all three stations. All parameters monitored were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

II. INTRODUCTION

On 28 and 29 August 2014, a benthic macroinvertebrate community assessment was conducted on the Broad River near the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina.

III. DESCRIPTION OF STUDY AREA

Collections of aquatic macroinvertebrates were made from three sampling locations in the Broad River near the Parr Hydroelectric Project (Figure 1).

Station 1 was located near the downstream end of Henderson Island, approximately 25 kilometers upstream of Parr Shoals Dam. The substrate consisted mainly of gravel, large boulders, exposed bedrock, and sand with silt along the edges.

Station 2 was located approximately 75 meters downstream of Parr Shoals dam. The substrate consisted mainly of gravel, large boulders, and exposed bedrock, in addition to some large logs and other woody debris.

Station 3 was located near the downstream end of Bookman Island, approximately 24 kilometers downstream of Parr Shoals Dam. The substrate consisted mainly of gravel, large boulders, and exposed bedrock, in addition to some large logs and other woody debris.

Figure 1. Overview of sampling locations for benthic macroinvertebrates to be collected from the Broad River as part of the relicensing of the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina.

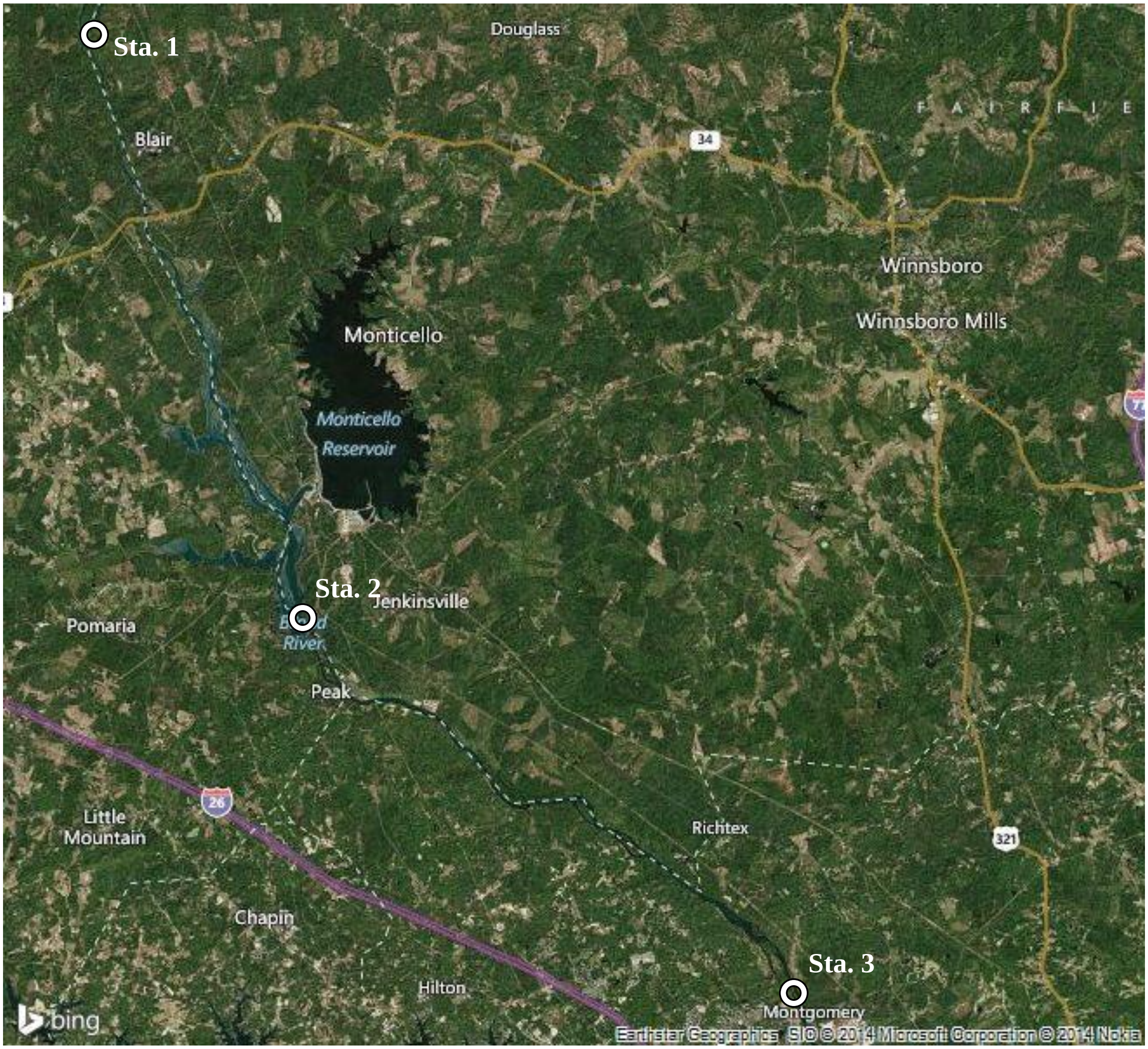

Figure 2. Location of Station 1 for collection of benthic macroinvertebrates from the Broad River as part of the relicensing of the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina.

Photo 1. Looking Upstream at Station 1, Henderson Island in the center.

Photo 2. Looking across Station 1, from the east bank.

Figure 3. Location of Station 2 for collection of benthic macroinvertebrates from the Broad River as part of the relicensing of the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina.

Photo 3. Looking downstream at Station 2, from the east bank.

Photo 4. Looking downstream at Station 2, from the east bank.

Figure 4. Location of Station 3 for collection of benthic macroinvertebrates from the Broad River as part of the relicensing of the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina.

Photo 5. Looking across Station 3, from the west bank.

Photo 6. Looking upstream at Station 3.

IV. METHODS

A. Field Sampling

Qualitative collections of aquatic macroinvertebrates were made with a D-frame aquatic dip net, a U.S. Standard No. 30 sieve, and hand picking organisms from substrates with forceps. The multiple habitat approach, where specimens from all available habitats (stream margins, leaf packs, aquatic vegetation, water-soaked logs, and sand deposits) are pooled to form one aggregate sample was utilized as the sampling procedure. Samples were preserved in the field with 80% ethanol. Each sample represented 3.0 hours of sampling effort. Sampling procedures and habitat types were kept similar at each station to enable species and numerical population comparisons between stations. Habitat scores were determined using the *Habitat Assessment Field Data Sheet for Low Gradient Streams* (Barbour *et al*., 1999).

B. Water Chemistry

Water chemistry parameters measured at each station in conjunction with the macroinvertebrate sampling included temperature, pH, conductivity, and dissolved oxygen.

C. Sample Processing

Upon return to the laboratory, macroinvertebrates were sorted from debris with the aid of a stereomicroscope. The macroinvertebrates were enumerated and identified to the lowest positive taxonomic level with the aide of appropriate microscopic techniques and taxonomic keys. All specimens will be maintained in CARNAGEY BIOLOGICAL SERVICES, LLC voucher collection for five years or placed into the permanent reference collection.

D. Data Analysis

Comparisons of the macroinvertebrate communities were based on the known tolerance levels and life history strategies of the organisms encountered and on changes in taxonomic composition between sampling stations. Changes in taxonomic composition were determined using metrics outlined in Rapid Bioassessment Protocol III of the US EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC, 1999). These metrics included the following:

1) Taxa richness - The number of different taxa found at a particular location is an indication of diversity. Reductions in community diversity have been positively associated with various forms of environmental pollution, including nutrient loading, toxic substances, and sedimentation (Barbour *et al*., 1996; Fore *et al*., 1996; Rosenberg and Resh, 1993; Shackleford, 1988).

2) EPT Index - EPT Index is the number of taxa from the insect orders Ephemeroptera, Plecoptera and Trichoptera found at a station. These three insect orders are considered to be intolerant of adverse changes in water quality, especially temperature and dissolved oxygen, and therefore, a reduction in these taxa is indicative of reduced water quality (Barbour *et al*., 1996; Lenat, 1988).

3) Chironomidae taxa and abundance - The Chironomidae are a taxonomically and ecologically diverse group with many taxa which are tolerant of various forms of pollution. The chironomids are often the dominant group encountered at impacted or stressed sites (Rosenberg and Resh, 1993).

4) Ratio of EPT and Chironomidae abundance - The relative abundance of these four indicator groups is a measure of community balance. When compared to a reference site, good biotic conditions are reflected in a fairly even distribution among these four groups (Plafkin *et al*., 1989). The value of this ratio is reduced by impact due to the general reduction of the more sensitive EPT taxa and an increase in the more tolerant chironomid taxa.

5) Ratio of scraper/scraper and filtering collectors - When compared to a reference site, shifts in the dominance of a particular feeding type may indicate a community responding to an over-abundance of a particular food source or toxicants bound to a particular food source (Rosenberg and Resh, 1993).

6) Shredder/total number of specimens collected - When compared to a reference site, reductions in the relative abundance of shredders can indicate changes in the quality or quantity of riparian zone vegetation or the presence of toxic substances bound to organic carbon contained in the leaf and woody material which comprises their food source (Plafkin *et al*., 1989).

7) Percent contribution of dominant taxon - This measures the redundancy and evenness of the community structure. It assumes a highly redundant community reflects an impaired community because as the more sensitive taxa are eliminated, there is often a significant increase in the remaining tolerant forms (Barbour *et al*., 1996; Shackleford, 1988).

8) Dominant taxa in common - When compared to a reference site, major shifts in the composition and abundance of dominant taxa can indicate environmental stress (Barbour *et al*., 1996; Shackleford, 1988).

9) Community loss index (Table 1) - This index measures the loss of taxa between a reference or control station and a study site. It is an index of dissimilarity, with values increasing as the degree of dissimilarity from the reference station increases (Courtemanch and Davies, 1987; Plafkin *et al*., 1989).

10) Jaccard coefficient of community similarity (Table 1) - This coefficient represents the degree of similarity in taxonomic composition between two stations in terms of taxon presence or absence. Values range from 0 to 1.0, increasing as the degree of similarity increases (Jaccard, 1912; Plafkin *et al*., 1989).

11) Sörensen coefficient (Table 1) - This coefficient represents the degree of similarity in taxonomic composition between two stations in terms of taxon presence or absence. Values range from 0 to 1.0, increasing as the degree of similarity increases (Breitenmoser-Würsten and Satori, 1995).

12) North Carolina biotic index (Table 1) - This index utilizes a pollution tolerance value developed over a wide range of conditions and pollution types to assess the amount of impact (North Carolina Department of Environment, Health and Natural Resources, 1997). The values range from 0-10, increasing as water quality decreases. Taxa are designated as Rare (1-2 specimens), Common (3-9 specimens), or Abundant (≥10 specimens) and assigned a 1, 3, or 10 abundance code, respectively, for calculation of the NCBI.

13) SCDHEC bioclassification – Bioclassification is determined by averaging scores for the NCBI and EPT index at each station, then rating sites as "Excellent, Good, Good-Fair, Fair, or Poor" (SCDHEC, 1999).

Table 1. Procedures used in the calculation of selected metrics used in this report.

Metric	**Procedure**
Community Loss Index	CL = d-a/e Where: a = number of taxa common to both samples. d = total number of taxa present in sample A. e = total number of taxa present in sample B.
Jaccard Coefficient of Similarity	JCS = a/a+b+c Where: a = number of taxa common to both samples. b = number of taxa present in sample B but not A. c = number of taxa present in sample A but not B.
Sörensen Coefficient	C_S= 2a/(d+e) Where: a = number of taxa common to both samples. d = the number of taxa present in sample A. e = the number of taxa present in sample B.
North Carolina Biotic Index	NCBI = TV_iN_i/N Where: TV_i = the tolerance for the *i*th taxon. N_i = the abundance code of the $_i$th taxon. N = sum of abundance codes for all taxa in the sample.

V. RESULTS

A. Physicochemical Analysis

The water chemistry data measured in conjunction with the macroinvertebrate assessment are presented in Table 2. The data reflected similar temperature, pH, dissolved oxygen, and conductivity at all three stations.

Table 2. Physicochemical data collected in conjunction with the macroinvertebrate assessment of The Broad River near the effluent discharge of the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina, 28 and 29 August 2014.

	Station		
Parameter	**1**	**2**	**3**
Water Temperature (ºC)	26.6	27.5	29.1
pH (SU)	7.2	7.4	8.0
Conductivity (μmhos/cm)	91	76	76
Dissolved Oxygen (mg/l)	6.8	5.9	8.9

B. Macroinvertebrate Community Analysis

A total of 1424 specimens representing 66 taxa were collected from the Broad River during this assessment. The taxa list, number of specimens, and relative abundance for each taxon are presented in Table 3. Bioassessment metrics for each sampling station are presented in Table 4. Table 5 lists the dominant taxa for each sampling station. Habitat assessment scores are presented in Table 6 for each station.

The sampling effort at Station 1, the upstream control, yielded 325 specimens representing 43 taxa (Table 3). An EPT index of 22 was calculated for this station (Table 4). The Chironomidae were represented by 3 taxa and contributed 2% of the total specimens collected. The NCBI value of 5.23 resulted in a water quality rating of “good” for this station. The SC Bioclassification score of 3.9 indicated a “good” rating for Station 1. The dominant functional feeding group was the scrapers, which contributed 46% of the collection. The dominant taxon was *Heterocloeon* sp., which contributed 11% of the collection (Table 5).

Station 2 yielded 548 specimens representing 37 taxa (Table 3). An EPT index of 17 was calculated for this station (Table 4). The Chironomidae were represented by 6 taxa and contributed 12% of the total specimens collected. The NCBI value of 4.84 results in a water quality rating of “excellent” for this station. The SC Bioclassification score of 3.8 indicated a “good” rating for Station 2. The dominant functional feeding group was the collector-gatherers, which contributed 31% of the collection. The dominant taxon was *Cheumatopsyche* sp., which contributed 17% of the specimens collected (Table 5).

Station 3 yielded 551 specimens representing 44 taxa. An EPT index of 22 was calculated for this station. The Chironomidae were represented by 6 taxa and contributed a total of 3% of the specimens collected. The NCBI value of 4.81 results in a water quality rating of "excellent" for this station. The SC Bioclassification score of 4.2 indicated a "good" rating for Station 3. The dominant functional feeding group was the scrapers, which contributed 41% of the collection. The dominant taxon was *Heterocloeon* sp., which contributed 11% of the specimens collected (Table 5).

VI. DISCUSSION

Results of the benthic macroinvertebrate assessment conducted on the Broad River, 28 and 29 August 2014, indicated the river's macroinvertebrate community was healthy at all three stations. All three stations had SCDHEC ratings of "good" which indicates that the river is fully supporting of aquatic life. The NCBI rating for Stations 2 and 3 was "excellent", while Station 1 had a value of "good". All three stations shared similar taxa richness, EPT indices, and number of Chironomidae taxa.

The water chemistry data measured in conjunction with the macroinvertebrate assessment showed similar temperature, pH, dissolved oxygen, and conductivity at all three stations. All parameters monitored were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

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Table 3. Macroinvertebrates, their North Carolina biotic index tolerance values (TV), functional feeding groups (FG), and abundance collected from the Broad River near the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina, 28 and 29 August 2014.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Annelida									
Hirudinea									
1	Hirudinea Genus species	5.00	P	1		10	0.00		0.02
Oligochaeta									
Lumbriculida									
Lumbriculidae									
2	Eclipidrilus lacustris	7.03	SC			1			0.00
Tubificida									
Naididae									
3	Pristina sp.		SC		1	1		0.00	0.00
4	Stylaria lacustris	9.40	SC			3			0.01
Arthropoda									
Arachnoidea									
Acariformes									
Hydrachnidae									
5	Hydrachna sp.	5.53	P	1			0.00		
Insecta									
Coleoptera									
Elmidae									
6	Dubiraphia quadrinotata	5.93	CG	3			0.01		
7	Macronychus glabratus	4.58	CG	13	16	17	0.04	0.03	0.03
8	Microcylloepus pusillus	2.11	CG			1			0.00
9	Stenelmis sp.	5.10	SC	8	3	37	0.02	0.01	0.07
Diptera									
Chironomidae									
10	Ablabesmyia peleensis	9.67	P	1	1		0.00	0.00	
11	Cricotopus sp.		SH		9	1		0.02	0.00
12	Nanocladius alternantherae	7.07	CG		4	6		0.01	0.01
13	Nanocladius crassicornis/cf. rectinervis	7.07	CG		5			0.01	
14	Nanocladius distinctus	7.07	CG		10			0.02	
15	Phaenopsectra obediens gr.	6.50	SC			1			0.00
16	Polypedilum flavum	4.90	SH	2	39	5	0.01	0.07	0.01
17	Thienemanniella lobapodema	5.90	CG	3		4	0.01		0.01
18	Tvetenia vitracies		CG			1			0.00

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 3. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Simuliidae									
19	Simulium luggeri		CF	9	19	30	0.03	0.03	0.05
Ephemeroptera									
Baetidae									
20	Baetis intercalaris	4.99	CG	24	31	4	0.07	0.06	0.01
21	Baetis tricaudatus	1.63	CG		10	4		0.02	0.01
22	Heterocloeon sp.	3.48	SC	37		61	0.11		0.11
Ephemerellidae									
23	Ephemerella sp.	2.04	CG	1	40	2	0.00	0.07	0.00
Heptageniidae									
24	Heptagenia sp.	2.57	SC	8		11	0.02		0.02
25	Maccaffertium exiguum	3.80	SC	3	5	6	0.01	0.01	0.01
26	Maccaffertium integrum	5.80	SC	4	10	9	0.01	0.02	0.02
27	Maccaffertium modestum	5.50	SC	17	52	41	0.05	0.09	0.07
28	Stenacron interpunctatum	6.87	SC	2			0.01		
Isonychiidae									
29	Isonychia sp.	3.45	CF	21	1	39	0.06	0.00	0.07
Leptohyphidae									
30	Tricorythodes sp.	5.06	CG	13	35	10	0.04	0.06	0.02
Heteroptera									
Gerridae									
31	Metrobates hesperius		P	10			0.03		
Lepidoptera									
Pyralidae									
32	Petrophila sp.	2.10	SH	1			0.00		
Megaloptera									
Corydalidae									
33	Corydalus cornutus	5.16	P	8	12	14	0.02	0.02	0.03
Odonata									
Calopterygidae									
34	Calopteryx sp.	7.78	P	5		12	0.02		0.02
Coenagrionidae									
35	Argia moesta	8.17	P		1	7		0.00	0.01
36	Argia tibialis	8.17	P	2			0.01		

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 3. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
Libellulidae									
37	Neurocordulia molesta	1.80	P		4			0.01	
38	Neurocordulia virginiensis	2.05	P		3			0.01	
Plecoptera									
Perlidae									
39	Agnetina sp.	0.00	P	1			0.00		
Trichoptera									
Brachycentridae									
40	Brachycentrus sp.	2.08	CF			1			0.00
Calamoceratidae									
41	Anisocentropus pyraloides	0.85	SH	1			0.00		
Hydropsychidae									
42	Cheumatopsyche sp.	6.22	CF	4	95	13	0.01	0.17	0.02
43	Hydropsyche betteni	7.78	CF	1	2		0.00	0.00	
44	Hydropsyche simulans/rossi		CF	5	26	4	0.02	0.05	0.01
45	Hydropsyche sparna	2.70	CF			14			0.03
46	Hydropsyche venularis	4.96	CF	5	1	15	0.02	0.00	0.03
47	Macrostemum carolina	3.52	CF			18			0.03
Hydroptilidae									
48	Hydroptila sp.	6.22	SC	8	21	2	0.02	0.04	0.00
Leptoceridae									
49	Ceraclea nepha/protonepha	2.01	CG		20			0.04	
50	Ceraclea sp.	2.01	CG			1			0.00
51	Nectopsyche exquisita	4.10	SH	4			0.01		
52	Oecetis georgia	3.00	P	1	25	2	0.00	0.05	0.00
53	Oecetis sp.	4.70	P	2	3		0.01	0.01	
54	Triaenodes ignitus	4.58	SH	4		5	0.01		0.01
55	Triaenodes injustus	2.47	SH			17			0.03
Philopotamidae									
56	Chimarra sp.	2.76	CF	1		55	0.00		0.10
Polycentropodidae									
57	Cyrnellus fraternus	7.34	CF		2			0.00	
Malacostraca									
Amphipoda									
Gammaridae									
58	Gammarus sp.	9.10	OM		1			0.00	

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 3. Continued.

				No. of Individuals			Relative Abundance		
Seq	**Taxon**	**TV**	**FG**	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 1**	**Sta. 2**	**Sta. 3**
	Talitridae								
59	Hyalella azteca	7.75	OM	1			0.00		
Mollusca									
Bivalvia									
Unionoida									
	Corbiculidae								
60	Corbicula fluminea	6.12	CF	17		3	0.05		0.01
	Pisidiidae								
61	Pisidiidae Genus species		CF		2			0.00	
Gastropoda									
Limnophila									
	Physidae								
62	Physa sp.	8.84	SC	1			0.00		
	Planorbidae								
63	Menetus dilatatus	8.23	SC	1	1	1	0.00	0.00	0.00
Mesogastropoda									
	Hydrobiidae								
64	Somatogyrus virginicus	6.40	SC	31	22	25	0.10	0.04	0.05
	Pleuroceridae								
65	Goniobasis catenaria catenaria		SC	29	11	25	0.09	0.02	0.05
Platyhelminthes									
Turbellaria									
Tricladida									
	Planariidae								
66	Dugesia tigrina	7.50	OM	11	5	12	0.03	0.01	0.02

* CG = collector-gatherer, CF = collector-filterer, OM = omnivore, P = predator, SH = shredder, SC = scraper

Table 4. Rapid bioassessment metrics calculated for the three sampling stations on the Broad River near the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina, 28 and 29 August 2014.

	Station		
Metric	**1**	**2**	**3**
Taxa Richness	43	37	44
Number of Specimens	325	548	551
EPT Index	22	17	22
EPT Abundance	167	379	334
Chironomidae Taxa	3	6	6
Chironomidae Abundance	6	68	18
EPT/Chironomidae Abundance	27.83	5.57	18.56
North Carolina Biotic Index	5.23	4.84	4.81
SCDHEC Bioclassification	3.9	3.8	4.2
Percent Collector-Filterers	19.38	27.01	34.85
Percent Collector-Gatherers	17.54	31.20	9.07
Percent Omnivores	3.69	1.09	2.18
Percent Predators	9.85	8.94	8.17
Percent Scrapers	45.85	22.99	40.65
Percent Shredders	3.69	8.76	5.08
Scraper/Collector-Filterers	2.37	0.85	1.17
Shredders/Total	0.04	0.09	0.05
Percent Dominant Taxon	11.38	17.34	11.07
Number Of Dominant Taxa	7	6	6
Dominants In Common		2	3
			1
Community Loss Index		0.51	0.32
			0.25
Jaccard Coefficient of Similarity		0.43	0.50
			0.47
Sörensen Coefficient		0.60	0.67
			0.64

Table 5. Dominant taxa (>5% of the collection) for the three sampling stations on the Broad River near the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina, 28 and 29 August 2014.

Station 1			**Station 2**			**Station 3**		
Taxon	**No.**	**Rel. Abd.**	**Taxon**	**No.**	**Rel. Abd.**	**Taxon**	**No.**	**Rel. Abd.**
Heterocloeon sp.	37	11.38	Cheumatopsyche sp.	95	17.34	Heterocloeon sp.	61	11.07
Somatogyrus virginicus	31	9.54	Maccaffertium modestum	52	9.49	Chimarra sp.	55	9.98
Goniobasis catenaria catenaria	29	8.92	Ephemerella sp.	40	7.30	Maccaffertium modestum	41	7.44
Baetis intercalaris	24	7.38	Polypedilum flavum	39	7.12	Isonychia sp.	39	7.08
Isonychia sp.	21	6.46	Tricorythodes sp.	35	6.39	Stenelmis sp.	37	6.72
Maccaffertium modestum	17	5.23	Baetis intercalaris	31	5.66	Simulium luggeri	30	5.44
Corbicula fluminea	17	5.23						

Table 6. Habitat assessment scores determined in conjunction with the macroinvertebrate assessment for the three sampling stations on the Broad River near the Parr Hydroelectric Project, Newberry and Richland Counties, South Carolina, 28 and 29 August 2014.

Habitat Parameter	***Sta. 1***	***Sta. 2***	***Sta. 3***
1. Epifaunal Substrate/Available Cover	15	15	16
2. Pool Substrate Characterization	13	13	13
3. Pool Variability	14	14	14
4. Sediment Deposition	14	18	15
5. Channel Flow Status	20	16	20
6. Channel Alteration	20	12	20
7. Channel Sinuosity	6	10	5
8. Bank Stability (Left Bank (LB*))	10	10	10
Bank Stability (Right Bank (RB*))	10	7	10
9. Vegetative Protection (LB*)	10	10	10
Vegetative Protection (RB*)	10	10	10
10. Riparian Vegetative Zone (LB*)	10	10	10
Riparian Vegetative Zone (RB*)	10	10	10
Total Score	**162**	**155**	**163**

* Left or right bank is determined when facing downstream.

APPENDIX H

PROPOSED STUDY PLAN

WATER QUALITY IN DOWNSTREAM WEST CHANNEL STUDY PLAN

WATER QUALITY IN DOWNSTREAM WEST CHANNEL STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
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September 2013

WATER QUALITY IN DOWNSTREAM WEST CHANNEL
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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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WATER QUALITY IN DOWNSTREAM WEST CHANNEL STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project (FERC No. 1894) ("Parr Fairfield Project" or "Project"), owned and operated by the South Carolina Electric & Gas Company ("SCE&G" or "Licensee"), is seeking a new license from the Federal Energy Regulatory Commission ("FERC"), as their current license is set to expire on June 30, 2020. The Parr Fairfield Project consists of two developments, including the Parr Hydro Development and the Fairfield Pumped Storage Development.

The Parr Reservoir, located in Fairfield and Newberry counties, South Carolina, is a 4,400 acre impoundment formed by the Broad River and the Parr Shoals Dam and serves as the lower reservoir for the Fairfield Pumped Storage Development. Monticello Reservoir, a 6,800 acre impoundment is formed by a series of four earthen dams and serves as the upper reservoir for the pumped storage development. While the stretch of the Broad River downstream of the Parr Shoals Dam (Parr Dam) is not included in the Project Boundary Line (PBL), Project operations do influence this area. For this reason, this downstream area, specifically the west bank area of the Broad River immediately downstream of the Parr Dam, is being examined for water quality.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license. A Water Quality TWC was formed to address any potential water quality issues associated with the Project, and is comprised of a variety of stakeholders, including the U.S. Fish and Wildlife Service (“USFWS”), the National Marine Fisheries Service (“NMFS”), the South Carolina Department of Health and Environmental Control (“SCDHEC”) and the South Carolina Department of Natural Resources (“SCDNR”), among others. During issues scoping, the TWC identified the west bank area of the Broad River below the Parr Dam as a potential area in need of water quality study. SCDNR expressed concern over the water quality, specifically dissolved oxygen (DO) levels, in this area of the Broad River during the warmer months. While existing water quality data does not display a dissolved oxygen issue over the Project Area generally, SCDNR wants to examine this west bank area more closely.

2.0 STUDY OBJECTIVES

The objective of this survey is to assess the water quality, specifically DO levels, of the west channel of the Broad River, immediately downstream the Parr Dam.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

The Broad River immediately downstream of the Parr Dam is naturally divided by Hampton Island, creating an eastern and western channel along the length of the island, approximately 1.25 miles. Water quality will be monitored at three sites along the western channel, including just downstream of the Parr Dam, midway down Hampton Island near the Highway 213 bridge, and at the lower extent of the western channel, just upstream of the confluence. A fourth site will be monitored as a control, and will be located along the eastern channel, at the approximate mid-point of the island. The monitoring sites are shown below in Figure 1.

The study will take place beginning April 1, 2015 and extend through November 30, 2015.

FIGURE 1 WATER QUALITY IN DOWNSTREAM WEST CHANNEL MONITORING SITES

4.0 COLLECTION METHODS AND ANALYSIS

Water quality will be monitored in the west channel area of the Broad River for temperature and DO using a HOBO U26 Dissolved Oxygen Logger (or similar type instrument). The loggers will be deployed at the four monitoring sites and attached to floats and weights to allow for suspension at approximate mid-depth in the river channel. The loggers will be calibrated according to the manufacturer's specifications and will be set to collect temperature and DO data on hourly intervals. Data will be downloaded on a monthly basis using manufacturer's software and compiled at the end of the monitoring season.

Additionally, a calibrated YSI meter will be used to collect DO, water temperature, and conductivity once a month when data is downloaded from the HOBO loggers at each monitoring site. A separate calibrated pH meter will also be used once a month to collect pH readings at each monitoring site.

5.0 SCHEDULE

The loggers will be deployed at the four monitoring sites on or around April 1, 2015 and will collect data for approximately eight months. The loggers will be checked monthly during the study period. This study may be extended based on a review of the results from the initial eight month period as determined by the Water Quality TWC.

Within 120 days of the close of field work, a final report summarizing the study findings will be issued. Study methodology, timing and duration may be adjusted based on consultation with resource agencies and interested stakeholders.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during the discussion of relicensing issues with all Water Quality TWC relicensing stakeholders.

MONTICELLO RESERVOIR FRESHWATER MUSSEL RECONNAISSANCE SURVEY STUDY PLAN

MONTICELLO RESERVOIR FRESHWATER MUSSEL RECONNAISSANCE SURVEY STUDY PLAN

PARR HYDROELECTRIC PROJECT (FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
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MONTICELLO RESERVOIR FRESHWATER MUSSEL RECONNAISSANCE SURVEY
STUDY PLAN

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr-Fairfield Hydro Project (FERC No. 1894) (Project) is a 525 megawatt (MW) licensed hydroelectric facility owned and operated by South Carolina Electric & Gas (SCE&G). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates to continuously pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations.

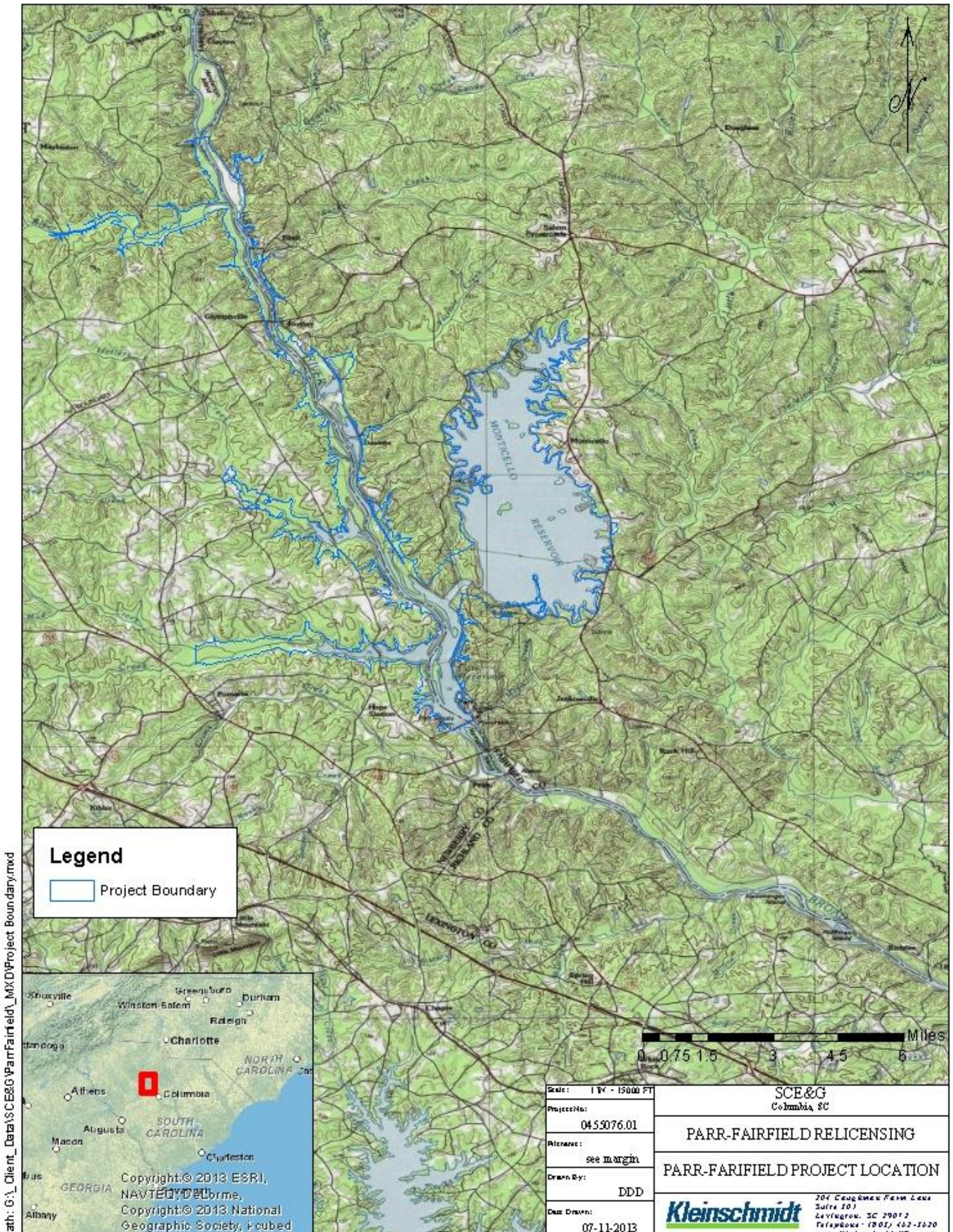
The Fairfield Pumped Storage Development is located directly off of the Broad River and forms the 6,800-acre upper reservoir, Monticello Reservoir, with four earthen dams. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO's), and interested individuals. Their collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working

Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

During early meetings aimed at scoping appropriate relicensing studies, the Rare, Threatened and Endangered Species (RT&E) TWC requested information describing the status of freshwater mussels in Parr and Monticello reservoirs, as well as in the downstream reach of the Broad River influenced by Project operations. A subsequent TWC review of existing mussel data for the Project vicinity determined that recent surveys conducted by the South Carolina Department of Natural Resources (SCDNR) (Price, 2010) and Alderman Environmental Services (Alderman and Alderman, 2012) were adequate for characterizing the mussel fauna of Parr Reservoir and the downstream reach of the Broad. The TWC further determined that no such data were available for Monticello Reservoir; thus a qualitative survey would be needed. This Study Plan was prepared pursuant to that determination.

FIGURE 1 PROJECT LOCATION MAP



Sources: ESRI, SCE&G, Kleinschmidt

2.0 STUDY OBJECTIVE

The study objective will be to determine whether native freshwater mussels are present within the pool of Monticello Reservoir, and if so, gather qualitative data describing the diversity, spatial distribution and relative abundance of the mussel fauna inhabiting the lake.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

The reconnaissance survey described herein will focus on selected habitats within the Monticello Reservoir pool that are likely to support populations of native freshwater mussels. Surveys will be conducted in 2015, likely during the summer to early fall months when water clarity and temperatures are sufficiently high to support wading and other in-water survey methods.

4.0 METHODOLOGY

Freshwater mussel surveys in Monticello will utilize qualitative methods that allow for rapid coverage of larger survey areas and have proven more robust at determining diversity of surveyed areas (Miller and Payne, 1993). Qualitative surveys will involve timed visual and/or tactile inspections of suitable habitat for presence of live freshwater mussels and/or shell material and will be conducted by a qualified malacologist with expertise in Broad River fauna. Although the number and specific location of qualitative survey points will likely be refined in the field based on professional judgment of the lead malacologist, it is expected that a minimum of 30 representative sites will be distributed throughout the reservoir[1]. Particular attention will be placed upon the examination of potential Savannah lilliput (*Toxolasma pullus)* (federal At Risk Species and state Species of Concern) habitat within backwater areas of the reservoir.

Exact methods for conducting visual and tactile searches will vary depending on water depth. However, it should be noted that water levels on Monticello Reservoir typically fluctuate up to 4.5 ft daily as a result of pumping operations, and as such, mussel surveys will focus primarily on those areas below the 4.5 ft depth contour where mussels are likely to become established. Depending upon water depths, wading, batiscope, snorkeling, or SCUBA will be used to conduct timed surveys at each of the selected sites:

[1] It is estimated that each site will require an average of 30 man-minutes to conduct a reconnaissance level survey.

- Wading – Where water is relatively shallow, clear, and flat (no disturbances by wind), a biologist walks over an area to conduct a visual and/or tactile survey for live mussels and shells. This method is typically focused upon examinations of exposed near-shore habitats.
- Batiscope or snorkeling – In clear to slightly turbid waters up to 2 meters deep, or in waters with wind-disturbed surfaces, a batiscope or snorkeling will be used to conduct a visual and/or tactile survey for live mussels and shells.
- SCUBA – In survey areas of Monticello Reservoir with depths from 1 to 8+ meters, a biologist will traverse the lake bottom using SCUBA to conduct a visual and/or tactile survey for mussel species that prefer deeper waters and may not be detected at near-shore sites.

Live and fresh dead mussels collected during the survey will be identified to species, enumerated and returned to their habitat, although some shell material and/or live specimens may be preserved and returned to the laboratory for taxonomic confirmation. All sampling stations, as well as any significant mussel beds found during sampling, will be documented using a Global Positioning System (GPS) receiver. Mussel habitat surveyed at each sample location, as well the species collected during the survey, will also be photo documented. Basic water quality parameters (temperature, dissolved oxygen and conductivity) will be collected near the substrate at representative sample areas.

5.0 REPORTING

A report will be prepared for TWC review and comment. The report will document methods and results as encountered in the field including:

- A species list documenting the diversity of mussel fauna of Monticello Reservoir.
- GIS maps depicting spatial distribution of mussel populations.
- Tabular summaries comparing Catch per Unit Effort and relative abundance of species encountered.
- Water quality data from the survey period.

6.0 SCHEDULE AND REQUIRED CONDITIONS

As previously noted, it is expected that field surveys will be conducted during the summer or fall of 2015. It is expected that this effort will require 2-3 days of field work to complete. A final report summarizing the study findings will be issued subsequent to the completion of field work. The methodology for this survey may be revised or supplemented based on consultation with the RT&E TWC and other interested stakeholders.

7.0 USE OF STUDY RESULTS

Study findings will be used as an information resource during discussion of RT&E species issues and for developing potential Protection, Mitigation and Enhancement measures with the TWC and other relicensing stakeholders.

8.0 REFERENCES

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RESERVOIR FLUCTUATION STUDY PLAN

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PARR HYDROELECTRIC PROJECT

FERC NO. 1894

Prepared for:

South Carolina Electric & Gas Company
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Reservoir Fluctuation
Study Plan

Parr Hydroelectric Project

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RESERVOIR FLUCTUATION
STUDY PLAN

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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RESERVOIR FLUCTUATION
STUDY PLAN

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGOs), and interested individuals. Their collaboration and cooperation is essential to the identification and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

During issues scoping, the Fisheries TWC identified the potential need for a Reservoir Fluctuation Study on the Parr and Monticello Reservoirs. The operating regime for the Project consists of a lowering and a refilling of the Project's two reservoirs on a daily basis. Although the amount that the Project reservoirs fluctuate varies (based on load demands and system needs), Monticello Reservoir is currently permitted by the FERC license to fluctuate up to 4.5 feet, while Parr Reservoir is permitted to fluctuate up to 10 feet. The magnitude of daily fluctuations varies seasonally in both impoundments. The largest daily fluctuations generally occur in June, July, and August in both reservoirs (see Table 1-1 and Table 1-2).

TABLE 1-1 MONTICELLO RESERVOIR MONTHLY AVERAGE ELEVATIONS: 2005-2013

Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	423.92	422.32	1.60
Feb	423.93	422.45	1.49
Mar	423.82	422.18	1.66
Apr	424.08	421.88	2.22
May	424.42	421.64	2.80
Jun	424.74	421.42	3.33
Jul	424.69	421.38	3.29
Aug	424.71	421.31	3.40
Sep	424.53	421.45	3.06
Oct	424.02	421.83	2.18
Nov	423.61	422.00	1.61
Dec	423.86	422.28	1.58
Average	**424.19**	**421.84**	**2.35**

TABLE 1-2 PARR RESERVOIR MONTHLY AVERAGE ELEVATIONS: 2005-2013

Monthly Average Res. Elev.			
	Max	**Min**	**Range**
Jan	263.04	259.96	3.08
Feb	262.88	260.01	2.87
Mar	263.44	260.32	3.13
Apr	263.81	259.61	4.20
May	264.22	258.79	5.43
Jun	264.59	258.09	6.49
Jul	264.72	257.96	6.75
Aug	264.74	257.71	7.03
Sep	264.17	258.27	5.90
Oct	263.60	259.14	4.46
Nov	263.53	259.97	3.56
Dec	263.38	260.11	3.28
Average	**263.84**	**259.16**	**4.68**

During February through April, when many fish species are spawning in shallow water habitat, average daily fluctuations range from 1.6-2.4 feet in Monticello Reservoir and from 2.9-4.2 feet in Parr Reservoir (Argentieri presentation 12-19-13; Tables 1 and 2). Resource agencies and stakeholders have expressed concerns of how these daily and seasonal fluctuations are affecting aquatic habitat along the shorelines of the reservoirs.

2.0 EXISTING INFORMATION

Fisheries

The Project area supports warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent survey work within the Project area documented 30 species of fish occurring in Parr Reservoir and 24 species in Monticello Reservoir (see Table 2-1).

TABLE 2-1 FISH SPECIES DOCUMENTED AT PARR AND MONTICELLO RESERVOIRS

COMMON NAME	SCIENTIFIC NAME	PARR	MONTICELLO
black crappie	*Pomoxis nigromaculatus*	x	x
blue catfish	*Ictalurus furcatus*	x	x
bluegill	*Lepomis macrochirus*	x	x
channel catfish	*Ictalurus punctatus*	x	x
flat bullhead	*Ameiurus platycephalus*	x	x
flathead catfish	*Pylodictis olivaris*	x	
gizzard shad	*Dorosoma cepedianum*	x	x
golden shiner	*Notemigonus chrysoleucas*	x	x
highfin carpsucker	*Carpiodes velifer*	x	
largemouth bass	*Micropterus salmoides*	x	x
longnose gar	*Lepisosteus osseus*	x	
northern hogsucker	*Hypentelium nigricans*	x	x
notchlip redhorse	*Moxostoma collapsum*	x	x
pumpkinseed	*Lepomis gibbosus*	x	x
quillback	*Carpiodes cyprinus*	x	x
redbreast sunfish	*Lepomis auritus*	x	x
redear sunfish	*Lepomis microlophus*	x	x
robust redhorse	*Moxostoma robustum*	x	x
sandbar shiner	*Notropis scepticus*	x	
shorthead redhorse	*Moxostoma macrolepidotum*	x	x
smallmouth bass	*Micropterus dolomieu*	x	x
snail bullhead	*Ameiurus brunneus*		x
spottail shiner	*Notropis hudsonius*	x	x
threadfin shad	*Dorosoma petenense*	x	x
warmouth	*Lepomis gulosus*	x	
white bass	*Morone chrysops*	x	
white catfish	*Ameiurus catus*	x	x
white perch	*Morone americana*	x	x
whitefin shiner	*Cyprinella nivea*	x	x
yellow bullhead	*Amierus natalis*	x	x
yellow perch	*Perca flavescens*	x	x

Although some seasonal variations in community structure have been documented, the fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch often being the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). Important game fish species such as largemouth bass, black crappie, and smallmouth bass (to a lesser extent) are also abundant in the two reservoirs. Life history and spawning preferences can influence the extent to which fish species are affected by reservoir fluctuations. Habitat and spawning preferences of the dominant fish species are briefly considered below.

Gizzard shad are a pelagic species that generally occupy the limnetic zone as well as feed along the littoral zone. Spawning typically occurs in the spring, associated with rapidly rising water levels. Gizzard shad typically spawn in shallow waters, 5 feet deep or less, and prefer recently inundated habitats, when available (Williams and Nelson, 1985). Blue and channel catfish typically occupy deep, protected areas, spawning at sites 6.5 to 13 ft deep (McMahon and Terrell, 1982). Bluegill typically inhabit and spawn within shallow, back-water habitats, at depths of 3 to 6 ft (Stuber et. al., 1982a). White perch also spawn in relatively shallow habitat within reservoirs (0-5 feet). Adult white perch exhibit seasonal movements, utilizing both shallow and deep water habitat (Stanley and Danie, 1983). Largemouth bass typically spawn in gravel, or other substrates such as vegetation, roots, sand, or mud, at depths of 1-3 feet, with a full range 0.5-15 feet (Stuber et. al., 1982b). Smallmouth bass spawning typically occurs over course gravel substrate in close proximity to a boulder, overhead limb, log, or stump, in shallow areas of reservoirs or in protected areas of streams where current is minimal (Edwards, et. al., 1983). Black crappie spawn in backwater habitats or littoral areas in lakes in beds of vegetation on a soft mud, sand, or gravel substrate (Edwards, et. al., 1982a). White crappie tend to spawn at depths from 0.5 to 13.5 ft in river pools or coves and littoral areas of lakes and reservoirs (Edwards, et. al., 1982b). Redear sunfish utilize a wide variety of spawning habitats, with nesting substrates ranging from sand, sand-clay, mud, limestone, shells, and gravel with no vegetation in water depths ranging from several inches to 24 ft deep (Twomey, et. al., 1984). Redbreast sunfish typically spawn in shallow waters (1 to 1.5 ft) near logs, stumps, or boulders in quiet backwater locations or open areas of lakes and reservoirs (Aho, et. al, 1986).

Small fishes, such as shiners, juvenile sunfish, and small suckers serve as the food base for larger, piscivorous species. In general, these species typically have high fecundity rates and will utilize a variety of habitat types for spawning, cover, and resting. These species are typically found within or in the vicinity of aquatic vegetation or other cover. When inundated, the shallow areas may be frequented by these species for forage and cover.

Pool Elevations

During the construction of Monticello Reservoir and the Fairfield Development in 1974, crest gates were added to Parr Shoals Dam, allowing for a full operating range of 256 ft to 266 ft at Parr Reservoir. Monticello Reservoir was constructed to allow for a full operating range of 420.5 ft to 425 ft.

SCE&G submitted surface area and capacity curves as part of the Final Environmental Impact Statement for Parr Hydroelectric Project, conducted in March 1974, after the crest gates were added to Parr Shoals Dam. In Monticello Reservoir, a change in elevation from 425 feet to 420.5 feet will reduce the surface area of the reservoir from 6,800 acres to 6,467 acres (95% of full pool surface area), resulting in a difference of 333 acres of shoreline exposed. The exposed shoreline is generally included in a narrow band that extends around the reservoir. A change in elevation on Parr Reservoir from 266 ft to 256 ft will reduce the surface area of the reservoir from 4,369 acres to 1,375 acres (31.5% of the full pool surface area), resulting in a difference of 2,994 acres of exposed lake bottom. Prior to the construction of the crest gates and reservoir expansion, the approximately 3,000 acres was not inundated or available as aquatic habitat in Parr Reservoir.

3.0 STUDY OBJECTIVES

Monticello Reservoir Study Objectives

The objective of this study with regards to Monticello Reservoir is two-fold. First, SCE&G will provide a qualitative assessment of the potential effects of operational reservoir fluctuations on aquatic habitat within the reservoir. As noted in Section 2.0, areas of shoreline are exposed during impoundment fluctuations, but the type and quality of those areas are not currently documented. This study will provide information to characterize habitats within areas exposed during lake-level fluctuations, including the collection of reservoir elevations at all study sites. Second, this study will identify potential fish habitat enhancements which could be considered as part of the Protection, Mitigation and Enhancements (PM&E) measures.

Parr Reservoir Study Objectives

Study objectives with regards to Parr Reservoir include providing a qualitative and quantitative assessment of the potential effects of operational reservoir fluctuations on aquatic habitat and navigation within the reservoir. This study will provide information to characterize habitats within areas exposed during lake-level fluctuations as well as identify areas with potential navigation issues caused by fluctuations. Data collected will characterize the degree to which reservoir fluctuations affect navigation in the reservoir and identify portions of the reservoir which are potentially influenced in relation to dewatering of aquatic habitat and constricted channel.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

The study will focus on the littoral zones of Parr and Monticello Reservoirs between maximum normal pool and minimum normal pool that are dewatered by reservoir fluctuations. Several transects will be established at representative locations along Parr and Monticello Reservoirs, where information such as slope and elevation will be gathered. Members of the Fisheries TWC will select these transect locations prior to the study being performed, which will be no later than the summer of 2015. The study will commence after transect locations are selected.

After fluctuation data is collected and analyzed, the TWC will meet to discuss potential PM&E measures that could be considered for each reservoir.

5.0 METHODOLOGY

The study area will include both Parr and Monticello reservoirs. A maximum of four Priority Areas will be identified in Parr Reservoir by the Fisheries TWC members. Potential Priority Areas in Parr Reservoir have been identified and are depicted in Figure 5-1 and Figure 5-2. These Priority Areas will be locations within the reservoir that best depict a variety of existing aquatic habitat types. Within each Priority Area, 3 to 5 transects will be identified across the wetted area. At each transect, elevations will be collected at full pool via GPS (GeoExplorer 6000 paired with an external Zephyr antenna or equivalent model) or survey methods, as well as at 1 foot increments as the reservoir level is lowered during a fluctuation cycle. Surveys will be performed during a low inflow and high energy demand period (possibly August/September) so that as much of the full operating range of 10 ft as possible, from 266 ft to 256 ft can be observed. From this information an estimate of how much reservoir area is dewatered at each 1 foot contour will be documented and compared to the existing Reservoir Area Curve for the Project. At or near the minimum normal pool elevation (256 ft), slope and habitat type will also be photographed. Prior to the field study, locations that may present potential navigation issues during low fluctuations in Parr Reservoir will be identified (or included as a Priority Area). While aquatic habitat information is being collected in Parr Reservoir, field workers will also examine these areas during a fluctuation cycle. Any areas that appear to have navigation concerns will be documented and photographed.

FIGURE 5-1 POTENTIAL PRIORITY AREAS IN UPPER PORTION OF PARR RESERVOIR

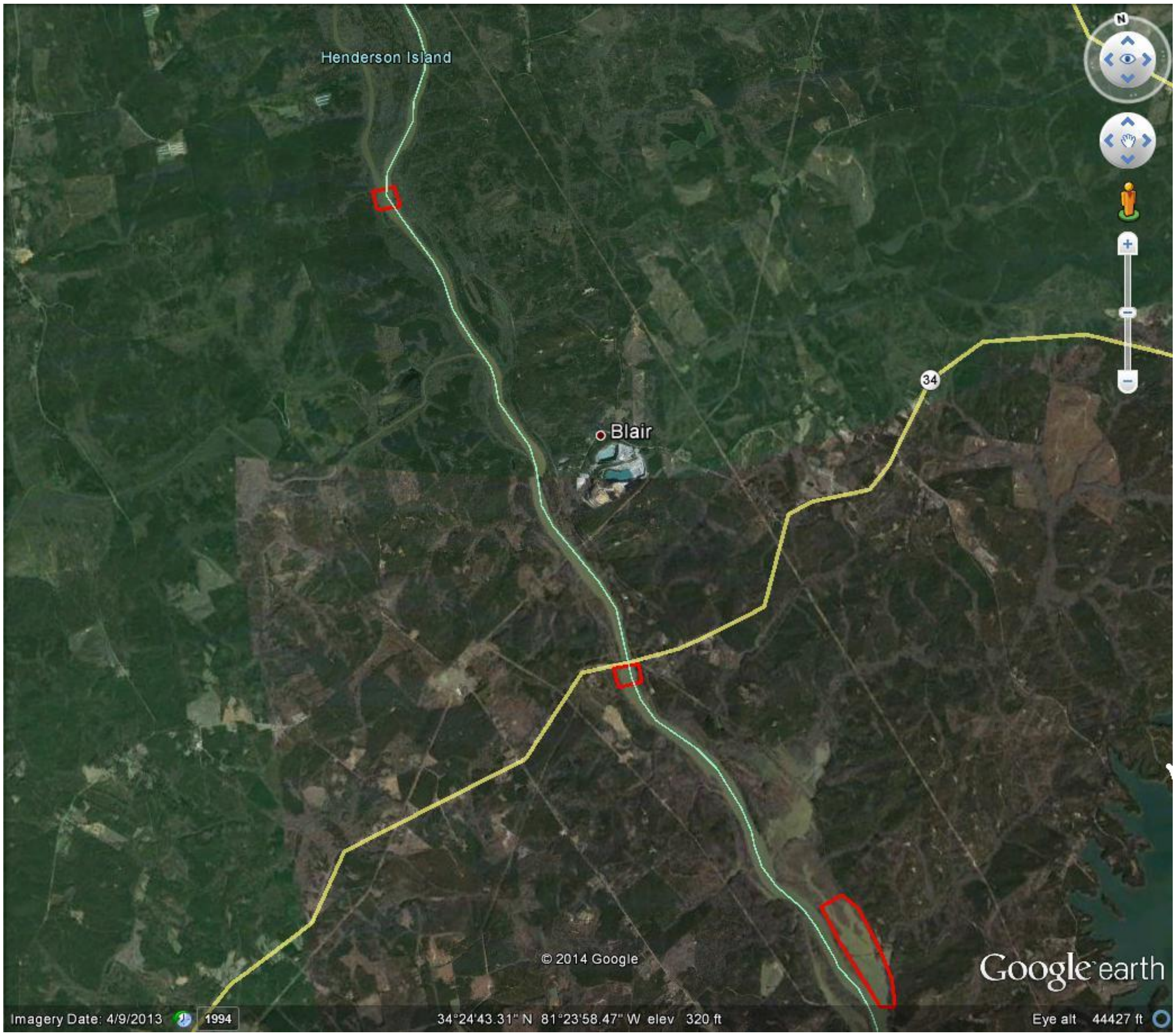
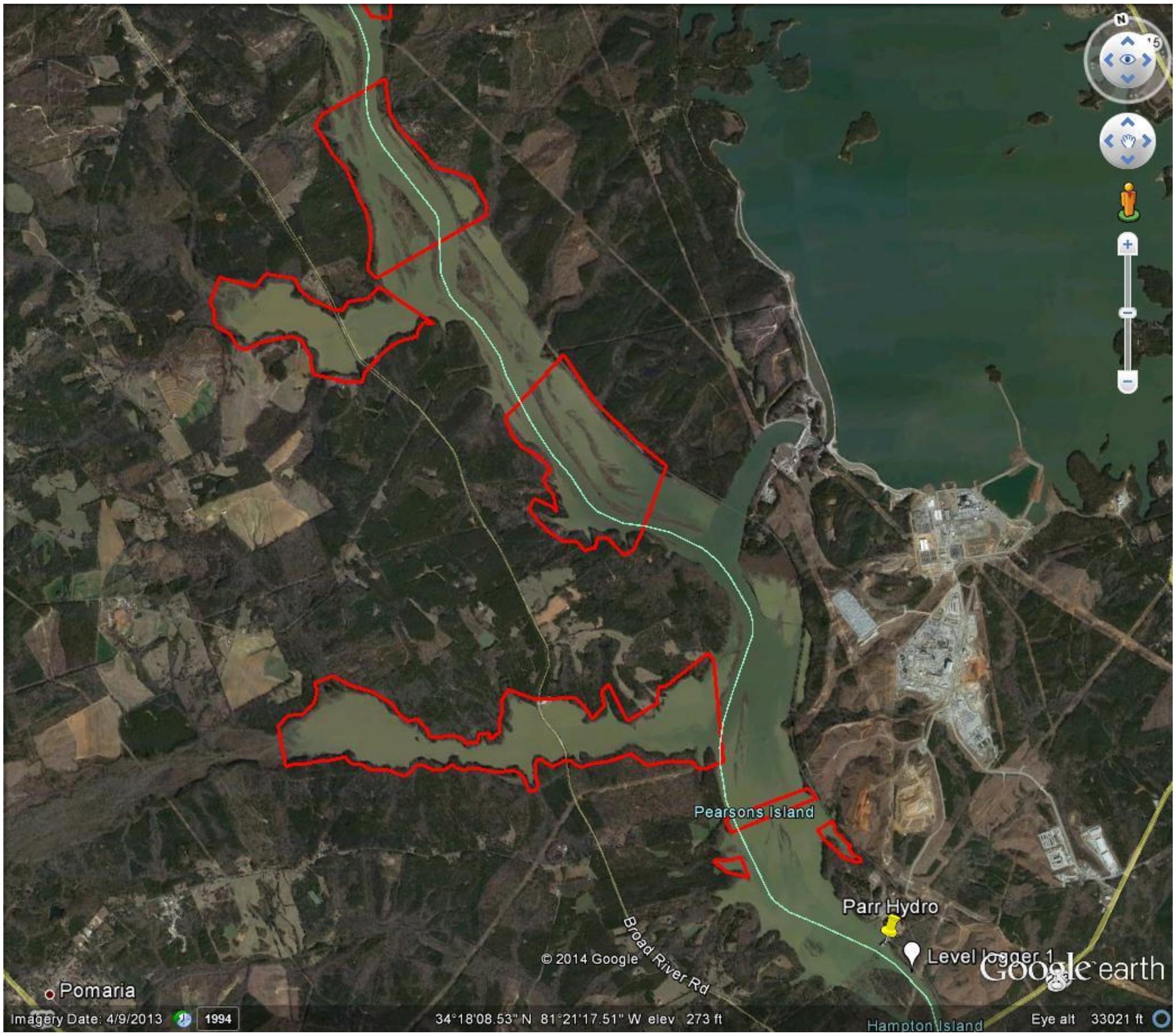


FIGURE 5-2 POTENTIAL PRIORITY AREAS IN LOWER PORTION OF PARR RESERVOIR



In Monticello Reservoir, from two to six Priority Areas will be identified that represent potential critical aquatic habitat areas (see Figure 5-3). At each of these locations, data will be collected to characterize the general slope (measured at 1 ft increments) and habitat type (photographed at each 1 ft increment) of the Priority Area for the 425 ft to 420.5 ft fluctuation band. Data will be collected to characterize the general slope and habitat of the Priority Area.

The collected data will be consolidated into a report for the Fisheries TWC review and comment. This report will be used as a basis for the Fisheries TWC to identify potential PM&E measures that could be implemented at each reservoir.

FIGURE 5-3 POTENTIAL PRIORITY AREAS IN MONTICELLO RESERVOIR

6.0 SCHEDULE

Selection of Priority Areas will be completed no later than July of 2015. Field collections will be completed no later than the fall of 2015. After field data collection have been summarized in a report and distributed for review, the Fisheries TWC will meet to discuss PM&E measures that are appropriate for each reservoir. A final report summarizing the study findings and potential PM&E measures that could be considered as part of the Final License Application will be issued in or around July 2016. Study methodology, timing and duration may be adjusted based on weather and consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, U.S. Fish and Wildlife Service (USFWS), Fisheries TWC, and other relicensing stakeholders.

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INSTREAM FLOW STUDY PLAN

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Co.
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

May 2014

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SOUTH CAROLINA ELECTRIC & GAS CO.
COLUMBIA, SOUTH CAROLINA

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INSTREAM FLOW STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS CO.
COLUMBIA, SOUTH CAROLINA

1.0 INTRODUCTION

The Parr Hydroelectric Project (FERC No. 1894) (Project) is a 525 megawatt (MW) licensed hydroelectric facility located on the Broad River in Newberry and Fairfield counties of South Carolina, and is owned and operated by South Carolina Electric & Gas (SCE&G). The Project consists of the Parr Shoals Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Parr Shoals Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Shoals operates in a modified run-of-river mode and normally operates to continuously pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations.

The Fairfield Pumped Storage Development is located directly off of the Broad River and forms the 6,800-acre upper reservoir, Monticello Reservoir, with four earthen dams. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

In anticipation of the Project relicensing process, SCE&G met with a number of state and federal resource agencies and interested stakeholders to begin scoping environmental issues as they pertain to project operation. As a result, the United States Fish and Wildlife Service (USFWS), South Carolina Department of Natural Resources (SCDNR), National Marine Fisheries Service (NMFS), and several Non-governmental Organizations (NGO's) requested studies to determine the potential impact of Project operation on fishery resources and aquatic habitat, including an Instream Flow Incremental Methodology Study (IFIM) for the Broad River downstream of the Project. SCE&G formed a Technical Working Committee (TWC) composed of representatives from each interested party that consults to provide input and guidance for the study design and execution.

1.1 EXISTING OPERATIONS

As previously noted Parr Shoals Development operates in a modified run-of-river mode and normally continuously operates to pass Broad River flow. Current minimum flow license articles require that 1,000 cubic feet-per-second (cfs), or average daily natural inflow to Parr Reservoir[1], whichever is less, be provided downstream of Parr Shoals Dam from March through May. During the remainder of the year, 800 cfs daily average flows and 150 cfs minimum flows, or natural inflow minus evaporation, whichever is less, are required downstream of the Parr Shoals Dam.

1.2 SUMMARY OF TWC CONCERNS

In general, the TWC is interested in exploring the protection of instream habitat in the Broad River below the Project (see Appendix A for a detailed summary of discussions) by evaluating existing and potential flow releases. The TWC has identified the following issues that this study will:

- assist in identifying minimum flows that are protective of aquatic habitat;
- provide data that can be used to evaluate minimum flows necessary for safe navigation; and
- provide data that can be used to evaluate the flow necessary to facilitate volitional upstream fish passage.

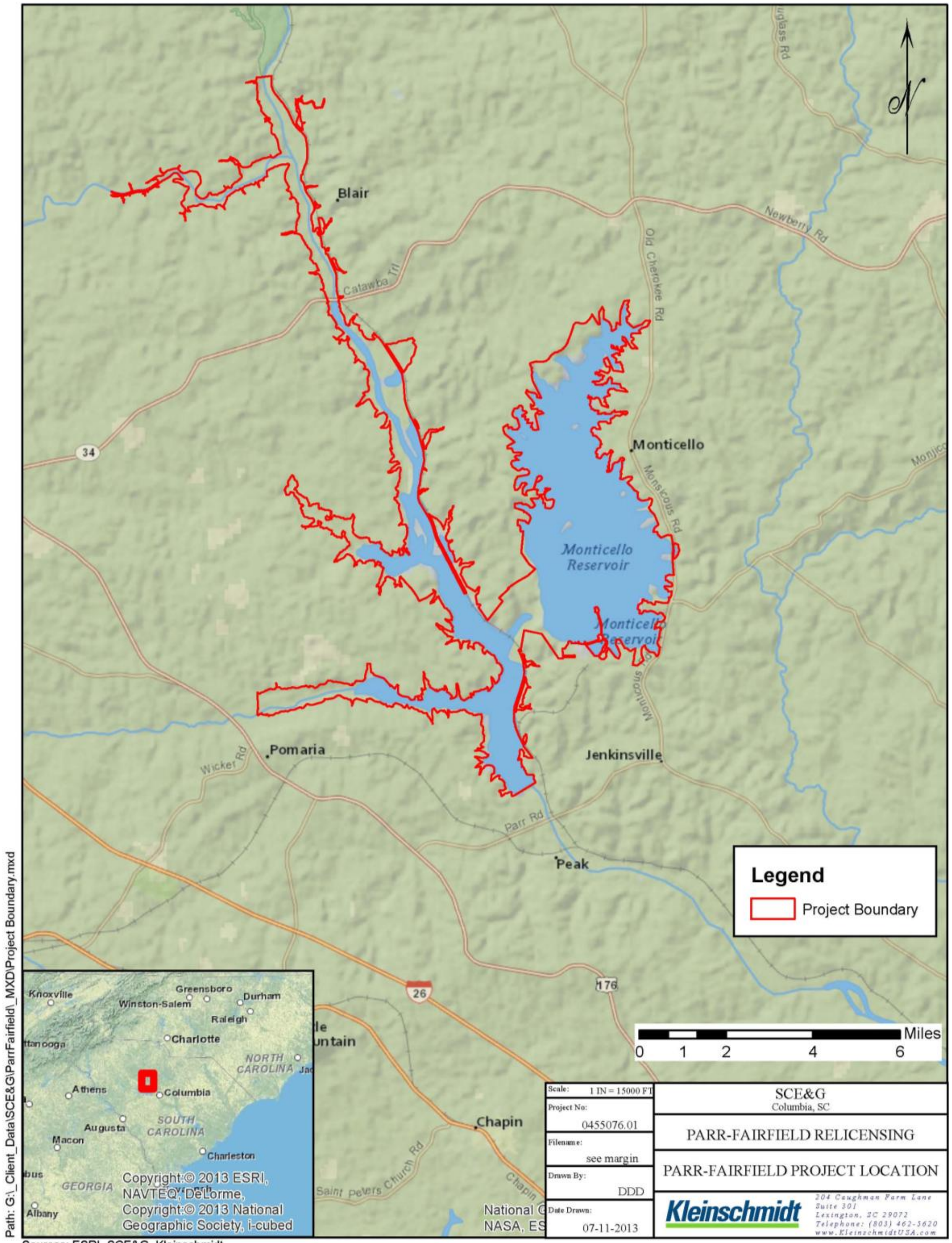
1.3 PURPOSE OF THIS STUDY

The scope of this study is to provide data quantifying the effects of flows on aquatic habitat suitability in the Broad River for the aquatic community and its managed fish resources, including diadromous and resident fish species, and aquatic invertebrates and to assist the TWC in identifying flow targets that support habitat requirements for a balanced aquatic community.

1 Evaporative loss from Parr and Monticello Reservoirs is subtracted from average daily natural inflow to determine flows downstream of Parr Dam.

These data will then be used in conjunction with hydrologic, operational and other models to evaluate the costs and benefits of providing alternate flows to the Broad River.

FIGURE 1   PROJECT LOCATION MAP



Sources: ESRI, SCE&G, Kleinschmidt

2.0 DESCRIPTION OF STUDY AREA

The Broad River rises on the east slope of the Appalachian Mountains, and flows southeasterly across the Piedmont geomorphic province to its confluence at the fall line with the lower Saluda River in Columbia, South Carolina (SCDHEC, 2007), where the combined flows form the Congaree River. Below the Parr Shoals Dam, the river is free flowing for approximately 26 miles through generally low gradient[2] riverine geomorphology until just below Boatrights Island. Below Boatrights Island, the Broad is influenced by backwatering from the Columbia Hydroelectric Project, which is located approximately two miles above the confluence with the lower Saluda River. The drainage area at the Parr Project is 4,750 square miles. A real time stream flow gage exists at USGS 02161000 (*Broad River at Alston, SC*), which is located approximately 1.5 miles below the Parr dam.

2.1 UPSTREAM AND DOWNSTREAM BOUNDARIES

The TWC identified the segment of the Broad River between the Parr Shoals Dam and the downstream end of the Bookman Island complex as the study area (Figure 3 and Figure 4). Flow in this reach is primarily influenced by releases from the Parr Shoals Dam and powerhouse. There are no significant flow contributions from tributaries within the study reach[3].

2.2 HABITAT AND GEOMORPHOLOGY

The Broad River flows southeasterly through a river corridor that is predominantly rural, and in general the river banks and riparian zones are forested. Overall the river is relatively straight for much of the reach, with moderate levels of sinuosity. The upper segment of the study area is dominated by well-defined banks (*i.e.* with discernible and consistent crests and toes) and relatively low-gradient pools, runs and glides, periodically segmented by short riffles. The lower segment also contains pools, glides and runs, but exhibits higher gradient bedrock drops and more pronounced riffles, and features ledge and boulder substrates which reflect down cutting through the piedmont terrace. There are a several islands with pronounced side channels and/or braids such as Haltiwanger, Bookman and Huffman islands.

[2] Reach is punctuated by short, higher gradient reaches (3-4%), near Haltiwanger and Bookman islands, but generally gradient is 1% or less.

[3] Because Little River, as well as other more minor tributaries, are ungaged, a desktop exercise using pro-rated discharge data from adjacent and/or similarly sized basins may be necessary to ensure that tributary flows during a normal water year do not exceed 10% of the total flow of the Broad River.

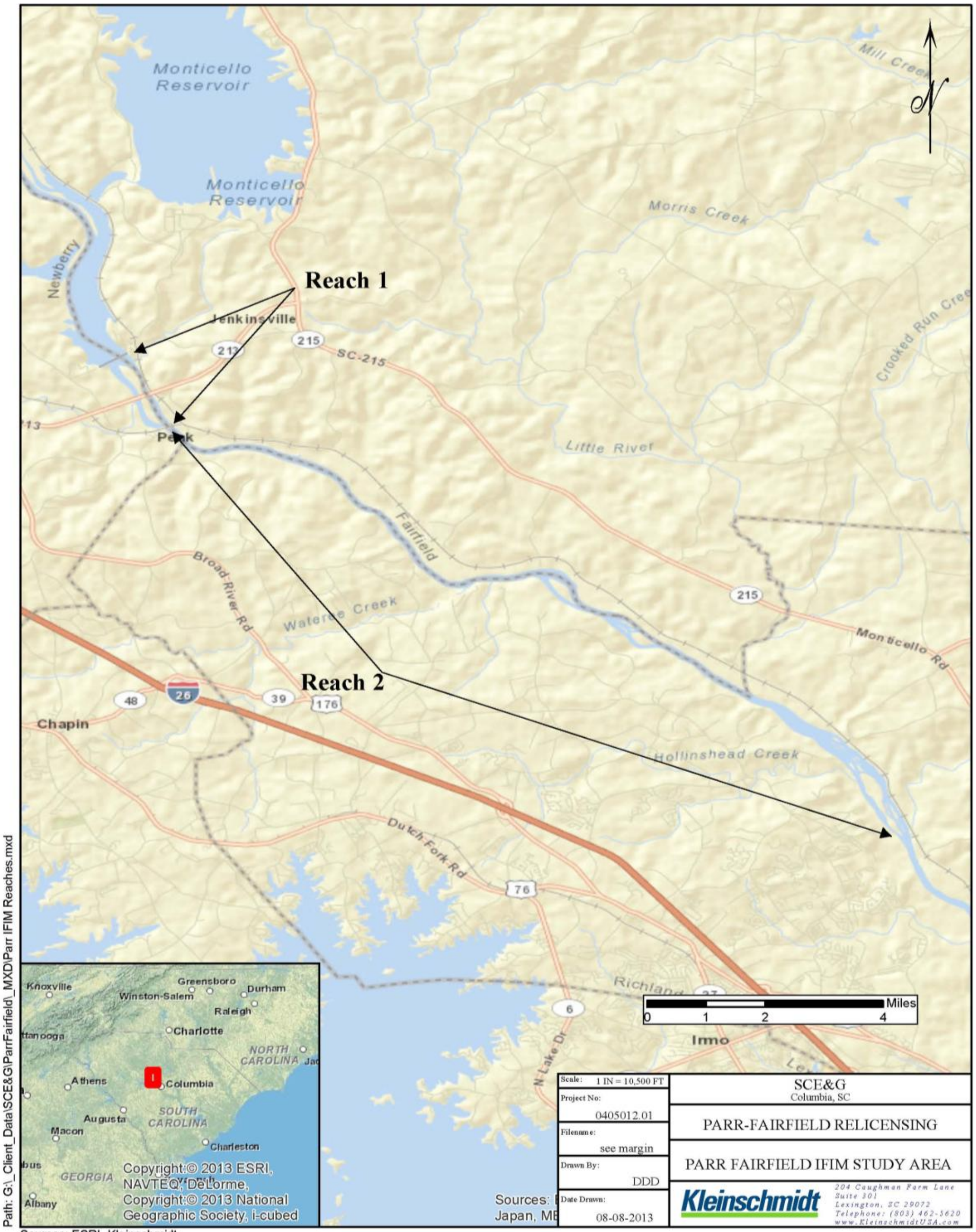
2.3 FISHERY, FISH MANAGEMENT OBJECTIVES, AND SEASONAL HABITAT USES

The varied instream features within the study area support a diverse community of warm water fish species and provide seasonal spawning and nursery habitat for anadromous American shad and striped bass. In addition, smallmouth bass, other centrarchids and catfish provide a sport fishery. Robust redhorse are rare migratory suckers present in the study area. Collaborative restoration efforts are underway to protect this fish and the USFWS describes it as an At-Risk-Species (ARS)[4]. Features within the study reach may also provide suitable conditions for Robust redhorse spawning and rearing (Appendix B). The Broad River spiny crayfish (*Cambarus spicatus*) is another ARS and has been documented from bank habitats of the Little River, a tributary that empties into the Broad River study area.

Anadromous fish restoration priorities for the Santee Basin focus on restoring runs of anadromous fish primarily up the Congaree and Broad rivers. The Santee Cooper Basin Diadromous Fish Passage Restoration Plan reports that the Broad River and its tributaries are the most promising sub-basin for diadromous fish restoration (USFWS et al., 2001).

[4] At-Risk-Species are species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

FIGURE 2 PARR FAIRFIELD INSTREAM FLOW STUDY AREA



Sources: ESRI, Kleinschmidt

3.0 PROPOSED METHODS

3.1 FIELD RECONNAISSANCE AND HABITAT MAPPING

The TWC concluded that an IFIM study would be appropriate to develop an understanding of key habitat-flow relationships in the Broad River, and elected to use a Physical Habitat Simulation (PHABSIM) model to quantify these relationships. The model will be used to quantify flows that meet habitat requirements of target species and life stages, based on output representing selected diadromous and resident fish. In addition, empirical data and/or a flow demonstration approach may be required to document flows that provide adequate fish passage at limiting bedrock ledges, such as those above Haltiwanger Island and near Huffman Island.

Consistent with IFIM protocol, a TWC comprised of agency, NGO and licensee biologists was formed for the purpose of making technical decisions regarding input parameters and review of study output. Specifically, that team designated or will designate:

1. boundaries of the study area,
2. locations of specific study sites,
3. locations of study site cell boundaries and/or transects,
4. Habitat Suitability Index (HSI) criteria, and
5. calibration flows and range of flows to be assessed.

The TWC members may also participate in field and analytical activities as feasible.

Mesohabitat Classification

Initially, a field survey will be conducted to quantify and map the distribution of mesohabitats in the Broad River study area. On June 18-19, 2013, the TWC conducted a reconnaissance survey of the study area (See notes in Appendix A). On July 31, 2013 the TWC discussed and finalized functional definitions of mesohabitat classes, as follows:

Riffle	Shallow, with moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel). Typically > 1% gradient.
Glide	Moderately shallow, well-defined non-turbulent laminar flow, transition from low to moderate velocity, lacking a definite thalweg, typically flat stream geometry, typically finer substrates, transitional from pool.
Run	Moderately deep, well-defined non-turbulent laminar flow, range from low to moderate velocity, well-defined thalweg, typically concave stream geometry, varying substrates, gently downstream slope (<1%).
Pool	Deep, low to no velocity, well-defined hydraulic control at outlet.
Rapid/Shoal	Shallow, with moderate to high velocity, turbulent, with chutes and eddies, high gradient, large substrates or bedrock. Typically >2% gradient.
Backwater	Varying depth, no or minimal velocity, off the primary channel flow.

Mesohabitat mapping will include a review of aerial photographs followed by ground verification. A field crew will field-delineate the relative quantity and spatial distribution of each mesohabitat type in the study area. Delineation will occur during a period of relatively low-to-moderate flow so that breaks in mesohabitat, substrate, object cover and hydraulics representative of approximate base flow conditions can be readily observed. Study team members are encouraged to participate in delineation to the extent feasible. The upstream and downstream boundary of each mesohabitat within the study area will be classified and geo-referenced in the field, and the information transferred to a Geographic Information System

(GIS) format. GIS will then be used to provide both a visual map and quantitative tabular information on the abundance of mesohabitat types in the study area.

Selection of Reaches, Study Sites and Transects

The TWC consulted in May 2013 to define study reaches and select potentially applicable mesohabitat study sites within each reach (Appendix A). The TWC then selected specific study sites and cell/transects within each study reach during the reconnaissance visit in June 2013 (Appendix A).

Within each study reach, the TWC identified study sites that represent typical and/or critical mesohabitats, and selected upstream and downstream cell boundaries within each study site based on localized observable shifts in stream width, cover, substrate, and hydraulics. The area between each upstream – downstream cell boundary is considered reasonably homogenous, and thus the field crew will subsequently locate a representative transect within each longitudinal cell.

Reach One, as defined by the TWC, extends from the Parr Shoals Dam downstream to the Palmetto Trail trestle (Figure 3), just below where the tailrace and bypass channels converge below Hampton Island. This reach contains five study sties (1 through 5) (Figure 3). Although PHABSIM will be the primary analytical tool used to describe habitat suitability, the TWC made two study site-specific exceptions. Study site 1 is partially composed of bedrock pools where a PHABSIM model is not applicable. These pools will be delineated so that each pool's volume can be estimated and the amount of flow necessary to maintain suitable water quality can be calculated, as well as the minimum flow necessary to maintain fish passage through the most limiting inter-pool channel constriction. Study site 4 will be assessed by employing a wetted perimeter transect, as described in the site selection notes (Appendix A).

Reach Two extends from the trestle downstream through the Bookman Island complex, and contains an additional five study sites (6 through 10) (Figure 4). The TWC noted that study site 7 is likely the most limiting for navigation and upstream fish passage due to the large bedrock ledge, and therefore will be assessed using the deKozlowski (1988) and Bulak and Jobsis (1989) criteria. The TWC also agreed that the Bookman Island complex (study site 10) could not be effectively modeled with PHABSIM due to the complex of channels, braids and islands, but will instead be assessed using a two-dimensional (2-D) modeling approach. The 2-D model defines an overall upstream and downstream model boundary of the study site but relies on a finite elements model rather than on the transect/cell boundary approached used in one-dimensional (1-D) PHABSIM modeling. The TWC also determined that habitat suitability in study site 9 (Huffman Island) would be evaluated via an empirical flow demonstration following development and review of results from study site 10.

During preliminary relicensing meetings, TWC members also requested information characterizing spawning habitat for robust redhorse (*Moxostoma robustum*) within the study area. It was subsequently determined that potential spawning sites would be field delineated concurrent with the mesohabitat assessment and other early field work to determine their proximity to the established IFIM study sites discussed above. The purpose of this effort was to determine if potential spawning sites fall within reasonable proximity to established IFIM study sites such that spawning habitat could be evaluated as part of the PHABSIM and 2-D modeling effort. Field reconnaissance for potential spawning sites was conducted by biologists from SCNDR, SCANA Environmental Services, and Kleinschmidt in October 2013 and February 2014, results of which are summarized in the attached memorandum (Appendix B).

FIGURE 3 AERIAL VIEW OF REACH ONE STUDY SITES

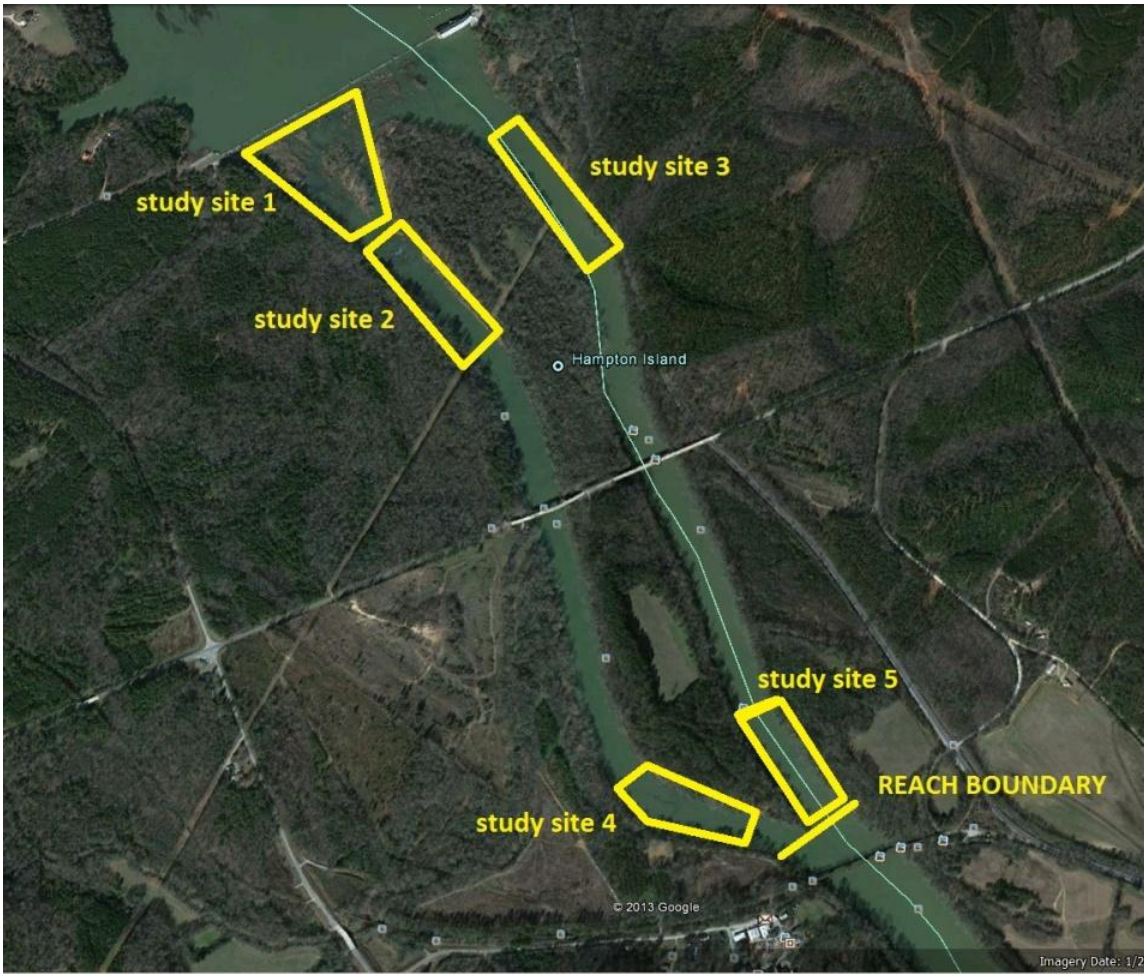
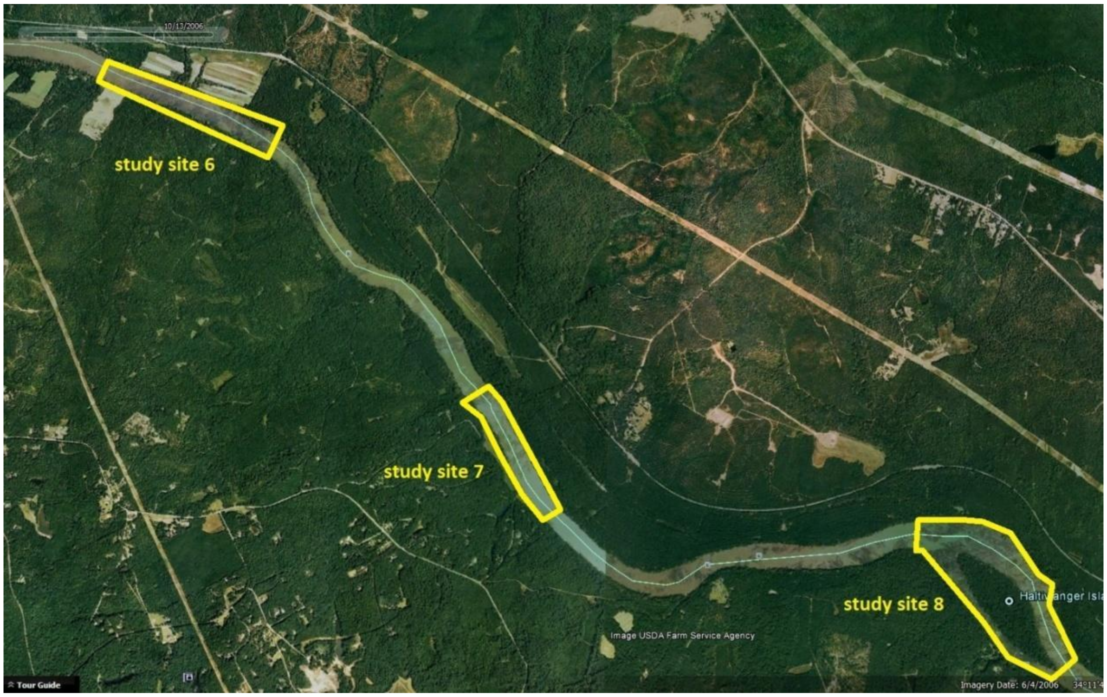


FIGURE 4 AERIAL VIEW OF REACH TWO STUDY SITES



3.2 FIELD DATA COLLECTION

3.2.1 PHABSIM STUDY SITES

General Approach

The second phase will entail the determination of habitat-discharge relationships for selected species, lifestages, and guilds as discussed by the TWC in July 2013 (Appendix A). Standard PHABSIM data collection and flow modeling procedures of the IFIM methodology (Bovee, 1982, Bovee, *et al*. 1998) will be used to evaluate habitat suitability in all 1-D reaches, and a 2-D model such as River 2-D or the equivalent will be employed to quantify habitat suitability in the Bookman Island complex (study site 10). As previously noted, empirical flow measurements will be obtained to evaluate zone-of-passage hydraulics at a limiting river channel sites, and also to evaluate habitat suitability in the Huffman Island vicinity (study site 9) following a review of flow recommendations related to the 2-D model conducted at Bookman Island (study site 10). The TWC also requested a wetted perimeter transect in Reach One at study site 4 below Hampton Island.

Modeling will be based on hydraulic data developed from cross-sectional depth, velocity, and substrate measurements using PHABSIM for Windows (V 2) (Milhouse, *et al.*, 1989), distributed by the USGS Fort Collins (CO) Science Center. River 2-D modeling will follow procedures described by Steffler and Blackburn (2002).

Flow Range to Be Modeled

Based on TWC consultation (See Appendix A), SCE&G anticipates that habitat-discharge relationships would be developed for flows ranging from 200 cfs to approximately 20,000 cfs, and that the modeling effort would focus on both selected mesohabitat types and the limiting fish passage and navigation channels selected by the TWC.

Suitability Index Criteria[5]

The TWC is presently gathering and considering specific Habitat Suitability Index (HSI) rating curves for use in this study. Based on TWC consultation, SCE&G proposes the use of HSI curves adopted primarily from prior studies, including the Saluda and Pee Dee instream flow studies. Provisional HSI curves were proposed and discussed on July 31, 2013 (Appendix A); however, collaboration on additional curve refinement is likely to occur, for example, with striped bass and smallmouth bass. In addition, appropriate cover and substrate coding for the Broad River spiny crayfish will be developed in consultation with the USFWS. Provisional curves, and related TWC discussion notes are contained in Appendix B. Additional species and life stages of interest for which stand-alone curves are unavailable or potentially inapplicable, have been classified by the TWC into habitat guild classes (*i.e*. deep slow, shallow slow, shallow fast, deep fast) and representative HSI curves for each guild selected by the team in consultation.

[5] This section will likely need modification assuming that HSI curves are finalized before submittal of the Pre-Application Document.

Data Collection (PHABSIM 1-D model)

The location of each transect will be field blazed with flagging or other appropriate means and documented using Global Position System (GPS) technology. Each study site and cell will be mapped sufficiently to quantify the area represented by each transect. The transect headpin and tailpin ends will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. Transect orientation will be such that each headpin will be positioned on river right (looking downstream) and tailpins consequently located river left. A measuring tape accurate to 0.1 ft will be secured at each transect to enable repeat field measurements to occur at specific stream loci[6]. Stream bed and water elevations tied to a local datum will be surveyed to the nearest 0.1 ft using standard optical surveying instrumentation and methods.

Depth, velocity, cover and substrate data will be gathered at intervals (verticals) along each transect. Each vertical will be located to the nearest 0.1 ft wherever an observed shift in depth or substrate/cover[7] occurs. Between 20 and 99 verticals per transect will be established as necessary to define cross-sectional habitat. Verticals will be arranged so that no more than 10% of the river discharge passes between any pair, thus enhancing hydraulic model calibration. At least one staff gage will be located per study site, and will be monitored at the beginning and end of each set of hydraulic measurements to confirm stable flow during measurements. If flow is found to be insufficiently stable[8], the related data will be discarded and re-measured once stable flow is established.

Mean column velocity will be measured to the nearest 0.1 ft/second with either a calibrated electronic velocity meter mounted on a top-setting wading rod, or alternatively an Acoustic-Doppler Current Profiler (ADCP) transducer. In water less than 2.5 ft depth, measurements will be made at 0.6 of total depth (measured from the water surface); at greater depths, paired measurements will be made at 0.2 and 0.8 of total depth and averaged.

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[6] Supplemental transects may be located as needed to record water surface and bed elevation data at hydraulic controls to establish backwatering parameters necessary for hydraulic modeling.

[7] Cover that is clustered and in close proximity to the transect (such as woody debris important to Broad River spiny crayfish) will be documented.

[8] "Stable water conditions" refers to absence of a pronounced upward or downward trend in staff gage height during the course of a set of hydraulic measurements. It should be noted, however, that previous IFIM experience by Kleinschmidt on other large rivers suggests that minor variations in staff gage height of up approximately 0.5 inch may occur, due to wind pitch and wave action. Under most such circumstances a hydraulic engineer will be consulted to evaluate whether measurements are acceptable or not for modeling purposes.

Each calibration flow will be provided by scheduled releases from the Project via unit operation and/or spillage. Turbine rating curves, USGS gaging, and study-site field gaging will be collectively used to estimate each calibration flow release. The hydraulic model will be built from measurements gathered at a *minimum* of three calibration flows to facilitate extrapolation of hydraulic data across the range of interest. To accomplish calibration, a full set of depth, velocity and water surface elevation (WSEL) data will be gathered at the intermediate flow, and WSEL will be measured at each transect for the low and high calibration flows. At transects with complex hydraulics such as braided channels or riffles, and/or sites with unusual backwatering or eddy effects, supplemental velocity data may be gathered at the low calibration flow to enhance model accuracy. This will be determined in the field on a case-by-case basis.

Each calibration flow should ideally be separated by about an order of magnitude to provide a suitable stage-discharge curve for the hydraulic model. At a minimum, SCE&G anticipates utilizing calibration flows of approximately: 400, 2000 and 10,000 cfs, as determined in consultation with the TWC (See July 31, 2013 meeting notes, Appendix A). Depending on calibration quality, this should allow the PHABSIM model to theoretically project Weighted Usable Area (WUA) for a flow range from 200 to approximately 20,000 cfs. The need for additional calibration flow data may vary by transect and will be evaluated on a case-by-case basis.

Data Collection (2-D Model)

As previously noted, the TWC deemed that a 2-D hydraulic model is most appropriate for capturing the hydraulics and habitat suitability of the Bookman Island complex (study site 10) due to the complex channel characteristics. For the 2-D model, two calibration flows will be employed. The exact flows required are not critical but should represent hydraulic conditions including both “typical” low and “intermediate” discharge through the study reach. Inflow will be estimated by means of gaging and/or an ADCP unit. The two calibration flows will be collected under approximately steady flow conditions, as safety and hydrologic conditions allow. The calibration flow data allows the modeler to evaluate the flow directionality and magnitude under different flow conditions through the study area. Additionally, at least three water level loggers will be deployed within the study reach to assist with model calibration. In general, specific locations will include one logger in the “upper” portion of the study reach, upstream of the islands, one logger in the right main channel, and a third logger in the left main channel.

A two dimensional substrate map will be developed based on data collected during the field effort. Substrate and cover will be categorized based on codes specified within the HSI curves in Appendix B. The 2-D model will be developed using a combination of terrain (Light Detection and Ranging (LIDAR) and/or Digital Elevation Model, depending on availability) and bathymetric bed elevation survey data[9]. This will include a WSEL survey, and flow gaging at the inlet and/or outlet of the study site boundaries.

Data Collection (ledge pools below dam in study site 1)

Pool volumes will be field surveyed to create a 3-D bathymetric map to estimate pool volume. Bed elevations will be gathered and spatially located using submeter accuracy GPS to create a bathymetric profile. The volumetric turnover rate at various inflows will then be calculated, and temperature and dissolved oxygen will be empirically measured at different inflows to assess the extent to which water quality will support aquatic life. The most limiting zone of passage point among pools will be identified and a cross sectional survey will be completed, after which a stage-discharge curve will be developed to estimate the minimum flow required to facilitate volitional fish movements through the restriction.

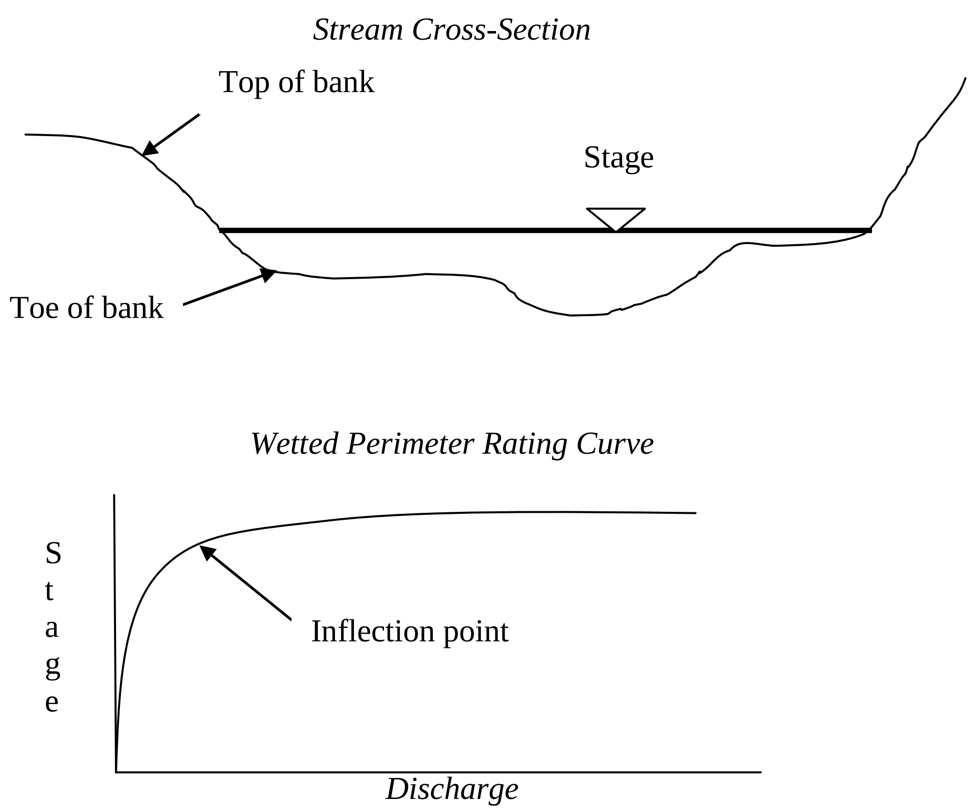
Data Collection (wetted perimeter at study site 4; backwater at lower West Channel)

Although originally established to assess the stage/discharge relationship associated with backwater effects of generation releases, efforts will be made to position this transect at the location most limiting to fish passage and one-way navigation. The transect end points at study site 4 will be field blazed with flagging or other appropriate means and documented with sub-meter GPS. The transect headpin and tailpin ends will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. A measuring tape accurate to 0.1 ft will be secured at the transect to enable repeat field measurements to occur at specific stream locations. If necessary, streambed and water elevations tied to a local datum will be surveyed to the nearest 0.1 ft using standard optical surveying instrumentation and methods. A sufficient number of verticals will be established along the transect to accurately depict cross-sectional channel geometry. Water elevation at three flows spanning the range of releases associated with the PHABSIM data collection will be recorded through both survey and staff gaging, so that a

[9] As noted in the Rocky Shoals Spider Lily (RSSL) Study Plan, elevations of the existing RSSL colonies may also be documented concurrent with the bathymetric bed elevation survey, if deemed feasible during execution of the IFIM study.

stage-discharge relationship can be established. These data will then be used to establish a wetted perimeter rating curve, as example of which is shown in Figure 5.

FIGURE 5 SCHEMATIC DIAGRAM OF WETTED PERIMETER CROSS-SECTION, WATER ELEVATION AND CORRESPONDING RATING CURVE



Hydraulic Modeling

Hydraulic modeling and quality assurance/quality control techniques will be in accordance with standard practice for PHABSIM and River 2-D. Hydraulic modeling will be accomplished by correlating each surveyed WSEL with discharge to develop a stage-discharge relationship for each transect. Once this relationship is established, the model then adjusts velocities obtained at calibration flows to each flow increment of interest for which a defined water stage has been calculated. The model is then calibrated by comparing simulated hydraulics to empirical measurements taken at the calibration flows. Detailed steps are summarized below:

Field data collected at transects (e.g. cross section surveys, WSELs, velocities, discharge and slope measurements) will be entered into a computer database compatible with PHABSIM software. All field calculations of discharge and data entry will be proofed and cross-checked for accuracy. The field data include measurements at three calibration flows, and are used to simulate depth, velocity, substrate and cover conditions at discharges other than the calibration flows. Discharges and WSELs are determined for all calibration flows. Bed profiles, substrate and cover used in the model are derived from surveys made during low flows. Velocity calibration in the PHABSIM model typically relies on velocities measured during mid-range flows, although velocity measurements are sometimes made in the field for low flows at features such as riffles where velocities are very irregular across the cross section.

Transects within a common study site and mesohabitat type will be linked hydraulically (*i.e.* within the same datum) with adjacent contiguous transects or with downstream hydraulic controls that create backwater conditions. Stand alone transects, however, will be independently modeled. Simulation of water surface elevations at each transect will be accomplished using one of three methods within PHABSIM: IFG4, MANSQ or WSP. Often, all three models are run with the best stage-discharge relationship determined for each cross-section. The specific model used at a given transect depends on site characteristics, including gradient and backwatering from downstream hydraulic controls. IFG4 uses a log-log fit to determine a stage-discharge curve for the three calibration flows. MANSQ determines the stage-discharge relationship using the Manning's equation for stream flow, while WSP uses hydraulically-linked cross-sections in a backwater model to determine the relationship. WSP is similar to backwater models such as the U.S. Army Corps of Engineers' HEC-RAS program.

Velocity calibrations for each transect are performed using routines within the IFG4 model, usually at the mid-range flow. Where a low flow velocity set is also available, two models may be prepared, one to cover low flows and the other to represent mid-range to high flows. The range of simulated flows represented by each calibration set is determined by the hydraulic engineer based on the model's performance at the calibration flows and trends in hydraulic parameters such as water surface elevation and velocity. PHABSIM output for each simulated flow, such as Velocity Adjustment Factors (VAFs), are plotted as smooth curves with aberrations in these curves indicative of range boundaries for a given calibration flow. Typically, these fall toward extreme low or high flows in high gradient channels, at which point one of the other three calibration sets will be used to continue the model out to the extremes. The hydraulic engineer will review all hydraulic output and determine and document the acceptable range of simulated flows. This range usually extends from slightly below the low calibration flow to slightly higher than the high calibration flow. All hydraulic model output is reviewed by a second hydraulic engineer before being used in habitat modeling.

Habitat Suitability

Once the hydraulic model is calibrated, estimates of habitat suitability at each flow increment of interest will be generated by combining the HSI and hydraulic model data using the HABTAE and supporting programs within PHABSIM. These ultimately produce output known as Weighted Usable Area (WUA) for each transect at each flow increment. WUA is an index of habitat suitability based on units of square ft of optimal habitat available per 1,000 ft of represented stream length. WUA output for all transects in a given mesohabitat type are then weighted according to actual linear distance each transect represents within the mesohabitat, as mapped in the field, to provide a mesohabitat habitat-flow curve. All mesohabitat WUA within a given study reach is then weighted and summed for each flow increment to provide a net WUA estimate for the entire study reach.

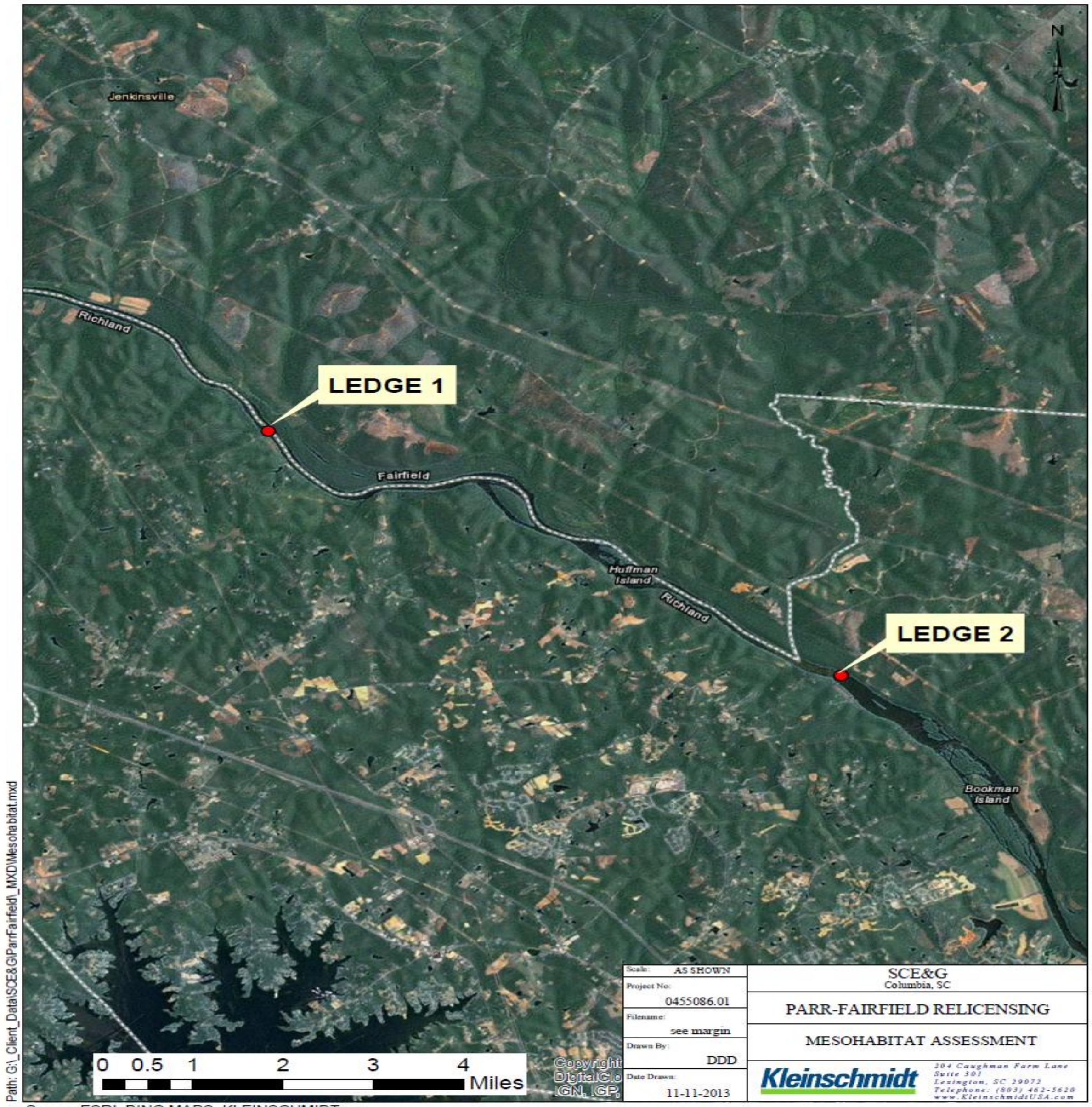
3.2.2 FISH PASSAGE AND NAVIGATION STUDY SITE(S)

During the IFIM field effort, data will also be collected to identify critical flows necessary to facilitate volitional upstream fish passage through limiting shoals areas, as well as one-way, downstream navigation through these sites. In preparation for this effort, the study area was examined during periods of low wadable flow when channel geometry and probable zone of passage routes were readily observed[10]. Two sites were selected that the TWC believes represent critical passage routes (Figure 6). The first is the bedrock ledge located approximately 2.4 mi upstream of Haltiwanger Island at Study Site 7 (81°15'46.507"W, 34°12'49.999"N). The passage point is on river left (looking upstream) and is approximately 45 ft wide (Figure 7), with an approximate change in elevation of 1.5 ft. The second is a ledge located approximately 1.3 mi upstream of Hickory Island and approximately 0.5 mi downstream of the mouth of Little River (81°10'15.941"W, 34°10'18.154"N). The passage point is also on river left (looking upstream) and is approximately 60 ft wide (Figure 8), with an estimated change in elevation of 1.5-2.0 ft.

[10] Field examinations were during the June 2013 agency field reconnaissance and during November 2013 as part of efforts to quantify mesohabitats occurring in the study area.

The field crew will obtain bed bathymetry, water elevation and velocity measurements at each calibration flow. These data will then be displayed graphically and in tabular format to develop a stage-discharge relationship that identifies flows that promote hydraulics that can provide suitable fish passage. Criteria for fish passage are presented in Bulak and Jobsis (1989). Recommendations for flows sufficient to support recreational navigation are described in the SC State Water Plan (SCDNR 2004) and deKozlowski (1988). According to those documents, instream flows in Piedmont streams should be sufficient to 1) provide one-way downstream passage of a 14 foot jon-boat without a motor through rocky shoals; and 2) provide two-way navigation in runs and pools with a 14 foot jon-boat with an outboard motor. Methodology and reporting requirements are described in greater detail in the *Parr Hydroelectric Project Downstream Navigational Flow Assessment Study Plan.*

FIGURE 6 FISH PASSAGE AND NAVIGATION PASSAGE STUDY SITES



Source:ESRI, BING MAPS, KLEINSCHMIDT

FIGURE 7 AERIAL VIEW OF BEDROCK LEDGE AT STUDY SITE 7.

FIGURE 8 AERIAL VIEW OF BEDROCK LEDGE ABOVE HICKORY ISLAND.

4.0 REPORTING

Phase 1 Report

A draft report will be prepared for TWC review and comment, documenting methods and results as encountered in the field and during modeling. This report will focus on analysis of the WUA /flow relationship at all study sites. Supporting hydraulic data will be presented in graphic and tabular form, along with an analysis of trends in the data, and documentation of study team consultation. Appendices will also include cross-sectional survey data and reference photographs of study sites. The report will be finalized and provided to the TWC following receipt of input from the study team.

Phase 2 Report - Dual Flow Analysis

During the second phase, a Dual Flow analysis will be performed following TWC review and approval of the Phase 1 report. The TWC will then consult to define the scope and parameters of the analysis. The purpose of this analysis will be to evaluate the effect on habitat suitability of various combinations of generation flows and base flows.

The assumption behind Dual Flow analysis for non-mobile organisms (e.g. macroinvertebrates, fish egg nests, *etc*) is that a specific patch of stream bed (represented by a modeled habitat cell) is only suitable as long as the hydraulic conditions remain suitable throughout the range of flows ("effectively-available habitat"). Habitat suitability is calculated by comparing the WUA of each 1-D or 2-D cell at each of two flows (a given base *vs.* generation flow pair). In the analysis, the lower of the two paired WUA values is considered to be the effectively available level of suitability for that cell. For example, if the habitat suitability value for a cell is zero at either the low *or* high flow, it is assumed to have zero effectively available habitat. The resulting WUA is then summed across all cells, to establish a composite WUA value for each flow pair of interest. For mobile lifestages, the same overall process is followed but the WUA comparison occurs at the study site scale rather than at the cell scale.

The TWC will consult to define bioperiods (seasons), and to select applicable base flow/peak flow couplets for analysis, subsets of habitat suitability criteria, and study site(s) at which to conduct the analysis. The report will provide both tabular and graphic data showing the ranges of WUA for each selected lifestage at each flow pair of interest, and a discussion of trends in the data.

5.0 CONSULTATION

This study relies upon periodic input from TWC members so that upon receipt of the final report, the TWC may provide flow recommendations to be used in other analyses such as assessing project operation issues, lake level management, and overall flow regime evaluation (see section 1.3). The TWC has thus far developed this study plan, conducted a reconnaissance of the study area, selected study reach boundaries, cell boundaries, developed provisional HSC, reviewed mesohabitat mapping of the study area, and met several times to confirm and/or refine aspects of the study plan.

SCE&G is responsible for conducting the study and analyses in accordance with this plan; during the course of the study, SCE&G will continue to consult with, and update the TWC regarding study progress, and seek input as necessary. This will include further development of HSC, advising TWC members of field data collection schedules, and modeling status prior to development of the Phase 1 Report. Following development of a draft Phase 1 Report, the TWC will conduct a workshop to review the WUA and flow relationships which are the foundation of flow recommendations and further Dual Flow analyses. The TWC will also select provisional base flow targets from the model output that can be used to conduct the empirical flow demonstration at Huffman Island (Study Site 9), and to verify modeling efficacy at other sites of interest, including zone of passage and navigability sites.

The final aspect of the study will be for the TWC to identify specific inputs for the Dual Flow analysis (described in Section 4), and to review and discuss the results of that analysis prior to developing preliminary habitat based recommendations for use in evaluating relicensing alternatives. Upon completion of the study and resulting consultation, minimum flow recommendations developed by the TWC will be provided to the Fish, Wildlife and Water Quality Resource Conservation Group (RCG) for consideration in development of the relicensing Protection, Mitigation and Enhancement (PM&E) Measures.

6.0 SCHEDULE

TASK	COMPLETION DATE[1]
Finalize target species/guilds	December 2013
Finalize HSI curves to be used	December 2013
Mesohabitat characterization; select transect locations	Winter 2014
Collect transect data	3rd Quarter 2015
Complete modeling	1nd Quarter 2016
Issue draft Phase 1 report	2rd Quarter 2016
Conduct empirical flow demonstration	2nd Quarter 2016
Develop Dual Flow analysis	3rd Quarter 2016
TWC review and analysis of Dual Flow results	3rd Quarter 2016
Issue final report	4th Quarter2016
Provide Flow Recommendations to RCG	4th Quarter 2016

[1] Schedule is tentative and is intended as a general guide.

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APPENDIX A
TECHNICAL WORKING COMMITTEE MEETING NOTES

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

May 7, 2013

Final KDM 05-31-13

ATTENDEES:

Bill Marshall (SCDNR)
Ron Ahle (SCDNR)
Gerrit Jobsis (American Rivers)
Shane Boring (Kleinschmidt)
Alan Stuart (Kleinschmidt)
Kelly Miller (Kleinschmidt)
Bill Stangler (Congaree Riverkeeper)
Ray Ammarell (SCE&G)
Vivianne Vejdani (SCDNR)
Bill Argentieri (SCE&G)
Milton Quattlebaum (SCANA)
Steve Summer (SCANA)
Randy Mahan (SCANA)
Dick Christie (SCDNR)
Tom McCoy (USFWS) via conference call
Prescott Brownell (NOAA)
Kerry Castle (SCDNR)

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Alan opens the meeting by briefly going over the agenda, then gives the group an overview of the float trip taken on March 19th and 20th. During this review, the group looks at the Project Area on a map, which sparks a discussion on the habitat just below the Parr Dam.

Ron explains how he is concerned about the separation in the habitat along the first mile of the Broad River, just below the Parr Dam. He says this is a highly utilized area of the river by fish species, and the side of the river along the west bank can grow stagnate during periods of low flow. Shane asks if a critical habitat study should be performed in this area. Ron says there are several critical habitats that need to be studied before the rest of the river is characterized. Prescott and Ron both mention they would like to have a habitat map made for as far down river as possible. Ron says that a habitat map should at least be made for the area immediately below the Parr Dam.

Gerrit tells the group he would also like to look at access along the river, since there are several areas that aren't accessible. Prescott mentions that he is interested in studying the tributaries along the river. Ron mentions that there is a good amount of data already available on the tributaries, collected by the DNR Stream Team.

Alan refers the group to a study on the Broad River, completed by Jason Bettinger (referred to throughout these notes as the Bettinger Study), as a possible starting point for the Parr Project's Mesohabitat Assessment and Instream Flow Study. The group notes that the Parr Project area was not included in this study, as the area in the Bettinger Study begins at Neal Shoals and extends upstream. However, the methodology used in the paper might still be utilized by the group.

After discussion on various needs for the Mesohabitat Assessment and Instream Flow Study, Gerrit focuses the group back on the agenda by beginning to list the goals and objectives for the study. Through much discussion the group agrees on four goals with corresponding objectives, as well as additional studies that need to be completed. These goals, objectives, and studies and included as an attachment at the end of these notes.

Steve and Ron then discuss the habitat issues at the west bank area. Ron says he believes that the decrease in DO and increase in temperature along the west bank area is related to the operating of the Fairfield Pumped Storage Project. Steve asks Bill if he has a copy of some aerial photos that were taken prior to Project construction since the west bank features are the result of natural topography, of which Bill answers he is not sure. Steve says he will try to find the photos, since they might show how river flow was distributed between the east and west bank area before the Project was built. Steve says that the issue will be getting water into that west channel during low flow situations. Gerrit says that Duke Energy is building a separate dam to help control flows at one of its projects. He believes the group needs to focus first on deciding what the flow needs for the area are, by seeing the area during higher flow situations. This will allow the group to evaluate how flows might be manipulated to create an even distribution over the area during low flow situations. Steve adds that LIDAR information will also be helpful, and that baseline data on temperature and DO in the west bank area will be needed to feed into the module. Ron mentions that spring through fall data needs to be collected, since he hasn't studied the area except during the summer. Kerry asks if turbidity will need to be examined along with the temperature and DO. The group considers this but decides that turbidity data is not necessary.

While looking at a photo of the dam, the group notes that there is a bit of leakage, which could be beneficial to the seemingly flow deprived west bank area. Ron agrees, but points out that during the summer, any benefits of the slight leakage at the dam may be diminished by the time they reach the central rocky location in the west channel.

The group then focuses their attention towards defining the geographic scope of the Mesohabitat Assessment and Instream Flow Study. The next hydro on the Broad River, downstream of the Parr Fairfield Project, is the Columbia Hydro Project. The upper reach of the PBL for the Columbia Hydro is noted as being at a Rocky Shoals Spider Lily population located just above the upper tip of Boatright Island. The group discusses whether or not this should mark the end of the scope for the Mesohabitat Assessment. It is decided that the scope for the Mesohabitat Assessment will stretch from Parr Dam downstream to the lower end of Bookman Island. Bill S. points out that there is a tributary on the lower end of Bookman Island, named Big Cedar Creek, and the scope should include this as well.

After deciding the scope, the group begins discussion on which definitions to use for the various mesohabitats. Two slightly varying sets of definitions are considered, including one used during the Saluda Hydro Relicensing Project, and one used in the Bettinger Study. Alan points out that using the definitions from the Bettinger study will be good for consistency, however, the group seems to prefer the definitions used during the Saluda Relicensing. Shane points out that there are several other commonly accepted definitions for the various mesohabitats and so the group decides to consider these options also. This issue is left undecided for now.

The group agrees to stay with the methodology that was used in the Bettinger Study. The group then discusses what the ideal flow would be when conducting the study. Ron says that lower flows make it easier to delineate the habitats, while Shane says the flow should be near the mean annual flow when mapping. Ron suggests a flow that is below 2,000 cfs would be best for conducting the study, and everyone agrees.

The focus then turns to identifying target and driver species for the various Habitat Use Guilds. Ron offers his personal list of fish species he has observed in the Broad River to be used as a starting point. The group decides on a list of driver species including:

- Smallmouth Bass
- American Shad
- Brassy Jumprock
- Whitefin Shiner
- Robust Redhorse
- Santee Chub
- Striped Bass
- Piedmont Darter
- Snail Bullhead
- Redbreast Sunfish
- Channel Catfish

Although the list is longer than is customary, Alan says that it can be included in the study plan with a caveat that says some of these species will later be grouped into guilds. Alan makes the point that the species which have HSI curves need to be identified, and suggests that Shane and Brandon Kulik work together on this task. Shane and Brandon will also recommend surrogates for the group to consider that can be used for the species that do not have HSI curves and work on guild classifications.

The group then focuses on establishing general transect locations for the study. Dick mentions that in the Bettinger Study a majority of the river was categorized as being glides, pools and shoals, and that these will be areas to look for when deciding on transect locations. Ron specifies that he would like at least one transect to be established right below the Parr Dam, in the area he has identified as a critical habitat. The group launches into a heavy discussion on where the transects should go and how many are needed. Eventually everyone agrees to four general areas for the study to implement the IFIM technique. These include an area immediately below Parr Dam, upstream of Haltiwanger Island, along the Coleman property, and at Haltiwanger Island. Additionally, two other sites were identified for studying wetted perimeter/staged discharge relationships, at Huffman Island and Bookman Island. These locations are included in Figure 1. With these sites agreed upon, the group decides to schedule a field trip to identify the specific locations for transects. Group members interested in participating in this trip are Ron Ahle, Shane Boring, Gerrit Jobsis, Bill Stangler, Bill Marshall, Alan Stuart, Vivianne Vejdani, Milton Quattlebaum, Tom McCoy, Prescott Brownell, Steve Summer, Ray Ammarell and/or Bill Argentieri.

To close the meeting, the group discusses scheduling, keeping in mind that the final study plan needs to be developed by early 2014 to be included in the PAD, which is due late 2014/early 2015. The actual IFIM study will be started during the summer of 2015. The group plans to meet again during the July-August timeframe to discuss the draft study plan and HSI curves. With this, the meeting adjourns. Action items stemming from this meeting are listed below, along with an attachment that includes all decisions made during the meeting.

ACTION ITEMS:

- Shane Boring will contact Brandon Kulik to work together on identifying relevant HSI curves and surrogates for the study. Shane will also ask Brandon to make guild recommendations.

- Shane Boring will research other options for mesohabitat definitions to be used in the study.

- Kelly will schedule the "Transect Identification Recon Trip" with the interested parties for June 18th and 19th.

- Kelly will schedule a follow-up meeting/conference call during the July-August timeframe for the discussion of HSI curves and study plan development.

Kleinschmidt

Goals and Objectives of Mesohabitat Assessment and Instream Flow Study

Goal 1: Characterize the flow/habitat relationships for aquatic species present in the lower Broad River below Parr Dam

- Objective A: Classify and quantify/map (characterize/define) Mesohabitats occurring within study area
- Objective B: Establish target species/guilds
- Objective C: Identify study methodology (recommended IFIM)
- Objective D: Identify tributaries and study areas (reaches) on the lower Broad River of interest for the study

Goal 2: Determine effects of Parr and FFPS operations on flows of the lower Broad River below Parr Dam

- Objective A: Identify operational ranges/constraints of two facilities
- Objective B: Evaluate effects of Project operations on Parr Dam releases at various inflow ranges into Project

Goal 3: Develop recommendations for Parr Hydro Project operations to enhance flows for aquatic resources in the Congaree River (this does not include a transect study)

- Objective A: Influence on diadromous fish (includes striped bass, sturgeon)
- Objective B: Influence on other resident aquatic species (including RT&E)
- Objective C: Influence on Congaree National Park
- Objective D: Consideration of Saluda operations consistent with goals of the Santee Basin Accord

Goal 4: Develop flow recommendations for lower Broad River below Parr Dam

- Objective A: Evaluate baseline habitat
- Objective B: Evaluate high and low flows
- Objective C: Seasonal and inter-annual variations of flow recommendations
- Objective D: Evaluate low flow protocol recommendations

Additional studies:
Temperature and DO in the west channel below Parr Dam (three monitoring locations)
Recreation flows – operation of Parr
Navigation flows – operation of Parr
Water Quality – operation of Parr

Define Geographic scopes of Mesohabitat Assessment and Instream Flow Study / Discuss Mesohabitat Assessment (including methodologies)

Geographic Boundary - Parr Dam to downstream end (lower extent) of Bookman Island, just below the confluence of Big Cedar Creek

Methodologies –
Mesohabitat unit definitions for visual assessment. (NOTE: May be modified by use of Saluda descriptions)

Habitat	Type Description
Riffle	Relatively shallow (<0.5m), swift flowing section of river where water surface is broken.
Glide	Relatively shallow (<1m); with visible flow but mostly laminar in nature; minimal observable turbulence; relatively featureless bottom.
Run	Deep (>1m), swift flowing sections with turbulent flow; surface generally not broken.
Pool	Deep (>1m) slow moving sections.
Shoals	Shoal area; which may contain a variety of habitat complexes.

Use same methods Jason Bettinger used for his study in the upper Broad River, such as GPS for start and end of each classification.

Mesohabitat study should be conducted below 2,000 CFS

Define Species of Interest for Instream Flow Study

Summary of Habitat Use Guilds

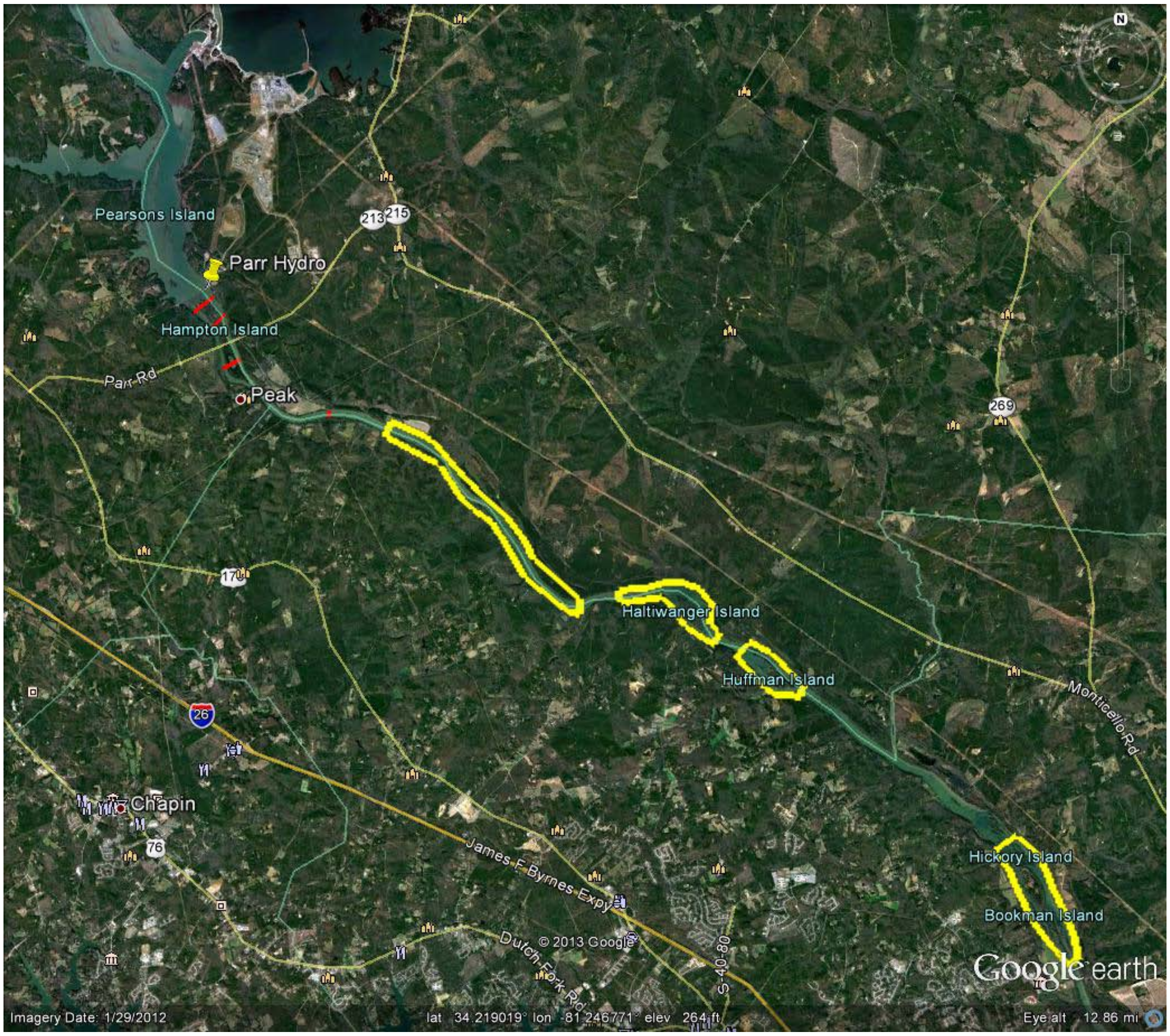
Driver Species:
American shad
Brassy jumprock
Channel catfish
Piedmont darter
Redbreast sunfish
Robust Redhorse
Santee chub
Small mouth bass
Snail bullhead
Striped bass
Whitefin shiner

Discuss Methodology (including HSI curves, number and location of transects, areas of specific interests)

Look for HSI curves that exist for driver species and make recommendations for surrogates and guilds

Methodology (number and location of transects, areas of specific interests): IFIM above Huffman Island, wetted perimeter for Huffman and Bookman islands.

Figure 1 General Transect Locations



Kleinschmidt

PARR-FAIRFIELD PROJECT

Instream Flow Study

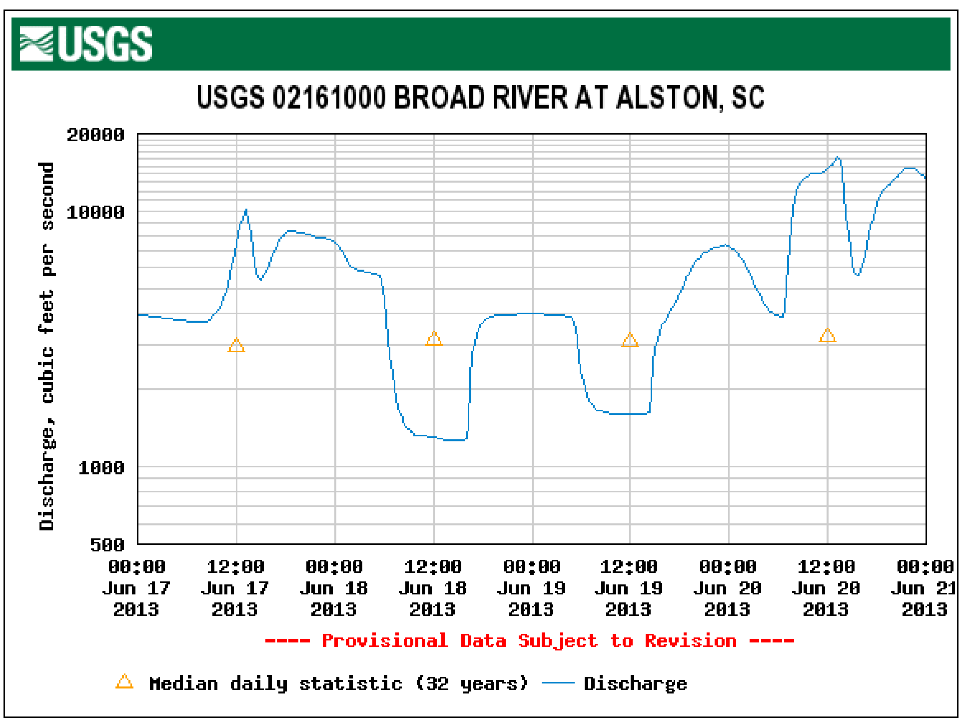
Study site and transect selection field visit summary

DATE: June 18-19, 2013

ATTENDEES:

Ron Ahl	S.C. Dept of Natural Resources (SCDNR)
Bill Marshall	SCDNR
Gerrit J¨bsis	American Rivers
Bill Stangler	Congaree Riverkeeper
Bill Argenteri	SC Electric & Gas (SCE&G)
Milton Quattlebaum	SCE&G
Alan Stuart	Kleinschmidt Associates (KA)
Shane Boring	KA
Brandon Kulik	KA

The goal of this meeting was to collaboratively select study reaches, study sites, transect cell boundaries and discuss data collection and modeling approaches for an IFIM Study of the Broad River, consistent with TWC objectives set at the May 7, 2013 TWC meeting. At that meeting, key river reaches for modeling and analysis were identified. During the site visit, participant hiked, waded and boated these reaches. During each day of the site visit, SCE&G managed discharge downstream from the Parr-Fairfield dam in the range of approximately 1,300-1,700 cfs so that the TWC could view mesohabitat and channel features.



The following notes reflect in-field study scoping decisions:

The study area was divided into two study reaches:

Reach 1 – from the dam to the confluence of the tailwater and bypass reach (near the downstream tip of Hampton Island (near the Palmetto Trail trestle crossing) and

Reach 2 - from the trestle downstream through Bookman Island complex.

<u>Reach 1 – from dam to downstream end of Hampton Island</u>

Study Site 1 – immediately below the western end of the dam, habitat is dominated by pools formed by perched bedrock ledge that primarily receive incidental flow during high flows or periodic spillage under existing operation. It was observed that there was little to no flow in this area on the day of site visits. The TWC agreed that the primary habitat issue was volitional passage of fish among pools, and adequate water circulation to maintain suitable temperature and dissolved oxygen (DO) for fish occupying pools, and that this site could not be effectively modeled using Physical Habitat Simulation (PHABSIM. Effort will focus on quantifying the turnover rate that maintains temperature and DO in pools) and adequate zone of passage at the most limiting channel constriction.

Photo 1. Ledge/pool area below dam in study site 1

Study Site 2 – Site viewed from Highway 213 bridge. Site located just to the west of the island, below site 1 on “bypass reach” side. The TWC agreed to 2 transects above power line in run/glide habitat to capture different substrate /cover conditions: one within boulder field, and a second in a more open channel between the boulder field and power line. The TWC concurred that this site could potentially be modeled with PHABSIM, and that the areas downstream from the power line within the study reach were backwatered, and composed of ephemeral fines that migrate.

Photo 2. Run/glide mesohabitat in study site 2 (in distance near transmission tower) looking upstream from highway bridge; ephemeral sand deposits are in foreground

Study Site 3 – Located on tailrace side of Hampton Island. The TWC delineated cell boundaries for this site and gathered GPS waypoints to mark upstream and downstream cell boundaries. Site consists of Run → Glide→ Riffle complex, and group agreed on one PHABSIM transect in each. Run begins at gravel bar approximately 100 yds downstream of powerhouse (GPS pt #77), transitions to glide (GPS pt "Glide3") and transitions to riffle bedrock ledge (GPS pt #77). Bottom of riffle needs to be determined from aerial or determined in field at time of transect set-up. Run transect selected at location of large sycamore near aforementioned gravel bar (flagged). Ron Stated that this is potentially a very important robust redhorse habitat site, and also important for quillback carpsucker, American shad, and represents complex habitat not represented elsewhere.

Study Site 4 - Just upstream of Palmetto Trail trestle at the lower end of channel on west side of Hampton Island. Group observed Native American weir and small shoal near lower end. Ron noted this as important habitat, noting that it is highly influenced by backwatering from powerhouse flows. The TWC decided that a stage/discharge transect would best fit for this area rather than a PHABSIM model, with the objective of evaluating response at different side channel and powerhouse flows

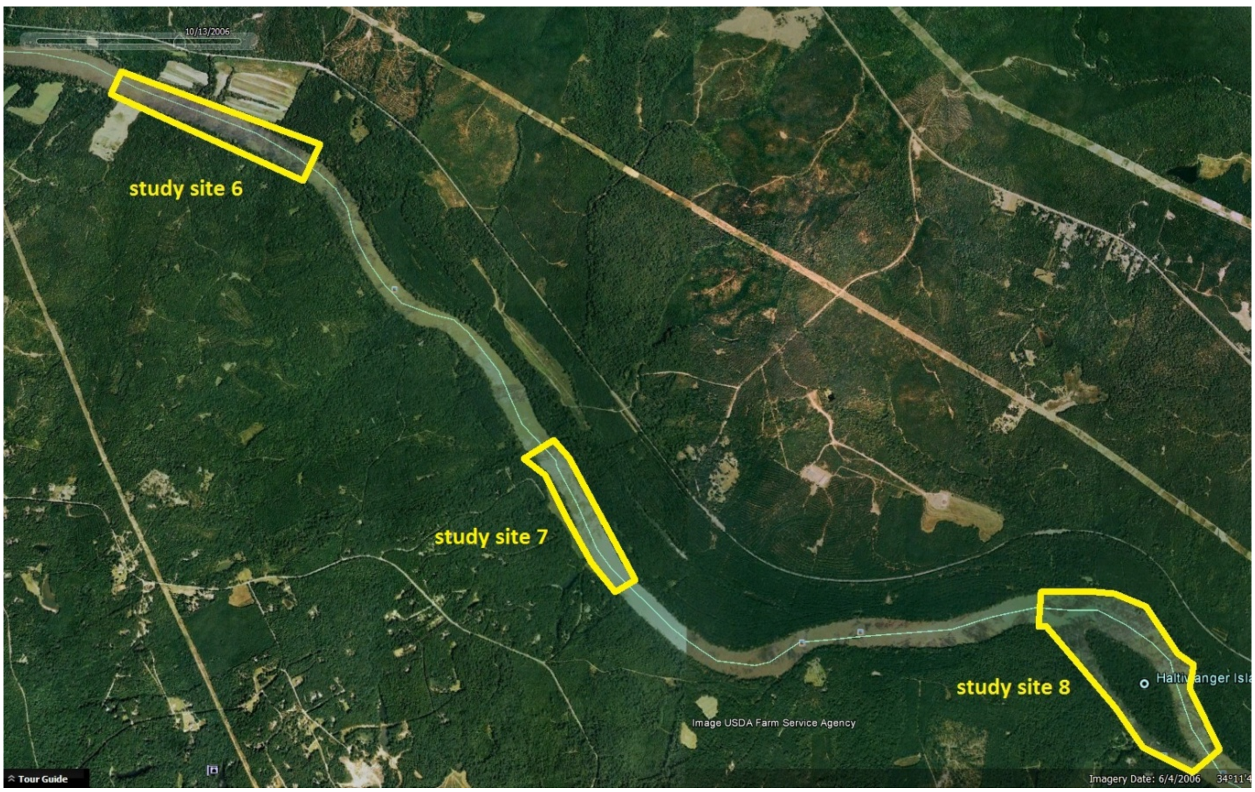
Photo 3. Run/riffle mesohabitat in study site 4, looking upstream from trestle

Study Site 5 – Just upstream of Palmetto Trail trestle on the downstream end of powerhouse side of Hampton Island. The TWC agreed to focus on 1 of the 2 shoals occurring in this area, with at least one riffle and one run transect for PHABSIM modeling.

Photo 4. Shoal mesohabitat in study site 5, looking upstream from trestle

<u>Reach 2 – from end of Reach 1 downstream through Huffman Islands</u>

The TWC then boarded canoes to traverse the next segment downstream to Haltiwanger Island. Brandon Kulik did not accompany the group on this segment due to a schedule conflict.



Study Site 6 – Large "main-channel riffle" approximately 2 miles downstream of Palmetto Trail trestle. Large field on river left, study site ends at large shed at downstream edge of field. Uppermost cell boundary at the head of riffle (GPS pt #79). Downstream end of study area delineated by GPS pt # 80. Numerous rocky areas spread across river, very different than shoal above RR bridge. Gerrit noted this area was too variable to capture with just one transect; potentially needs to 2-3. It was noted that most rocks covered at observed flow (approx 1400cfs), but many shallow areas with rocks just under surface.

Study Site 7 – "Big Ledge" (near George Addy Rd.) that Ron noted as being very unique to the River (GPS pt # 81). Consisted of Glide → Shoal → Pool complex. The TWC agreed that 2-3 PHABSIM transects likely needed, with one each in glide and riffle mesohabitats, and potentially one in the pool. The TWC was undecided on how and whether to include the pool in a PHABSIM model, or how best to document it. The TWC noted that site is likely the most limiting for navigation and upstream fish passage, and therefore should also be assessed for navigation and fish passage due to the large bedrock ledge (See DeKozlowski 1986 for methodology).

Study Site 8 – The TWC concluded the first day of site work at the Haltiwanger Island complex. The TWC noted very diverse habitat above island; river right and river left channels are at this flow (approx 1,400 cfs). The majority of water appeared to be flowing down left channel. The TWC agreed that one PHBSIM transect above island was needed and at least one for river right and river left channels adjacent to island. The group also noted that it would be important to determine how flow partitioned between channels at different flows.

Study Site 9 – The TWC boated upstream to the Chapel Shoals/Huffman Island Complex on June 19. Gerrit Jobsis was unable to participate due to a schedule conflict. Bill Argenteri joined the group.

Huffman Island divides the flow between two channels.

The TWC concluded that a wetted perimeter analysis was not suitable for this site, and initially considered this as a potential study area for River 2D modeling, with data collection occurring at the shoals at the downstream end of Huffman Island and Chapel Shoals at the upper end, with less intense data collection along the two connecting channels. The group also considered simplifying modeling by using the shoal spanning the whole channel immediately downstream from the island as a surrogate study site. However, after viewing the larger, more complex river channel located a short distance downstream at Bookman Island (see discussion of study site 10), it was concluded that a thorough modeling effort at Bookman Island would adequately account for flows at the Chapel Shoals/Huffman Island site. The TWC agreed that once potential flow targets are determined based on the Bookman Island model, a flow demonstration of such flows will be conducted at Huffman Island as necessary to empirically document habitat suitability in the Huffman Island study site.

Study Site 10 – Bookman Island complex. This complex is comprised of numerous small and large islands, main and side channels, and complex bed bathymetry. The TWC agreed that, due to the size and complexity, neither a wetted perimeter nor 1-D PHABSIM model would be sufficient, but that a 2D model of this would be the most conclusive way to quantitatively evaluate habitat suitability. The group agreed that a 2D data collection effort would be conducted throughout the reach from the upstream tip of Hickory Shoal downstream to where the channels converge below Bookman Island.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

July 31, 2013

Final KDM 08-20-13

ATTENDEES:

Bill Marshall (SCDNR)	Bill Argentieri (SCE&G)
Ron Ahle (SCDNR)	Milton Quattlebaum (SCANA) via conf. call
Gerrit Jobsis (American Rivers)	Steve Summer (SCANA)
Shane Boring (Kleinschmidt)	Brandon Kulik (Kleinschmidt) via conf. call
Alan Stuart (Kleinschmidt)	Dick Christie (SCDNR)
Kelly Miller (Kleinschmidt)	Tom McCoy (USFWS)
Bill Stangler (Congaree Riverkeeper)	Byron Hamstead (USFWS)
Vivianne Vejdani (SCDNR)	Rusty Wenerick (SCDHEC)
Frank Henning (Congaree National Park)	Fritz Rohde (NOAA)
Chad Altman (SCDHEC)	

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

After introductions, Alan opens the meeting by reviewing the agenda. He then turns the meeting over to Brandon and Shane to give an overview of the IFIM recon trip that was held June 18th and 19th. Brandon reviews the notes from the trip, which were provided to the group via email on July 10th, giving a description of each of the ten study sites. Study site 7 was noted by Ron to be a very unique stretch of the river and a very important study area. He said this area has a defined drop with an obvious glide that is highly utilized by fish. Ron says this area of the river is unique because of the size of the drop, but it is also quite representative of the river overall, due to the types of habitats it provides. The group agreed that Site 7 should be evaluated using the DNR's navigation criteria and that other sites should also be considered.

Brandon and Ron then discussed the pool that was located at study site 7 and whether this area was going to be included in the study. Brandon says while pools don't really influence flow decision-making, this area should be documented. Frank H asked if the pool areas need to be studied from a sediment standpoint, to determine if there is enough flow to flush sediment out of the pool, and prevent sediment trapping. Ron and Shane both agree that this shouldn't be an issue, as there is plenty of flow to keep the sediment moving. Ron says the pools will be mapped during the mesohabitat study, and agrees with Brandon that transects aren't needed here.

Brandon then describes how a 2D model works, which is a possible option for study site 9. 2D modeling uses a honeycomb type of data gathering, which fit together to form a picture. This gives a different view of a site versus a straight transect. The group decided that a 2D model should be used at study site 10, at Bookman Island. Gerrit asks how the analysis for the 2D modeling will be

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conducted, with the flows being at the selected levels. Brandon says that field data will be collected at Bookman and then used to see what flow range makes the most sense for modeling. Alan asks if the entire Bookman Island complex will be used for modeling at Huffman Island, or will just a piece of the complex be used. Brandon says the entire Bookman Island complex will be used. He adds that the two island complexes will not be mathematically linked, but instead an empirical examination will be used to determine similarities between the two (i.e., a field verification, similar to what was done for the Saluda Project) of flow recommendations, to ensure that recommendations developed are based on work at Bookman are applicable to Huffman Island.

Gerrit mentions the importance of determining how the channels at Bookman are linked, and how some of the smaller channels may be isolated during periods of lower flow. Brandon assures Gerrit that the 2D modeling will include the small cross-channels around the islands, so that these areas may be studied as well. Gerrit says he wants to make sure the study plan captures not only the analysis using HSI curves, but also how various flows affect these small channels. He would like to have a site visit to examine Huffman and Bookman Islands during several different flows to ground truth 2D modeling results.

With this, Alan notes that there seems to be concurrence within the group on the study approach, and asks Brandon if he has enough information to develop a study plan. Brandon says he does and will begin developing a study plan to bring back to the group for review.

The group then begins discussing the HSI curves that Brandon sent to the group to review. Brandon proposes that we use the Hightower curves for the American shad. Alan mentions that these curves are the ones sent to the group by Prescott Brownell a month earlier.

Ron then questions some of the guild classifications for the various fish species. He disagrees with some of the guild assignments and Alan and Dick suggest we work through the information until everyone can agree. The group discusses the difference between shallow versus deep and fast versus slow. The group also discusses the addition of other species at various life stages to the list. Ron suggests listing all life stages for the smallmouth bass in the study plan. Ron disagrees with the curve that corresponds to the smallmouth bass spawning, saying that spawning tends to decrease in waters deeper than approximately 4.5 feet. Brandon agrees, recommending the curve be changed to a stair step, with spawning increasing after reaching a depth of approximately 0.5 feet. Shane agrees to do some research on smallmouth bass spawning and work with Brandon to develop a modified curve for this species for discussion within the TWC.

The group discussed brassy jumprock curves and the need to change the guild for adults to Deep Fast and the guild for juveniles to Shallow Fast.

Gerrit recommends that striped bass spawning lifestage be included in the study. Ron agrees. The group discussed applicable curves from the Pee Dee IFIM study and Crance. Gerrit recommended that we bring in DNR striped bass expert Dr. Jim Bulak to help determine/develop appropriate curves.

The group discussed the importance of adding snail bullhead juvenile lifestage to the study and the need to review bullhead and catfish lifestage curves.

Gerrit and Ron ask for clarification regarding the channel index scale. Brandon explains the scale where 0 corresponds to detritus, 1 to fines, 2 to small gravel, 3 to large gravel, 4 to small cobble, 5 to large cobble, 6 to small boulder, 7 to large boulder, 8 to smooth bedrock, and 9 to irregular bedrock. Shane adds that a table from Wentworth will be included in the study plan that describes these substrates. Gerrit observes that the curves use different channel indices and recommends that all curves use the same channel index.

The group then focuses on modifying the guilds and habitat suitability criteria that Brandon provided. These modifications are included at the end of these notes. Gerrit mentions that the original studies should be referenced in the study plan and not just the broader study in which they were last used, such as the Pee Dee River IFIM.

The group discusses the range of operational flows that modeled as part of the IFIM study, as well as what calibration flows would be needed to model that range. Alan mentions that a range of 250 cfs to 2100 cfs was modeled during the IFIM study for the Saluda Relicensing Project. Brandon suggests putting some level loggers out in the river ahead of the study. Gerrit suggests that a dual flow analysis should be evaluated, to determine Project effects. The group decides on the following calibration flows to allow for modeling of the full range of operational flows: low flow of 400 cfs, with a medium flow of 2000 cfs and a high flow of 10,000 cfs.

After lunch, the group discusses the mesohabitat definitions that Shane provided. Tom says he likes the measurements that are included in the Bettinger definitions and the extra details that are included in the Catawba Wateree definitions. He would like to combine these two with the Saluda definitions. Ron says he doesn't want hard lines to be set for each definition with regards to depth as depths change depending on river flow. He would like to see the depths to be used as guides, but not exact measurements. Brandon suggests adding general depths and flows to the definitions for each habitat. Brandon points out that many of these habitats have already been identified on the river by the group during the IFIM recon trip. The group just needs to agree on the wording for each definition. The group discusses the differences between a glide versus a run, deciding that the slope upstream or downstream is a determining factor. The group works to modify the Saluda definitions and these modifications are included at the end of these notes.

SCE&G and Kleinschmidt personnel will begin to develop the study plans for the IFIM study and Mesohabitat Assessment and will have a draft ready for TWC review and approval by the beginning of October. The group plans to meet or have a conference call before the mesohabitat assessment is started. Any action items stemming from this meeting are included below.

ACTION ITEMS:

- Shane will research the smallmouth bass spawning and will work with Brandon develop a new HSI curve for review within the TWC.
- Shane will refine the mesohabitat definitions and distribute to the group for approval.

DRAFT MEMORANDUM

TO: Parr-Fairfield Hydro: Instream Flow/Aquatic Habitat TWC

FROM: Brandon Kulik

DATE: July 9, 2013

RE: **PROPOSED HABITAT SUITABILITY CRITERIA**

On May 7, 2013, the Instream Flow/Aquatic Habitat Technical Working Committee (TWC) agreed upon species and lifestages for which habitat suitability should be evaluated on the Broad River below the Parr-Fairfield Project as a part of AN IFIM study (Table 1)..

Table 1: Evaluation species elected by the TWC

- Smallmouth Bass
- American Shad
- Brassy Jumprock
- Whitefin Shiner
- Robust Redhorse
- Santee Chub
- Striped Bass
- Piedmont Darter
- Snail Bullhead
- Redbreast Sunfish
- Channel Catfish

The purpose of this memo is to recommend potential Habitat Suitability Criteria (HSC) for use in this study that are applicable to the above species. Smallmouth bass and redbreast sunfish criteria were sourced from the Saluda study, as the TWC has already vetted these curves. Although the Saluda study had employed TWC-approved American shad HSC, these criteria have recently been refined, based on the research of Joe Hightower in North Carolina (Hightower, *et. al*, 2012) and provided to us by NOAA Fisheries. We propose that the TWC consider using these updated criteria.

The remaining species do not have well developed, individual HSC. However, the Pee Dee IFIM study addressed habitat suitability for these species by classifying each of them into applicable guilds. This information was provided to the Saluda IFIM TWC during study scoping (Gerrit Jobsis, October 16, 2006). Based this information (Table 2), we classified the remaining Parr-Fairfield evaluation species and lifestages into proposed guild categories (Table 3)

Attachment A displays the coordinates for the resulting HSC proposed for use, based on the source material identified in Table 3.

Table 2. Guild classification for individual species and lifestages, from Pee Dee River IFIM study (2004)

Species and Habitat Guild Assignment Table for the
Pee Dee River Instream Flow Study. Revision 2 - July 9, 2004.

Scientific Name	Common Name	Habitat Types and Guilds[1, 2, 3]			
		Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Petromyzontidae	**Lampreys**				
Petromyzon marinus	sea lamprey		A		
Acipenseridae	**Sturgeons**				
Acipenser oxyrinchus	Atlantic sturgeon				S
Acipenser brevirostrum	shortnose sturgeon				S
Lepisostedidae	**Gars**				
Lepisosteus osseus	longnose gar	A, J		A, J, S	
Amidae	**Bowfin**				
Amia calva	bowfin			A, S	
Anguillidae	**Freshwater eels**				
Anguilla rotstrata	American eel	J		A, J	J
Clupeidae	**Herrings**				
Dorosoma cepidanum	gizzard shad	A, J		A, J, S	
Dorosoma petenense	threadfin shad	A, J		A, J, S	
Alosa mediocris	hickory shad			J, S	
Alosa sapidissima	American shad			J	J, S
Alosa aestivalis	blueback herring			J, S	
Cyprinidae	**Carps and Minnows**				
Cyprinus carpio	common carp	J, S		A, J, S	
Notemigonus crysoleucas	golden shiner	A, J, S		A, J, S	
Hybognathus regius	Eastern silvery minnow	J, S		A, J, S	
Nocomis leptocephalus	bluehead chub		A, S		
Cyprinella analostana	satinfin shiner	A, J, S		A, J, S	
Cyprinella nivea	whitefin shiner	A, J	S	A	
Cyprinella pyrrhomelas	fieryblack shiner	A, J	S	A	
Notropis altipinnis	highfin shiner	J, S		A	
Notropis amoenus	comely shiner	A, J	S	A, J	
Notropis hudsonius	spottail shiner	A, J	S	A, J	
Notropis petersoni	coastal shiner	A, J	S	A	
Notropis scepticus	sandbar shiner	A, J	S	A	
Catostomidae	**Suckers**				
Catostomus commersoni	white sucker	J	S	A, J	A
Minytrema melanops	spotted sucker	J	S	A	
Scartomyzon spp.	brassy jumprock	J	S	A	A
Moxostoma macrolepidotum	shorthead redhorse	J	S	A	A[4]
Moxostoma anisurum	silver redhorse	J	S	A, J	
Moxostoma robustum	robust redhorse		S	A, J	
Moxostoma sp.	Carolina redhorse		S	A, J	
Carpiodes cyprinus	quillback		S	A	S
Erimyzon oblongus	creek chubsucker	S?		A, J, S?	
Carpiodes velifer	highfin carpsucker		S	A	S
Ictiobus bubalus	smallmouth buffalo	J	A	A, S	A
Ictiobus cyprinellus	bigmouth buffalo			A	

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Table 2.
Continued

Scientific Name	Common Name	Habitat Types and Guilds[1,2,3] Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Ictaluridae	**Bullhead catfishes**				
Ictalurus punctatus	channel catfish			A, J	J
Ictalurus furcatus	blue catfish			A, S	A
Ameiurus catus	white catfish			A	A, J
Ameiurus brunneus	snail bullhead			A	
Ameiurus nebulosus	brown bullhead			A	
Ameiurus platycephalus	flat bullhead			A	
Pylodictus olivaris	flathead catfish	J		A, J, S	
Esocidae	**Pikes**				
Esox americanus americanus	redfin pickerel			A, J, S	
Esox niger	chain pickerel			A, J, S	
Umbridae	**Mudminnows**				
Umbra pygmaea	Eastern mudminnow			A, J, S	
Poeciliidae	**Livebearers**				
Gambusia holbrooki	Eastern mosquitofish			A, J, S	
Aphredoderidae	**Pirate perches**				
Aphredoderus saynus	pirate perch			A	
Atherinidae	**Silversides**				
Labidesthes sicculus	brook silverside			A	
Percichthyidae	**Temperate basses**				
Morone americana	white perch	J	S	A, J	S
Morone chrysops	white bass	J	S	A, J	S
Morone saxatilis	striped bass				A, S
Centrarchidae	**Sunfishes**				
Lepomis auritus	redbreast sunfish	J, S		A, J, S	
Lepomis cyanellus	green sunfish			A, J, S	
Lepomis gibbosus	pumpkinseed	J, S		A, J, S	
Lepomis macrochirus	bluegill	J, S		A, J, S	
Lepomis microlophus	redear sunfish			A, J, S	
Lepomis punctatus	spotted sunfish			A, J, S	
Micropterus salmoides	largemouth bass	J, S		A, J, S	
Pomoxis nigromaculatus	black crappie			A, J, S	
Percidae	**Perches**				
Etheostoma olmstedi	tessellated darter	A, J	S	A	
Percina crassus	Piedmont darter		A, S		
Perca flavescens	yellow perch			A, J, S	

[1]Habitat types based on predominant habitat types present in the Pee Dee River derived from the aerial videography study.

[2]Life stages: A = adult, J = juvenile, including young-of-year, and S = spawning.

[3]Classification of species and life stages into habitat types based on Becker (1983), Hamilton and Nelson (1984), Aadland et al. (1991), Jenkins and Burkhead (1994), Rhode et al. (1994), Leonard and Dilts (2003), and Progress Energy (2003).

[4]Foraging adults based on Jenkins and Berkhead (1994).

Table 3. Proposed HSC source data for Parr-Fairfield IFIM study

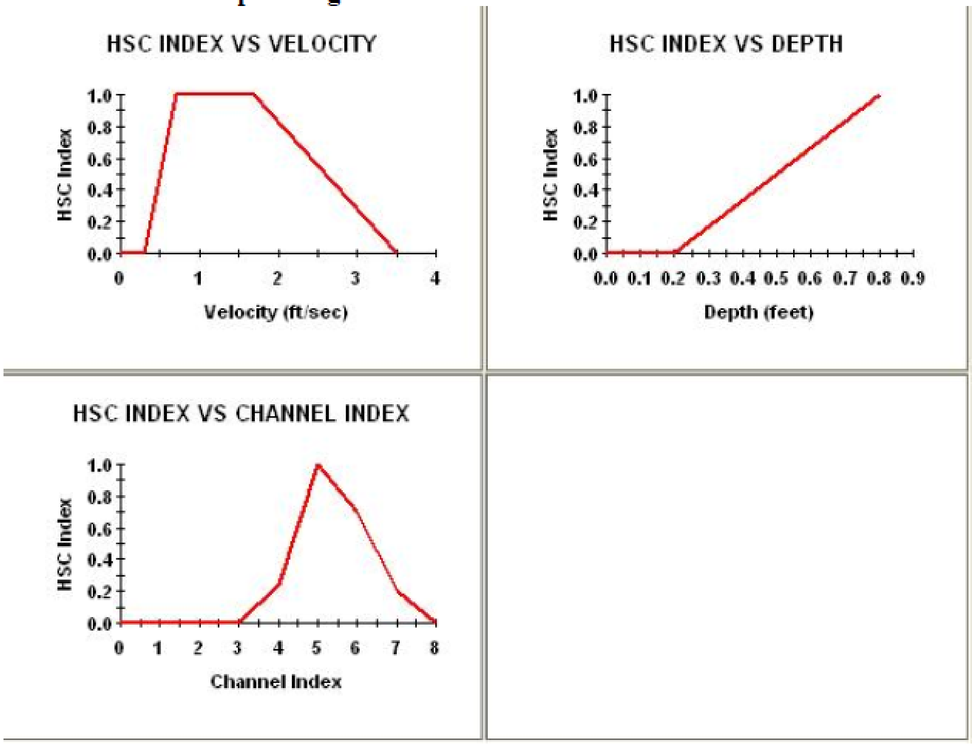
species criteria	lifestage	source	guild
Smallmouth Bass	All (spawning, fry, juvenile &adult)	Saluda	N/A
American Shad	spawning	Hightower, *et al.*, 2012	N/A
Brassy Jumprock	adult	Pee Dee River IFIM	deep ~~slow~~fast
Brassy Jumprock	juvenile	Pee Dee River IFIM	shallow ~~slow~~fast
Brassy Jumprock	spawning	Pee Dee River IFIM	shallow fast
Whitefin Shiner	adult	Pee Dee River IFIM	shallow slow; deep slow
Whitefin Shiner	juvenile	Pee Dee River IFIM	shallow slow
Whitefin Shiner	spawning	Pee Dee River IFIM	shallow fast
Robust Redhorse	adult	Pee Dee River IFIM	~~deep slow~~Stand alone species (Bud Freeman HSI)
Robust Redhorse	juvenile	Pee Dee River IFIM	Stand alone species ~~deep slow~~
Robust Redhorse	spawning	Pee Dee River IFIM	Stand alone species ~~shallow fast~~
Santee Chub	adult	Pee Dee River IFIM	shallow fast
Striped Bass	Adult	Pee Dee River IFIM	Deep slow, deep fast
Striped Bass	Spawning		N/A (Crance, Bulak)
Piedmont Darter	adult	Pee Dee River IFIM	shallow fast
Piedmont Darter	spawning	Pee Dee River IFIM	shallow fast
Snail Bullhead	Adult	Pee Dee River IFIM	deep slow
Snail Bullhead	Juvenile		shallow fast
Redbreast Sunfish	Adult	Saluda	N/A or deep slow?
Redbreast Sunfish	Spawning		Shallow slow?
Channel Catfish	adult	Pee Dee River IFIM	deep slow
Channel Catfish	juvenile	Pee Dee River IFIM	deep slow; deep fast

LITERATURE CITED

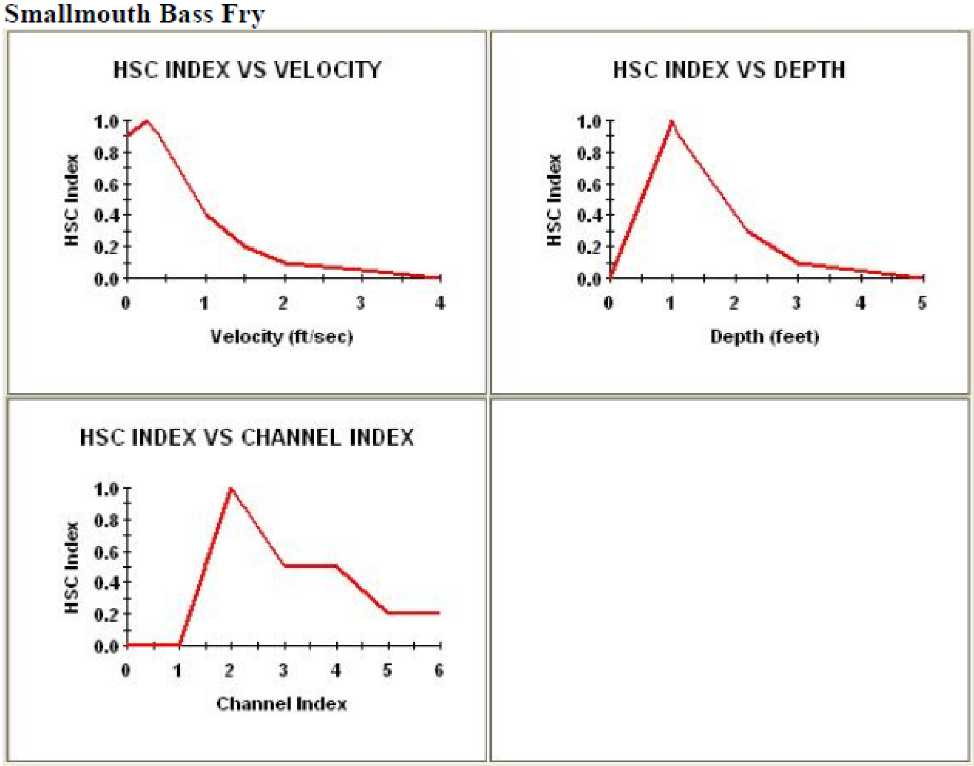
Hightower JE, Harris JE, Raabe JK, Brownell P, Drew CA. 2012. A Bayesian spawning habitat suitability model for American shad in southeastern United States rivers. Journal of Fish and Wildlife Management 3(2):184–198; e1944-687X. doi: 10.3996/082011-JFWM-047

Attachment A
Habitat Suitability Criteria

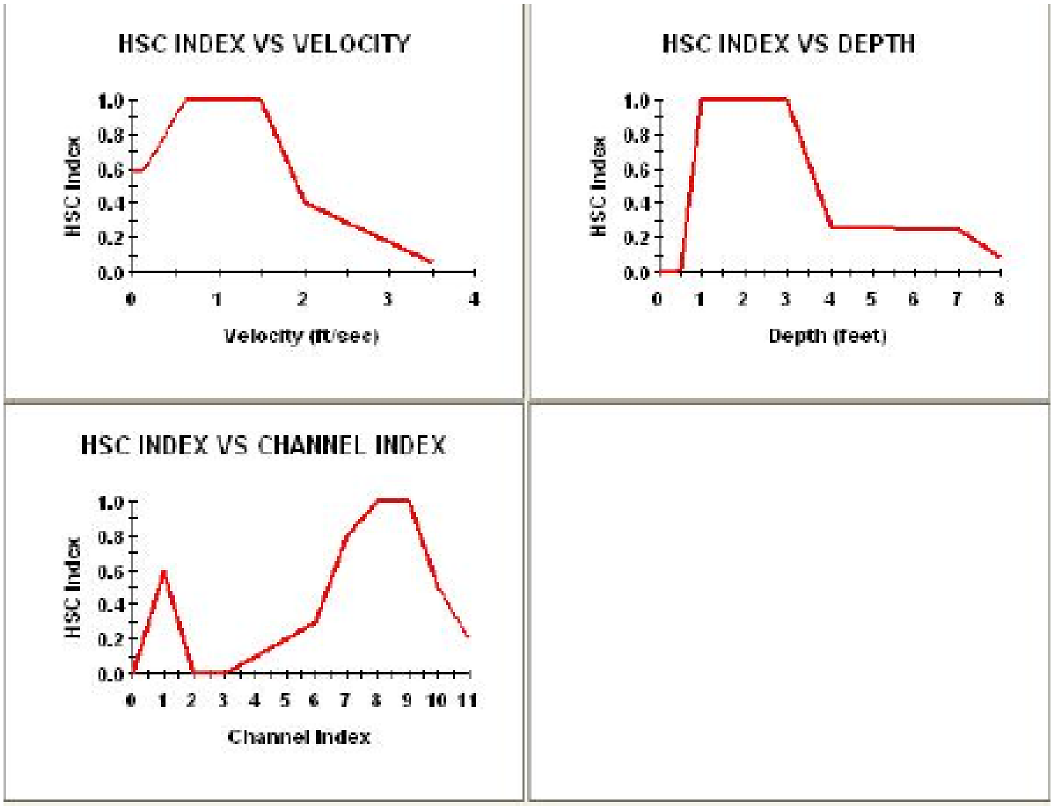
Smallmouth Bass Spawning



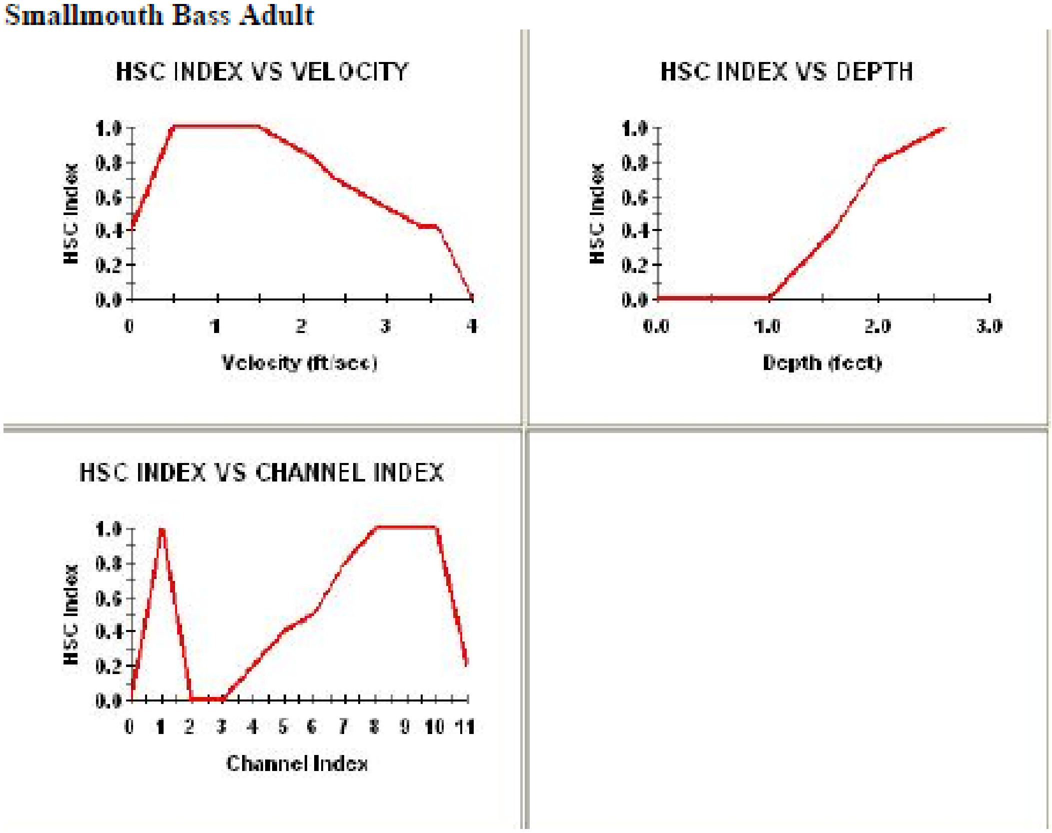
Smallmouth Bass Fry



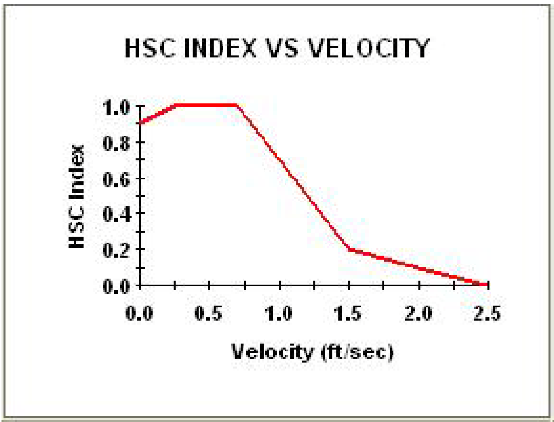
Smallmouth Bass Juvenile

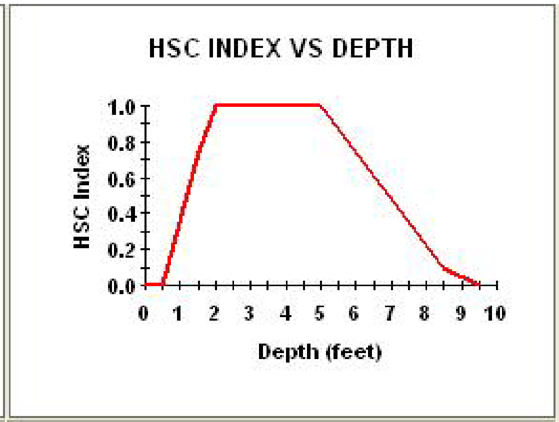


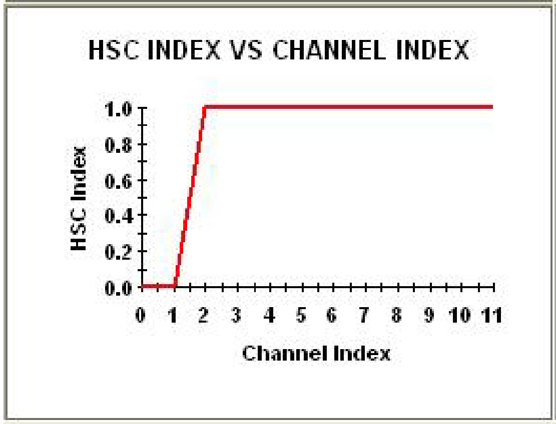
Smallmouth Bass Adult



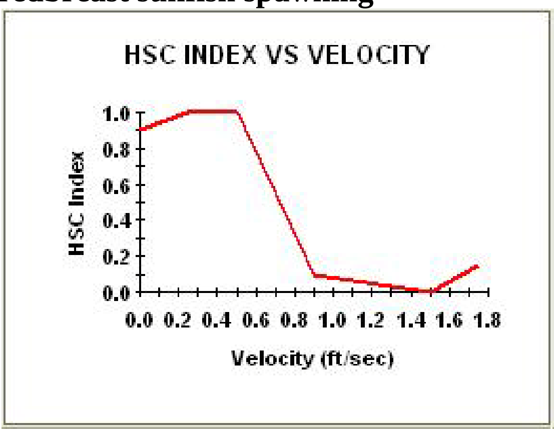
redbreast sunfish adult

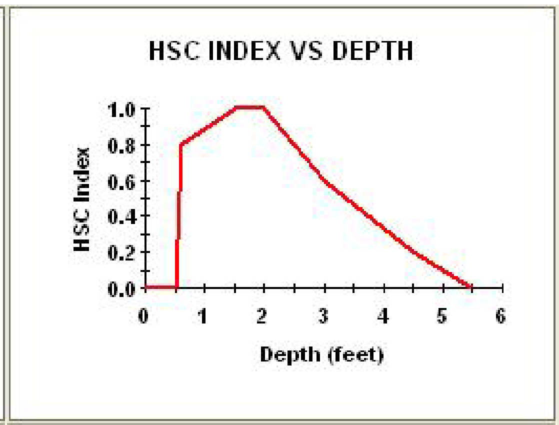


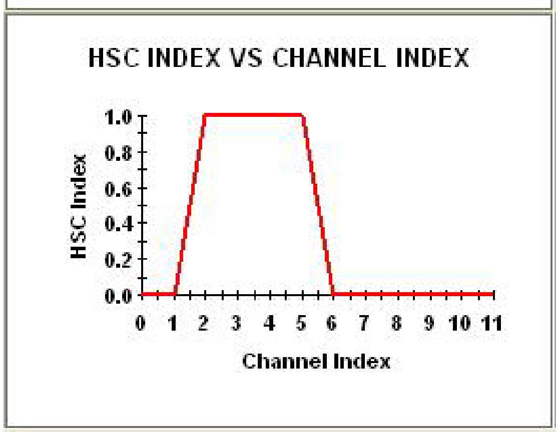




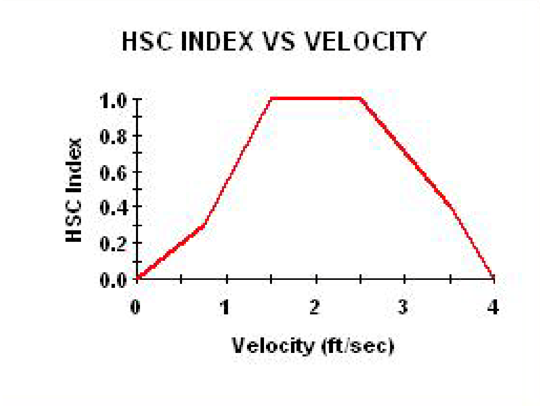
redbreast sunfish spawning

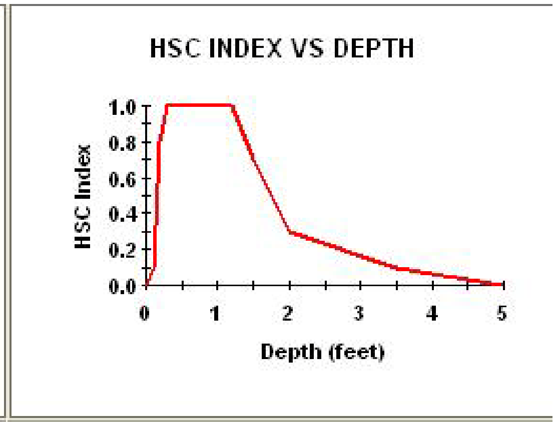


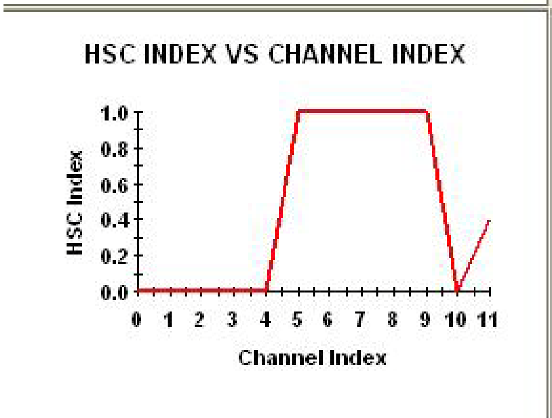




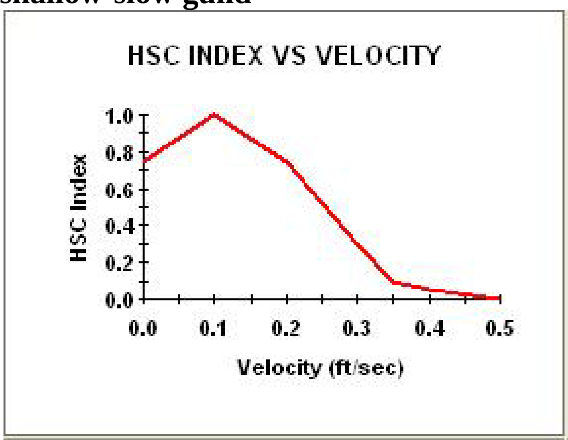
shallow-fast guild

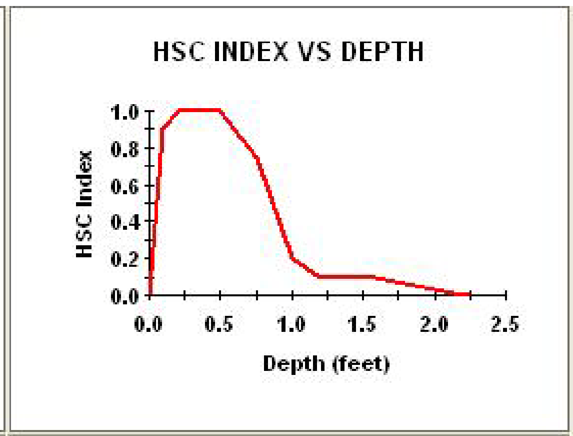


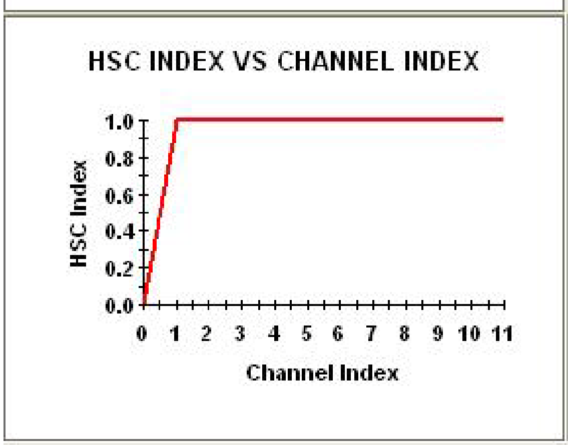




shallow-slow guild

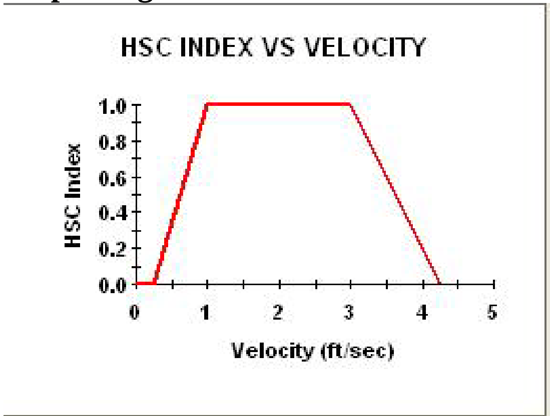


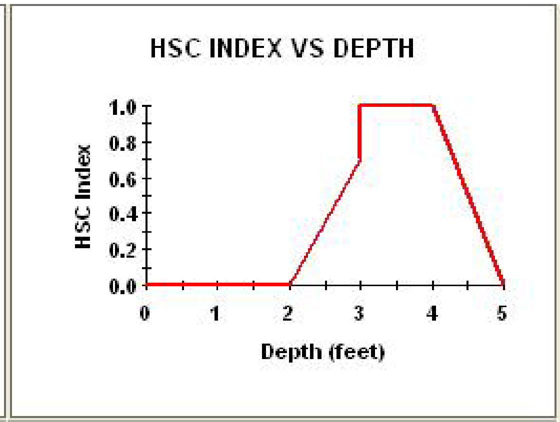


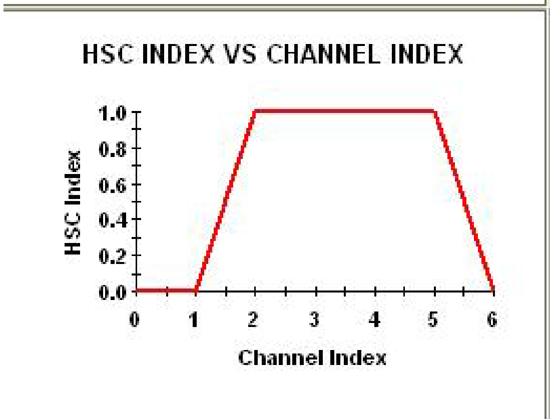


Kleinschmidt

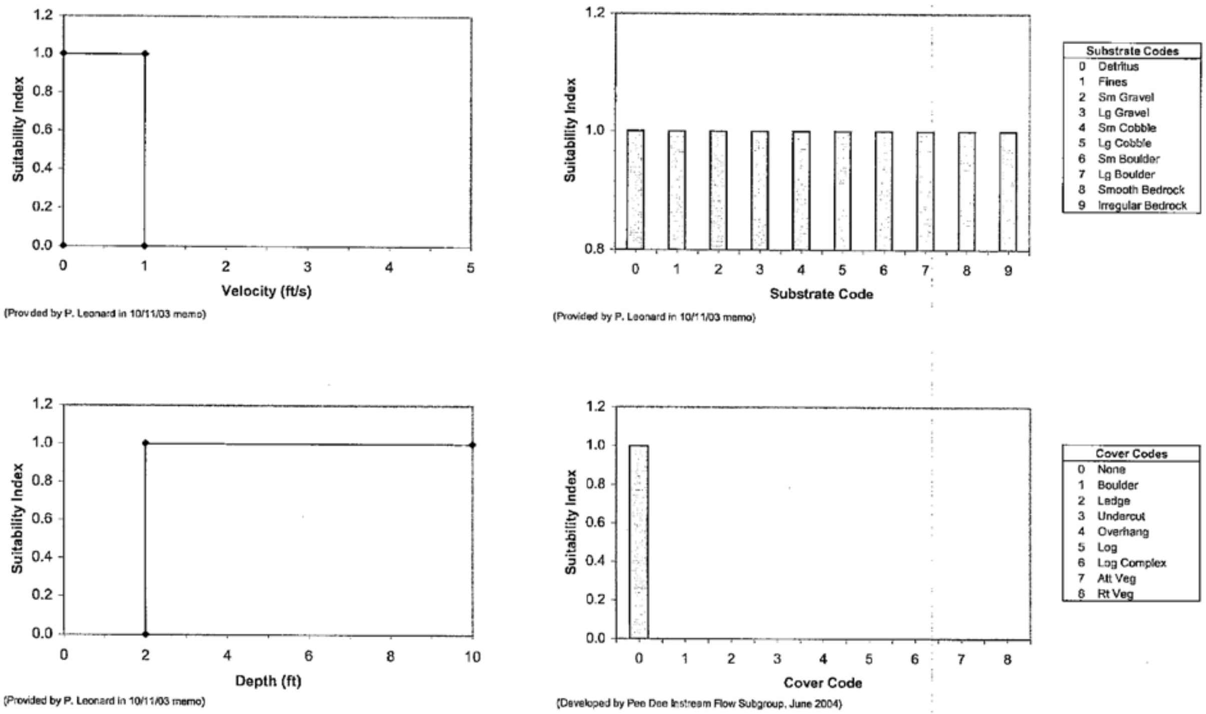
Deep-fast guild



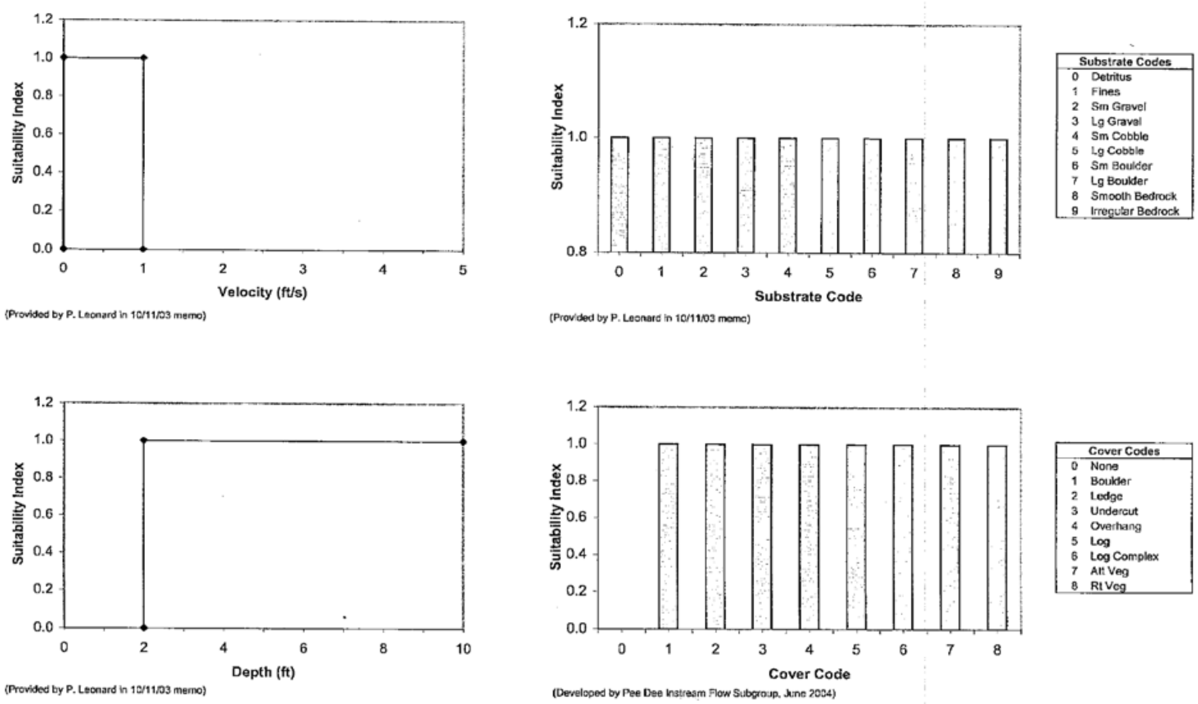




Deep Slow Guild, No Cover
Generic guild habitat suitability



Deep Slow Guild, Cover
Generic guild habitat suitability



AMERICAN SHAD spawning (*Hightower, et al., 2012*).

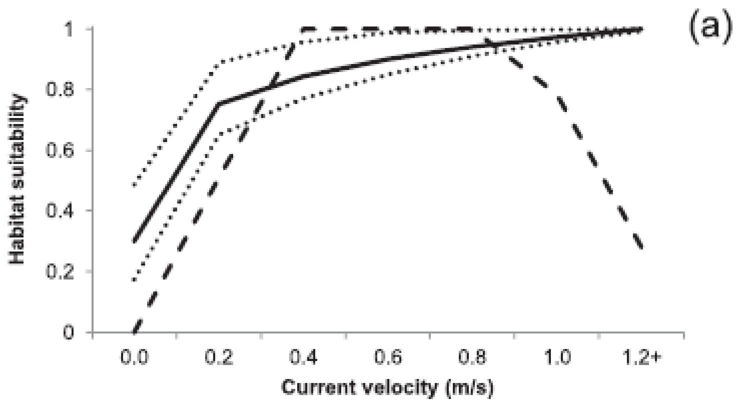


Figure 5. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for current velocity (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.2-m/s velocity bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

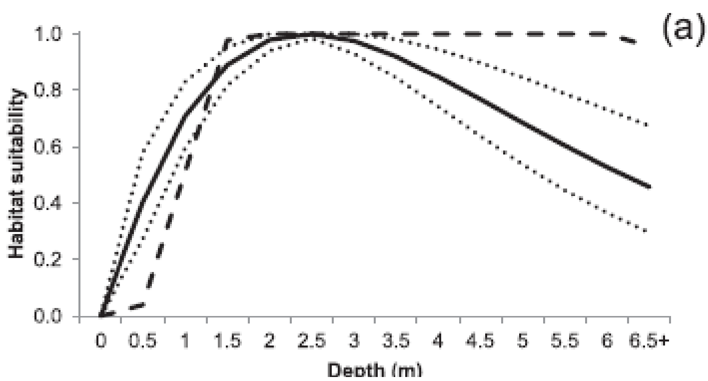


Figure 6. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for water depth in m (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.5-m depth bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

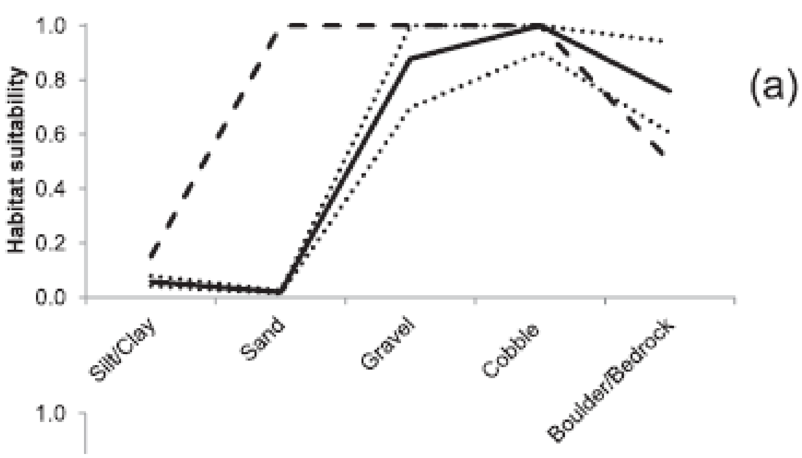


Figure 7. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for substrate (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b** and **c**) data on habitat use vs. availability, by substrate category. The dashed line shows the suitability curve developed by Stier and Crance (1985), using averages for combined categories (silt/clay, boulder/bedrock).

Mesohabitiat Classifications

Bettinger et al 2003

Habitat Type	Description
Riffle	Riffle Relatively shallow (<0.5m), swift flowing section of river where water surface is broken.
Glide	Relatively shallow (<1m); with visible flow but mostly laminar in nature; minimal observable turbulence; relatively featureless bottom
Run	Deep (>1m), swift flowing sections with turbulent flow; surface generally not broken
Pool	Deep (>1m) slow moving sections.
Shoals	Shoal area; which may contain a variety of habitat complexes.

Saluda Hydro IFIM Study

Habitat Type	Description
Riffle	Shallow, with moderate velocity, turbulent, high gradient, moderate to large substrates (cobble/gravel). Typically > 1% gradient.
Glide	Moderately shallow, well-defined non-turbulent laminar flow, transition from low to moderate velocity, lacking a definite ~~well-defined~~ thalweg, typically flat stream geometry, typically finer substrates, transitional from pool.
Run	Moderately deep ~~to deep~~, well-defined non-turbulent laminar flow, range from low to moderate velocity, well-defined thalweg, typically concave stream geometry, varying substrates, gently downstream slope (<1%).
Pool	Deep, low to no velocity, well-defined hydraulic control at outlet.
Rapid/Shoal	Shallow, with moderate to high velocity, turbulent, with chutes and eddies, high gradient, large substrates or bedrock. Typically >2% gradient.
Backwater	Varying depth, no or minimal velocity, off the primary channel flow ~~long backwatered reaches.~~

Catawba Wateree

Habitat Type	Description
Glide	Depending on the strength of the shoal and the bed profile directly upstream of the control, a glide or a pool will be created. A glide is generally defined by slower velocities and a relatively uniform bed profile, but a rough bed profile is not uncommon. Glides will either progress into a more concave bed profile just upstream of the shoal (creating a pool), or maintain their uniform hydraulic and bed features until direct contact with the shoal. Substrates can be large or small but, except at very high flows, do not create turbulence. Due to the slower velocities and increased depths, finer substrates will typically begin to settle in glides.
Run	Immediately downstream of the shoal, there is typically a transition area prior to the water entering the next pool or glide. This unit consists of relatively fast moving, turbulent water and a gradually descending bed profile. When mapping habitat in higher discharges (deeper flow), these areas can be visually identified by an upwelling of water just on the downstream edge of the shoal. This “roiling” effect is created by the sudden drop in water off of the shoal due to the lack of any backwater effect. Substrate composition varies from fine sediments to cobble and boulders. As the water begins to collect and back up further downstream, velocities slow, depths increase, and the transition into a glide or pool occurs.
Pool	If the bed profile upstream of the shoal is more concave or possesses significant undulations, a pool will be formed. Pools are visually represented by the slowest velocities of the four main habitat types and the most extreme depths. Steep banks and narrow channels relative to the rest of the reach can often be associated with pools. The stronger or more defined the downstream control (shoal), the more defined the pool. Substrate composition in pools generally consists of a layer (thick or thin) of finer substrates over boulder or bedrock.
Shoal	Shoals are relatively shallow, submerged ridges that occur with a consistent frequency down the longitudinal profile of the river. Shoals act as downstream controls to pools and glides and create the hydraulic conditions necessary to form runs immediately downstream. Substrate composition in shoals is typically bedrock, boulders, and coarse substrates. The “strength” of each hydraulic control dictates the magnitude to which it influences the upstream habitat types. Each shoal will create a unique situation upstream in which pools, glides or both may be identified.

AFS Aquatic Habitat Assessment Methods (Bain and Stevenson, 1999)

Habitat Type (macrohabitats)	**Description**
Glide	Nonturbulent, low-moderate velocity; gravel, cobble, sand substrate; slop 0-1%. Wide channel lacking a definite thalweg; usually at the transition between a pool and riffle; no major flow obstructions; lacks features associated with pools; moderately shallow (10-30 cm)
Run	Nonturbulent, swift velocities; gravel, cobble, boulder substrate; low slope. Occurs over a defined thalweg flat plane with a uniform channel form; no major flow obstructions; moderately shallow; deeper than riffles.
Pool	Formed from lateral construction of channel or sharp drop in water surface profile. Features: bend in channel, large-scale obstructions (e.g. boulder, log). Concave in shape; direction of flow varies widely; depth greater than riffle or runs.
Riffle	Moderate turbulence; little to no whitewater; high turbulence at points of channel construction. Moderate velocity (20-50 cm/s). Gravel, pebble, cobble substrates (totally or partially submerged). Slope <4%. Channel profile usually straight to convex.
Rapid	Considerable turbulence and whitewater. High velocity (>50 cm/s). Course, exposed, cobble, gravel substrate. Slope of 4-7%. Steps and pocket pools common; planar longitudinal profile.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Instream Flows TWC Meeting

March 5, 2014

Final KDM 04-8-14

ATTENDEES:

Bill Marshall (SCDNR)	Bill Argentieri (SCE&G)
Ron Ahle (SCDNR)	Milton Quattlebaum (SCANA)
Gerrit Jobsis (American Rivers)	Steve Summer (SCANA)
Shane Boring (Kleinschmidt)	Brandon Kulik (Kleinschmidt) via conf. call
Henry Mealing (Kleinschmidt)	Dick Christie (SCDNR)
Kelly Miller (Kleinschmidt)	Randy Mahan (SCANA)
Bill Stangler (Congaree Riverkeeper)	Byron Hamstead (USFWS)
Vivianne Vejdani (SCDNR)	Fritz Rhode (NOAA) via conf. call

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Henry opened the meeting with introductions and then Shane lead the group in a review of the Mesohabitat Assessment Report. Shane explained the intent of the study and reviewed the results, including an overview of the maps. Ron asked to see an individual breakdown of maps 2a, 2b and 2c and Shane said he will provide these maps to the group.

Bill M. asked if we learned anything new from the study. Shane said that the most restricted point on the river for fish passage and boat navigation was identified. This area is right above the Bookman Shoals complex. This area is identified in the IFIM Study Plan as an area that needs further study. Shane said they also did a survey for Robust Redhorse spawning areas during the mesohabitat study. Two areas were identified including a location right downstream of Parr Shoals Dam and another location upstream of Bookman Shoals. Shane said that Scott Lamprecht agreed that these spots seemed ideal for Robust Redhorse spawning. Milton said he also went out on the river with Scott and they identified another area near the Bookman Shoals complex and Hickory Island. A spot near Haltiwanger Island was also identified. Shane will develop a memo summarizing all of this information on Robust Redhorse spawning sites and will distribute this memo to the group. He will also append the memo to the final IFIM report. Shane will edit the IFIM Study Plan so it mentions that the Robust Redhorse memo will be appended to the final IFIM report.

Shane also said that during the mesohabitat assessment they learned that Bookman Island is very complex with lot of cross channels, braiding and varying elevations. He said that at least seven channels had been identified in the area. Fritz added that seams of bedrock add complexity because they act as weirs, moving the water in different directions depending on flow. He said it is good that 2D modeling will be performed in this area during the IFIM study. Byron asked if the 2D modeling will include the two Robust Redhorse sites identified in the Bookman Island complex and Shane said yes. Shane added that the upstream site at Haltiwanger Island will be studied using PHABSIM along with the site right below Parr Shoals Dam at Hampton Island. Ron said that the area just downstream of the Parr Shoals Dam is good for Robust Redhorse because there seems to be a dike formed by the rock with a gravel bed, covered by deep water. Ron said suckers are often found in this area.

Ron said that the Broad River downstream of Parr Shoals Dam is very complex, and that the maps included in the Mesohabitat Assessment Report are generalized. But he believes they are fairly accurate and that the proportions of the various mesohabitat types found in the river are accurate. Shane agreed and said that sometimes while looking at a cross section of the river, one side of the river may have a run and the other side may have a backwater pool. Shane said this was hard to convey in the maps, but that overall the map delineations and the report are very accurate.

Byron asked if areas of constriction throughout the river have been mapped out. Shane said GPS points have been taken and can be provided to the group, but cross sections detailing depth and other information has not been mapped out yet and will be completed as part of the IFIM study. Shane showed the group, using Bing maps, two areas in the river where fish passage and navigation may be possible. These areas will be studied in more detail during the IFIM study.

The group began reviewing the IFIM Study Plan and Shane mentioned that the Mesohabitat Assessment Report will be added as an appendix to the final IFIM Report. Byron wanted to know how the information collected in the IFIM study would be used for determining suitable crayfish habitat. Will the amount and type of cover available at various depths be examined? Henry said this will not be done using PHABSIM, but this information can be collected as part of the general description of the study area. Gerrit asked if when determining cover types, isn't it typical to not only look at the transect, but upstream as well? Brandon said yes because at the upstream/ downstream cell boundary level, the area is reasonably homogenous but within the cross section localized substrate variations can be like a mosaic, so it is typical to look upstream and downstream a reasonable distance to characterize the substrates assigned to a particular vertical. Brandon said that in regards to crayfish, the group can establish what the important cover types are for a particular species beforehand so that the field crews know what to look for during data collection. Byron said he will do some additional research to identify the preferred covers for the spiny crayfish. He is interested in determining how much cover is available and how much is exposed at varying water levels. Henry said that this may be possible with rocky substrates since they are fairly permanent, but that the abundance and distribution of woody debris can change from year to year so only general qualitative observations can be made. Henry said that if large woody debris is located at a PHABSIM transect, it will be surveyed in depth, otherwise just general descriptions of what is located upstream and downstream will be recorded to characterize conditions and where it is located relative to water levels. Brandon said that photos and possibly videos will also be taken to document the substrate and cover types in the area. If Byron develops a specific list of the type of substrate and cover that is important for crayfish, including a description of the types of woody debris preferred (approximate size and position in the water column), it will make it easier to document these during the study. Brandon said they can look at what is exposed during low flows and also record how high flows mobilize these substrates. Ron said that in his experience the large woody debris found in the central portion of the river is usually located in areas of accumulating sand and is typically transient and moving. All other woody debris tends to be found along the shorelines. Byron said that the wetted perimeter study will provide a lot of information on the woody debris found throughout the river. He will determine what the specific habitat requirements are for the spiny crayfish, an at risk species which is currently under candidate review, and provide these to the group prior to the IFIM study.

In section 3.2.2 of the IFIM Study Plan, Shane added in a description of the downstream ledge which may be a possible navigation site.

Bill S. asked why the river directionality is positioned looking upstream. Shane said that it just depends on how the biologist is trained. The group agrees to change all direction references to looking downstream.

Prior to the meeting, Gerrit submitted a comment regarding the inclusion of a Dual Flow analysis (DFA) into the IFIM Study Plan. Brandon explained to the group what a DFA is and his description is attached to the end of these notes. He said the goal of a DFA is to assess Project generating flows and how various operating scenarios affect habitat suitability. Base flow and generating flow couplets of interest are identified, along with selection of key species and lifestages. Effectively available habitat for a particular study site is calculated at pair of stream flows. A comparison of the amount of units of WUA available at the base flow versus the units of WUA at the generating flow is completed. DFA only records WUA corresponding to the lower of the two paired values regardless of whether the lower WUA occurs at the low or high flow. The assumption is that the lower WUA value represents the level of suitability persisting under both conditions For example, if the habitat value is zero at the low or high flow, then the value for that pairing is zero. Shane said this can be done as a desktop exercise and doesn't require any extra field effort however a basic PHABSIM analysis must be completed and reviewed first since this step establishes the quantification basis.

Gerrit said DFA can also be done to mitigate the effects of peak flows by changing the base flow. He said you can iteratively move the base flow up or peak flow down to mitigate and lessen the affect on habitat to assess different operating scenarios. The idea is that if the higher the habitat suitability is a majority of the time, then the episodes of lower habitat suitability are less stressful to the aquatic species . Bill A. asked if base flows would be changed during certain times of the day or seasonally. Gerrit said this is a seasonal change. Brandon said spatially peaking effects attenuate going downstream so that the effect is most pronounced nearest the tailrace. The group would have to decide if the analysis should focus on the upstream reaches of the river or the downstream reaches.

The group decided that the study plan needs to include information on process steps regarding the DFA. The TWC will review initial WUA output and then meet to determine the DFA scope. No additional field work will be needed. Shane will add a few paragraphs to the IFIM Study Plan describing the DFA process. Kelly will send these paragraphs out to the TWC for review and comment.

Other additions to the IFIM Study Plan include mentioning the Robust Redhorse memo, adding in crayfish habitat suitability information (provided by Byron) and adding wording on the identification of substrates for crayfish during the IFIM study. Ron mentioned he would like to see a more specific schedule for when the IFIM study will take place because he would like to help. He would like to see the schedule already included in the IFIM Study Plan expanded to include more specifics. He would also like to see qualifiers added in to account for bad weather or flows that might inhibit data collection. All of these changes will be made to the study plan in track changes and sent out to the TWC for review and approval.

Dick asked the group if they want to specify the goals of the analyses in the study plan. For example, SCDNR's recommendation is to identify a minimum flow that would provide 80 percent of maximum WUA. The group decided to add a list or table outlining the process of the study, which will include an expanded section on TWC consultation.

Gerrit asked if there will be demonstration flows scheduled following the results of the IFIM study regarding navigation and fish passage. Bill A. said that there can be demonstration flows and Shane will add this into the process schedule.

Dick mentioned the navigation component of the IFIM Study Plan and said that it was not consistent with the Navigational Flows Study Plan, which is discussed in the Recreation TWC. The Navigational Flows Study Plan needs to be changed to include a description of the two-way navigation requirement. This study will still only focus on one way navigation, but a description of two-way navigation needs to be included. This study plan will be re-circulated to the Recreation TWC for approval and then finalized.

Shane then gave the group an overview of the 2014 field season efforts for the IFIM study. Level loggers will be deployed in late March or early April in 12 different locations from the Parr Shoals Dam to the Columbia Dam pool, near the rowing facility. Level logger data is being collected to examine travel time for flows and to develop stage discharge relationships. Additionally, 2-D data collection will be completed in the Bookman Shoals area (Study Site 10), which includes latitude, longitude and elevation data for the entire two mile study area. At Study Site 1, a terrain model for quantifying pools and fish passage will be created. Cross sectional profiles including bed elevations and water surface elevations will also be collected at Study Site 4. Bill S. asked how many points will be examined at Study Site 10. Shane said he isn't sure yet, but it will be a good idea to look at existing LiDAR data and DEM data to make sure they establish an adequate number of points. This should give clarity to the density of points needed for the model. Densities could be as tight at every three meters. Shane said that the TWC is welcome to help with these efforts this year as well. Emails will be sent to the group to notify them as soon as possible when the work will be done.

The IFIM Study Plan will be updated to reflect the items discussed at the meeting and sent back out to the TWC for approval. Action items stemming from this meeting are listed below.

ACTION ITEMS:

- Byron will identify the preferred habitat substrates for the spiny crayfish and provide this information to the group for use during the IFIM study.

- Shane will change the language in the IFIM Study Plan to reflect a "looking downstream" perspective.

- Shane will add in a section describing the process steps of the IFIM study with an expanded section on TWC consultation. He will also expand the schedule to include more specific dates and times which will include demonstration flows if possible. He will also add qualifiers to account for bad weather or flows that might inhibit data collection.

- Shane will add in a section to the IFIM Study Plan discussing Dual Flow Analysis. He will also add in a few sentences discussing the information collection on Robust Redhorse spawning areas. Additionally, once Byron provides the information regarding preferred spiny crayfish habitat substrates, Shane will include this in the IFIM Study Plan.

- Kleinschmidt will update the Navigational Flows Study Plan with information on two-way navigation and redistribute to the Recreation TWC.

DUAL FLOW ANALYSIS

- The basic WUA/flow relationship is the foundation
- Base flow/generating flow couplets of interest are identified
- Key species/lifestages (or guilds) are strategically selected
- Effectively available habitat for a study site[1] is calculated at pairs of stream flows: (base) non-peaking and a (generation) peaking flow.
- Dual Flow analysis only records WUA corresponding to the lower (*"effectively available"*) of the two paired values. If the habitat value is zero at either the low or high flow, then the value for that pairing is zero.
-

Example:

basic WUA/flow relationship (*example from Chippewa River, WI*):

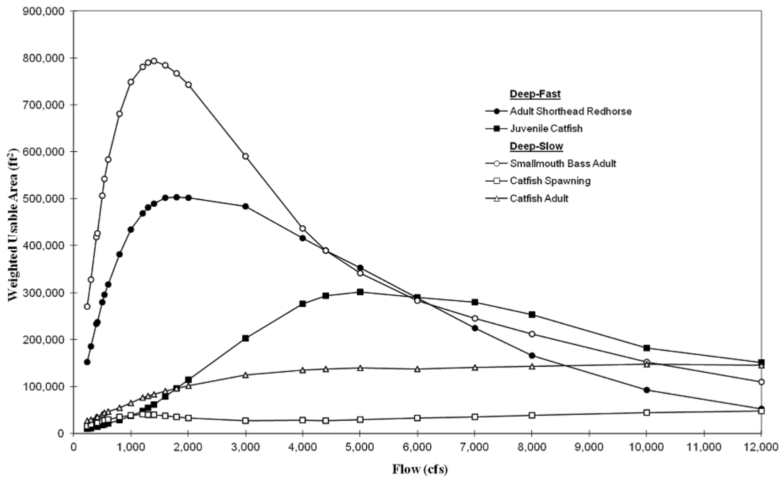
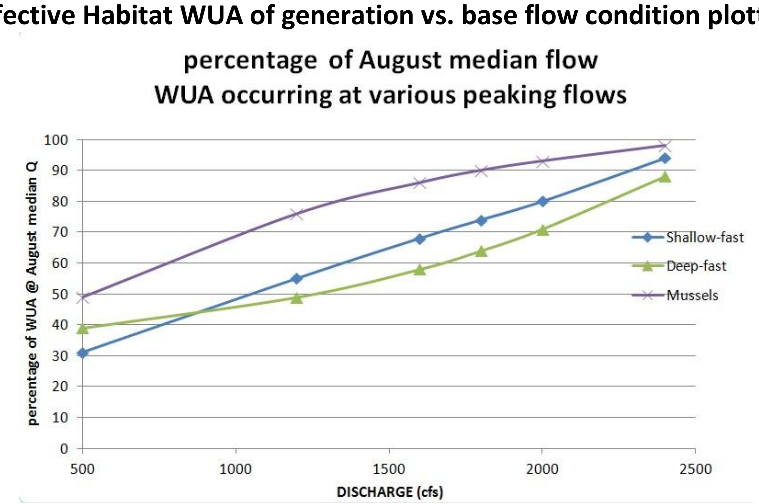


Figure 4. Habitat-discharge relations for fishes in Deep-Fast and Deep-Slow habitat guilds within the Cornell Project instream flow study area.

Effective Habitat WUA of generation vs. base flow condition plotted



[1] For non-mobile life stages such as macroinvertebrates or nest spawning, calculations can optionally be performed at the cell level using the "HABEF" routine in PHABSIM

APPENDIX B

ROBUST REDHORSE SPAWNING HABITAT MEMORANDUM

MEMORANDUM

TO: Parr/Fairfield Hydro Relicensing Fisheries and Instream Flow TWC

FROM: Shane Boring and Milton Quattlebaum

DATE: April 29, 2014

RE: Robust Redhorse Spawning Areas

An assessment of spawning habitat for robust redhorse (*Moxostoma robustum*) was requested by stakeholders during the study scoping phase of relicensing. Stakeholders agreed that a qualitative assessment of the Instream Flow Incremental Methodology (IFIM) study reach downstream of Parr Shoals Dam would be conducted concurrently with the mesohabitat assessment and other field efforts during the fall of 2013 and winter of 2014. This memorandum summarizes the assessment results.

Methods

The reach of the Broad River extending from Parr Shoals through the Bookman Island complex was observed by biologists (Milton Quattlebaum (SCANA), Ron Ahle (South Carolina Department of Natural Resources), and Shane Boring (Kleinschmidt Associates)) in October and November 2013 during the mesohabitat assessment conducted in support of the proposed IFIM Study. A follow up visit was made by Quattlebaum and Scott Lamprecht (South Carolina Department of Natural Resources) in February 2014. During the assessment, the group utilized published habitat suitability criteria to identify areas along the river reach they believed were potential robust redhorse (RRH) spawning sites. According to Freeman and Freeman (2001), RRH spawning habitat is characterized as being mid-channel gravel bars dominated by medium to coarse gravel with less that 30% sand and minimal fine particles. Spawning sites are also characterized as containing gravel small enough to be moved for egg deposition, but large enough to offer interstitial space for the eggs. Water depths are typically between 1 and 3.6 feet, with an average water column velocity of 0.85 to 2.20 ft/s. Sites encountered during the assessment that appeared to display these characteristics were noted on the field datasheets, their locations were documented with Global Positioning System (GPS), and in some instances, the sites were photographed.

Results

Four potential RRH spawning sites were examined during the assessment. The upstream-most site is located in the tailrace of the Parr development powerhouse within IFIM Study Site 3 (Figure 1). Fisheries Technical Working Committee (TWC) members have noted that RRH activity is well documented at that site, including observed potential spawning behavior. Three new sites were located during the assessment: one just upstream of Haltiwanger Island and two in the Bookman Shoals complex (IFIM Study Site 10) in the vicinity of Hickory Island (Figure 2). Results of PHABSIM and 2-D modeling conducted as part of the IFIM study will develop weighted usable area (WUA) estimates of spawning habitat under various flow scenarios, which will be taken into consideration by the TWC in developing a downstream flow recommendation that is best for multiple species, including RRH spawning.

FIGURES

FIGURE 1 POTENTIAL ROBUST REDHORSE SPAWNING AREA DOWNSTREAM OF PARR DAM

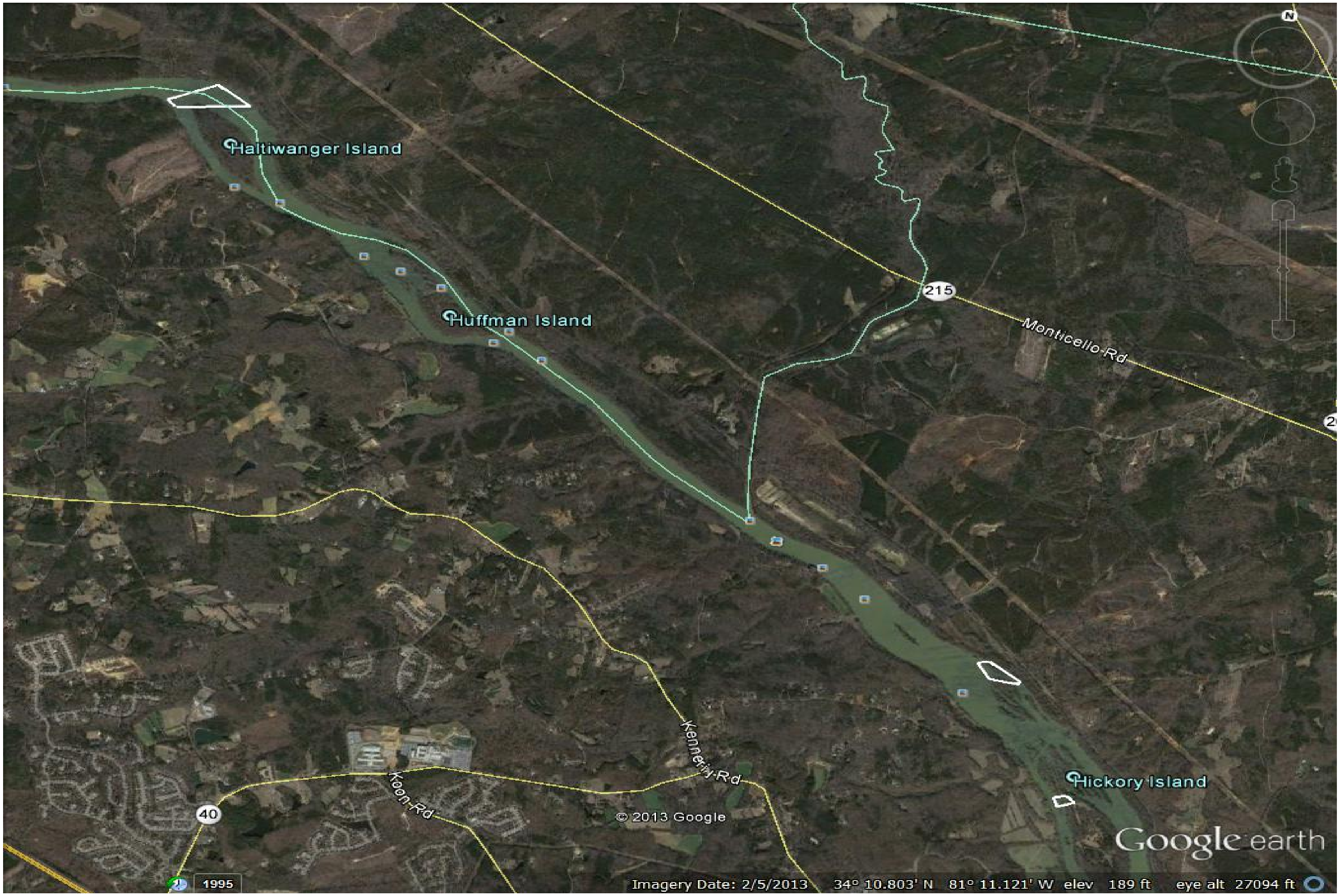


FIGURE 2 POTENTIAL ROBUST REDHORSE SPAWNING SITE AT HALTIWANGER ISLAND AND IN BOOKMAN SHOALS COMPLEX

APPENDIX C

PROVISIONAL HABITAT SUITABILITY CURVES FOR TARGET SPECIES/GUILDS

DRAFT MEMORANDUM

TO: Parr-Fairfield Hydro: Instream Flow/Aquatic Habitat TWC

FROM: Brandon Kulik

DATE: July 9, 2013

RE: **PROPOSED HABITAT SUITABILITY CRITERIA**

On May 7, 2013, the Instream Flow/Aquatic Habitat Technical Working Committee (TWC) agreed upon species and lifestages for which habitat suitability should be evaluated on the Broad River below the Parr-Fairfield Project as a part of AN IFIM study (Table 1).

TABLE 1 EVALUATION SPECIES ELECTED BY THE TWC

- Smallmouth Bass
- American Shad
- Brassy Jumprock
- Whitefin Shiner
- Robust Redhorse
- Santee Chub
- Striped Bass
- Piedmont Darter
- Snail Bullhead
- Redbreast Sunfish
- Channel Catfish

The purpose of this memo is to recommend potential Habitat Suitability Criteria (HSC) for use in this study that are applicable to the above species. Smallmouth bass and redbreast sunfish criteria were sourced from the Saluda study, as the TWC has already vetted these curves. Although the Saluda study had employed TWC-approved American shad HSC, these criteria have recently been refined, based on the research of Joe Hightower in North Carolina (Hightower, *et. al*, 2012) and provided to us by NOAA Fisheries. We propose that the TWC consider using these updated criteria.

The remaining species do not have well developed, individual HSC. However, the Pee Dee IFIM study addressed habitat suitability for these species by classifying each of them into applicable guilds. This information was provided to the Saluda IFIM TWC during study scoping (Gerrit Jobsis, October 16, 2006). Based this information (Table 2), we classified the remaining Parr-Fairfield evaluation species and lifestages into proposed guild categories (Table 3) Attachment A displays the coordinates for the resulting HSC proposed for use, based on the source material identified in Table 3.

TABLE 2 GUILD CLASSIFICATION FOR INDIVIDUAL SPECIES AND LIFESTAGES, FROM PEE DEE RIVER IFIM STUDY (2004)

Species and Habitat Guild Assignment Table for the Pee Dee River Instream Flow Study. Revision 2 - July 9, 2004.

Scientific Name	Common Name	Habitat Types and Guilds[1, 2, 3]			
		Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Petromyzontidae	**Lampreys**				
Petromyzon marinus	sea lamprey		A		
Acipenseridae	**Sturgeons**				
Acipenser oxyrinchus	Atlantic sturgeon				S
Acipenser brevirostrum	shortnose sturgeon				S
Lepisostedidae	**Gars**				
Lepisosteus osseus	longnose gar	A, J		A, J, S	
Amidae	**Bowfin**				
Amia calva	bowfin			A, S	
Anguillidae	**Freshwater eels**				
Anguilla rotstrata	American eel	J		A, J	J
Clupeidae	**Herrings**				
Dorosoma cepidanum	gizzard shad	A, J		A, J, S	
Dorosoma petenense	threadfin shad	A, J		A, J, S	
Alosa mediocris	hickory shad			J, S	
Alosa sapidissima	American shad			J	J, S
Alosa aestivalis	blueback herring			J, S	
Cyprinidae	**Carps and Minnows**				
Cyprinus carpio	common carp	J, S		A, J, S	
Notemigonus crysoleucas	golden shiner	A, J, S		A, J, S	
Hybognathus regius	Eastern silvery minnow	J, S		A, J, S	
Nocomis leptocephalus	bluehead chub		A, S		
Cyprinella analostana	satinfin shiner	A, J, S		A, J, S	
Cyprinella nivea	whitefin shiner	A, J	S	A	
Cyprinella pyrrhomelas	fieryblack shiner	A, J	S	A	
Notropis altipinnis	highfin shiner	J, S		A	
Notropis amoenus	comely shiner	A, J	S	A, J	
Notropis hudsonius	spottail shiner	A, J	S	A, J	
Notropis petersoni	coastal shiner	A, J	S	A	
Notropis scepticus	sandbar shiner	A, J	S	A	
Catostomidae	**Suckers**				
Catostomus commersoni	white sucker	J	S	A, J	A
Minytrema melanops	spotted sucker	J	S	A	
Scartomyzon spp.	brassy jumprock	J	S	A	A
Moxostoma macrolepidotum	shorthead redhorse	J	S	A	A[4]
Moxostoma anisurum	silver redhorse	J	S	A, J	
Moxostoma robustum	robust redhorse		S	A, J	
Moxostoma sp.	Carolina redhorse		S	A, J	
Carpiodes cyprinus	quillback		S	A	S
Erimyzon oblongus	creek chubsucker	S?		A, J, S?	
Carpiodes velifer	highfin carpsucker		S	A	S
Ictiobus bubalus	smallmouth buffalo	J	A	A, S	A
Ictiobus cyprinellus	bigmouth buffalo			A	

TABLE 2 *CONTINUED*

Scientific Name	Common Name	Habitat Types and Guilds[1, 2, 3]			
		Shallow Slow	Shallow Fast	Deep Slow	Deep Fast
Ictaluridae	**Bullhead catfishes**				
Ictalurus punctatus	channel catfish			A, J	J
Ictalurus furcatus	blue catfish			A, S	A
Ameiurus catus	white catfish			A	A, J
Ameiurus brunneus	snail bullhead			A	
Ameiurus nebulosus	brown bullhead			A	
Ameiurus platycephalus	flat bullhead			A	
Pylodictus olivaris	flathead catfish	J		A, J, S	
Esocidae	**Pikes**				
Esox americanus americanu	redfin pickerel			A, J, S	
Esox niger	chain pickerel			A, J, S	
Umbridae	**Mudminnows**				
Umbra pygmaea	Eastern mudminnow			A, J, S	
Poeciliidae	**Livebearers**				
Gambusia holbrooki	Eastern mosquitofish			A, J, S	
Aphredoderidae	**Pirate perches**				
Aphredoderus saynus	pirate perch			A	
Atherinidae	**Silversides**				
Labidesthes sicculus	brook silverside			A	
Percichthyidae	**Temperate basses**				
Morone americana	white perch	J	S	A, J	S
Morone chrysops	white bass	J	S	A, J	S
Morone saxatilis	striped bass				A, S
Centrarchidae	**Sunfishes**				
Lepomis auritus	redbreast sunfish	J, S		A, J, S	
Lepomis cyanellus	green sunfish			A, J, S	
Lepomis gibbosus	pumpkinseed	J, S		A, J, S	
Lepomis macrochirus	bluegill	J, S		A, J, S	
Lepomis microlophus	redear sunfish			A, J, S	
Lepomis punctatus	spotted sunfish			A, J, S	
Micropterus salmoides	largemouth bass	J, S		A, J, S	
Pomoxis nigromaculatus	black crappie			A, J, S	
Percidae	**Perches**				
Etheostoma olmstedi	tessellated darter	A, J	S	A	
Percina crassus	Piedmont darter		A, S		
Perca flavescens	yellow perch			A, J, S	

[1]Habitat types based on predominant habitat types present in the Pee Dee River derived from the aerial videography study.

[2]Life stages: A = adult, J = juvenile, including young-of-year, and S = spawning.

[3]Classification of species and life stages into habitat types based on Becker (1983), Hamilton and Nelson (1984), Aadland et al. (1991), Jenkins and Burkhead (1994), Rhode et al. (1994), Leonard and Dilts (2003), and Progress Energy (2003).

[4]Foraging adults based on Jenkins and Berkhead (1994).

TABLE 3 PROPOSED HSC SOURCE DATA FOR PARR-FAIRFIELD IFIM STUDY

SPECIES CRITERIA	LIFESTAGE	SOURCE	GUILD
Smallmouth Bass	all	Saluda	N/A
American Shad	spawning	Hightower, *et al.*, 2012	N/A
Brassy Jumprock	adult	Pee Dee River IFIM	deep slow
Brassy Jumprock	juvenile	Pee Dee River IFIM	shallow slow
Brassy Jumprock	spawning	Pee Dee River IFIM	shallow fast
Whitefin Shiner	adult	Pee Dee River IFIM	shallow slow; deep slow
Whitefin Shiner	juvenile	Pee Dee River IFIM	shallow slow
Whitefin Shiner	spawning	Pee Dee River IFIM	shallow fast
Robust Redhorse	adult	Pee Dee River IFIM	deep slow
Robust Redhorse	juvenile	Pee Dee River IFIM	deep slow
Robust Redhorse	spawning	Pee Dee River IFIM	shallow fast
Santee Chub	adult	Pee Dee River IFIM	shallow fast
Striped Bass	adult	Pee Dee River IFIM	deep fast
Piedmont Darter	adult	Pee Dee River IFIM	shallow fast
Piedmont Darter	spawning	Pee Dee River IFIM	shallow fast
Snail Bullhead	adult	Pee Dee River IFIM	deep slow
Redbreast Sunfish	adult	Saluda	N/A
Channel Catfish	adult	Pee Dee River IFIM	deep slow
Channel Catfish	juvenile	Pee Dee River IFIM	deep slow; deep fast

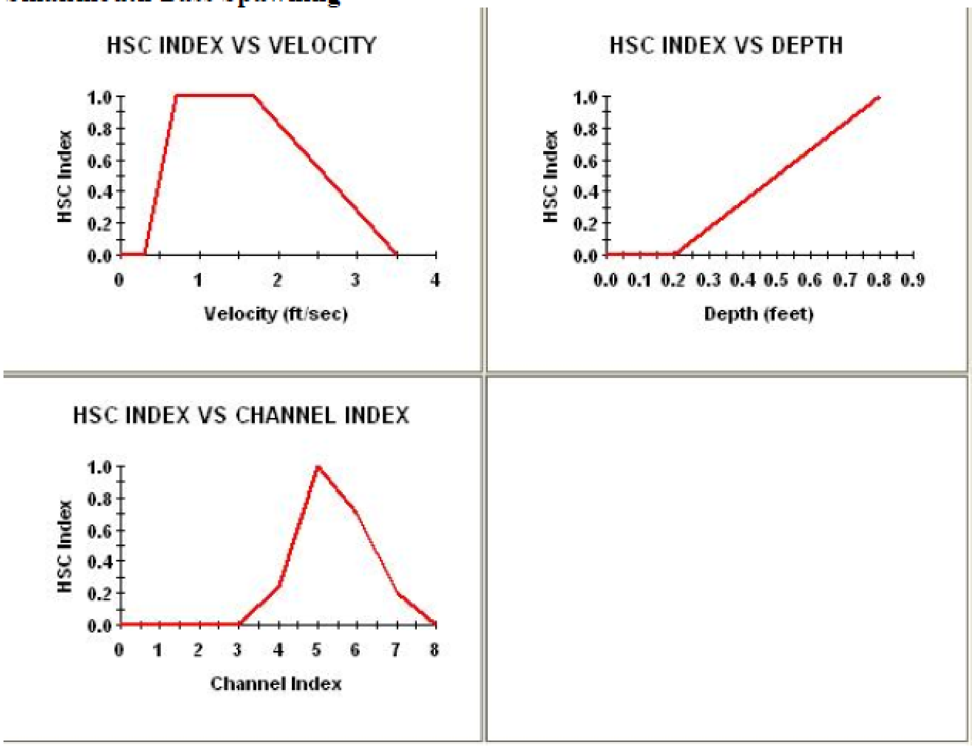
LITERATURE CITED

Hightower JE, Harris JE, Raabe JK, Brownell P, Drew CA. 2012. A Bayesian spawning habitat suitability model for American shad in southeastern United States rivers. Journal of Fish and Wildlife Management 3(2):184–198; e1944-687X. doi: 10.3996/082011-JFWM-047

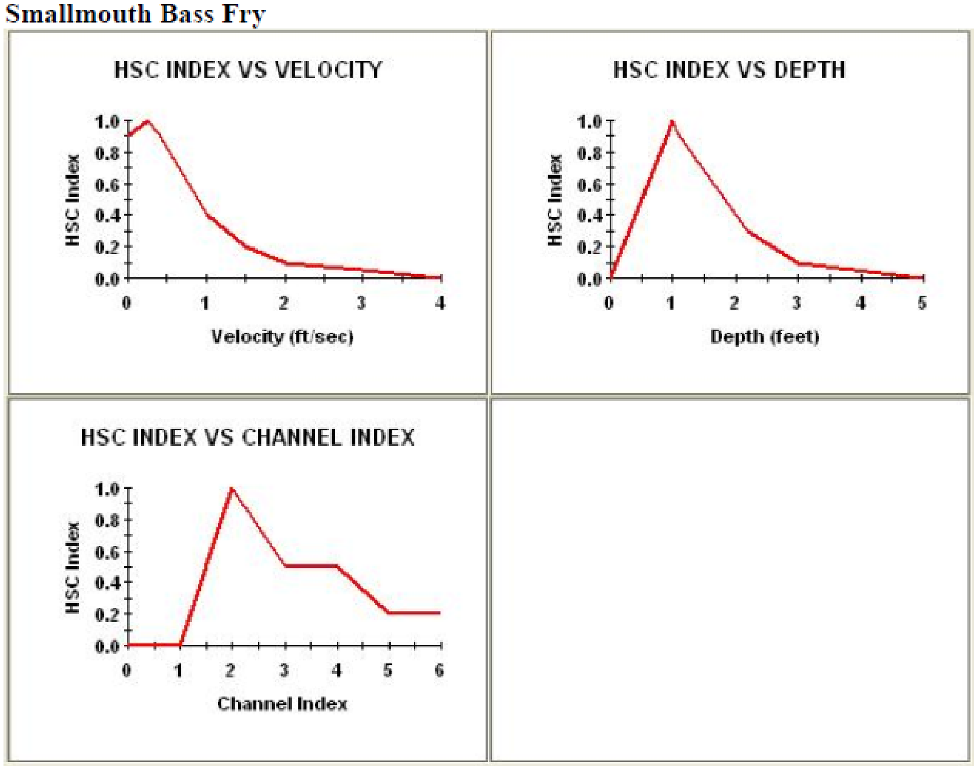
ATTACHMENT A

HABITAT SUITABILITY CRITERIA

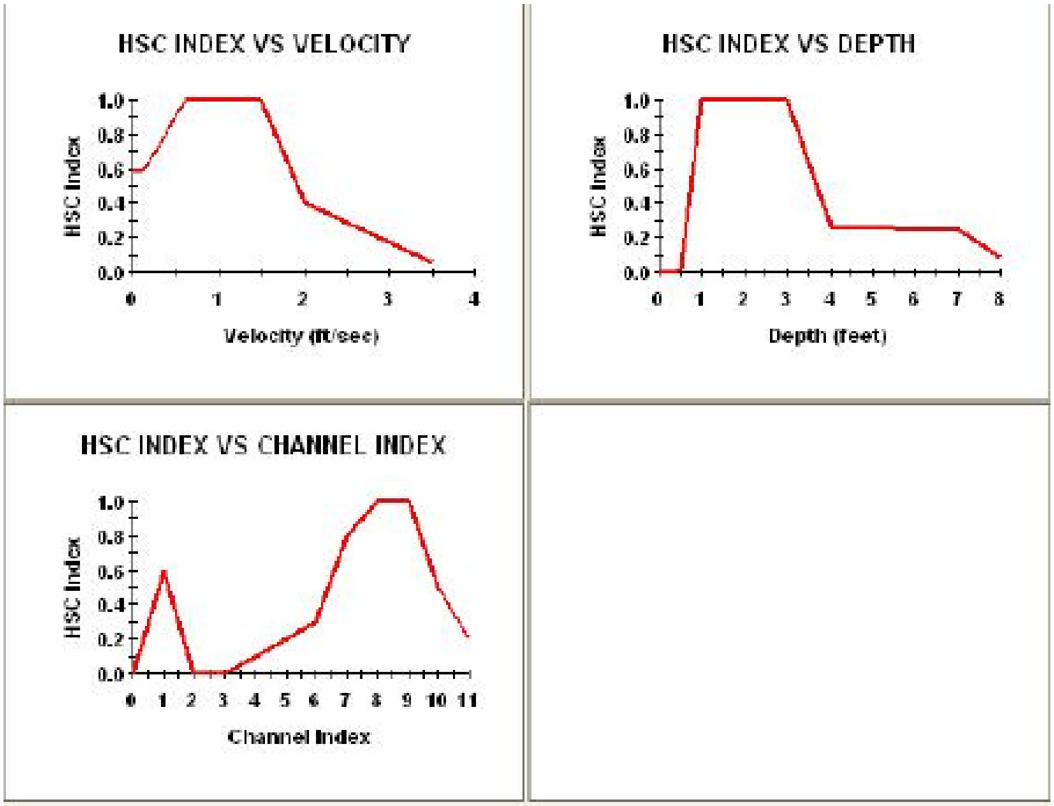
Smallmouth Bass Spawning



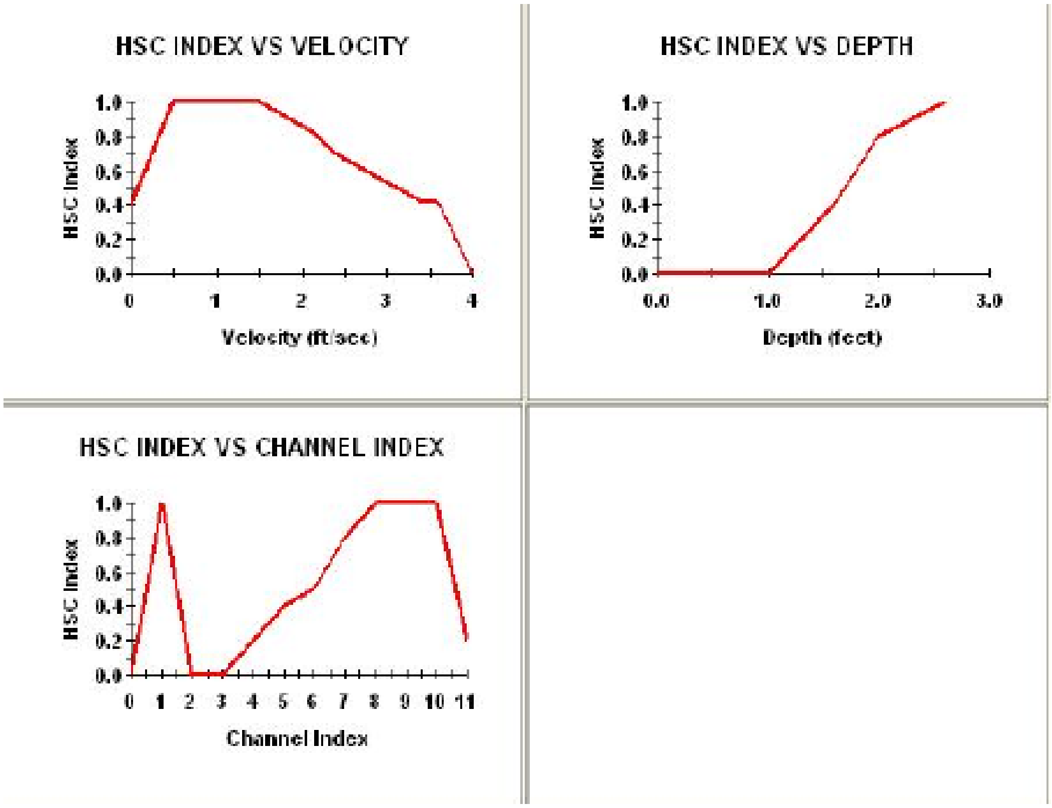
Smallmouth Bass Fry



Smallmouth Bass Juvenile

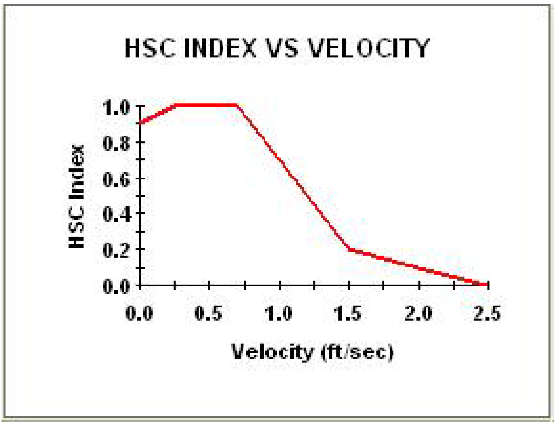


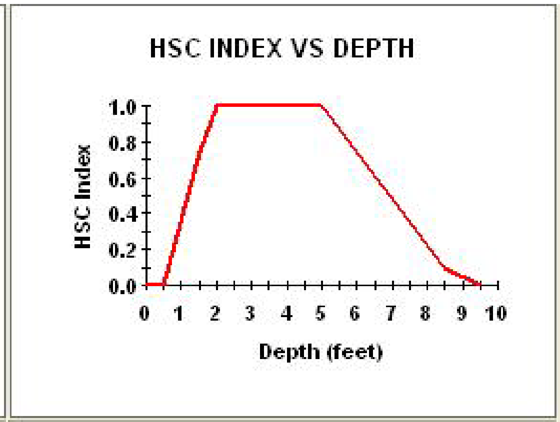
Smallmouth Bass Adult

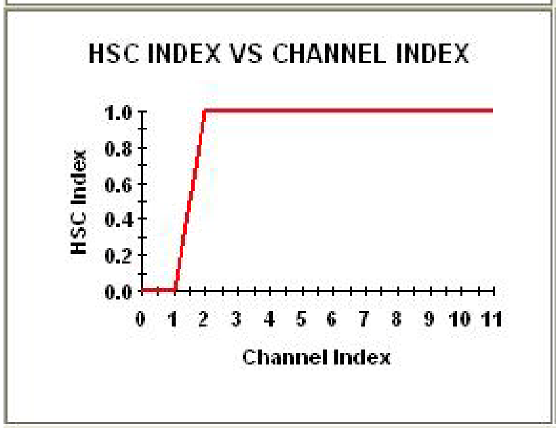


Kleinschmidt

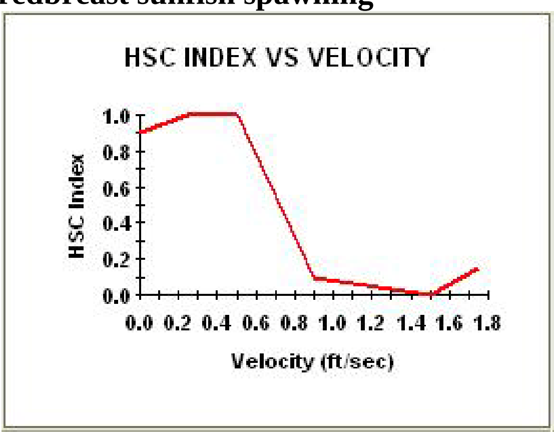
redbreast sunfish adult

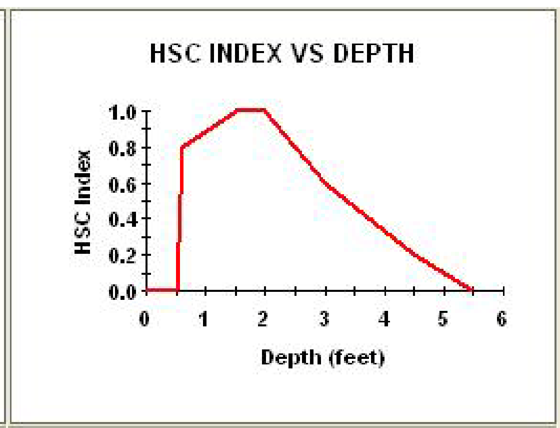


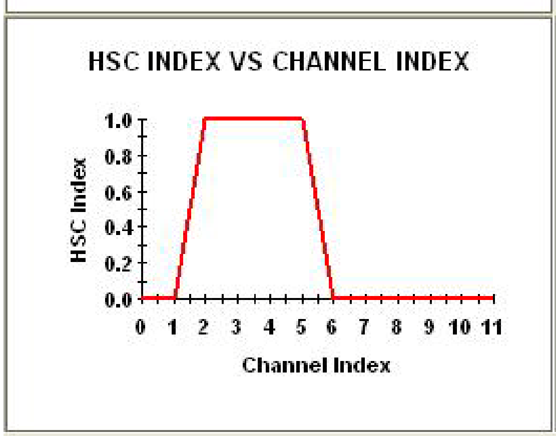




redbreast sunfish spawning

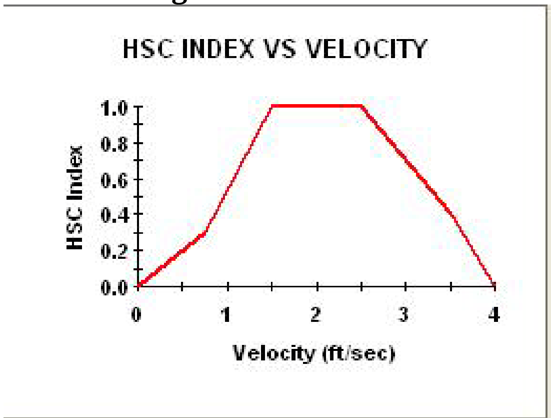


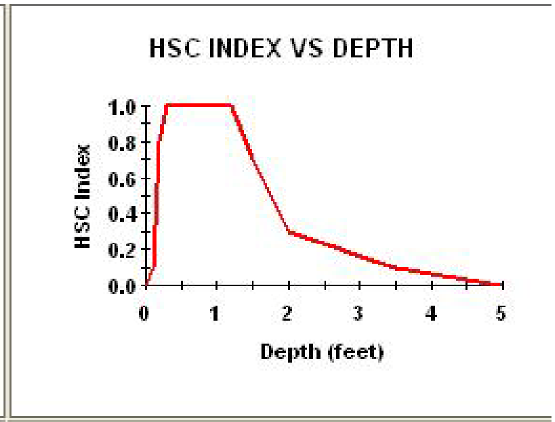


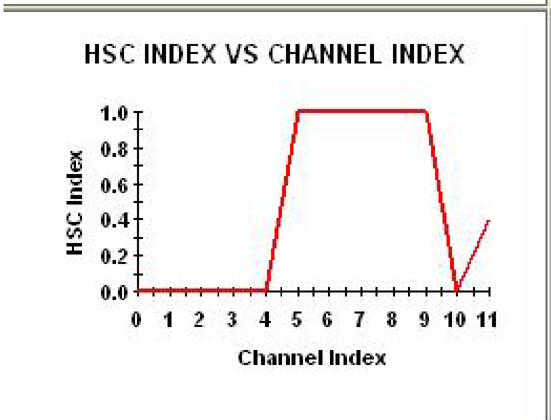


Kleinschmidt

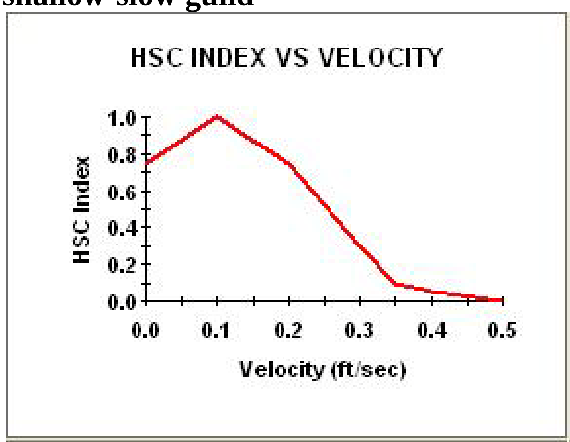
shallow-fast guild

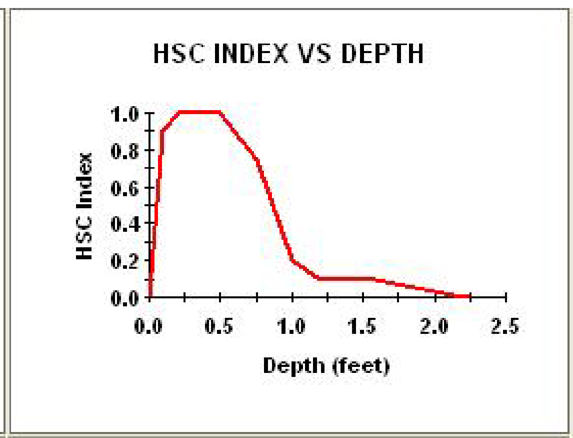


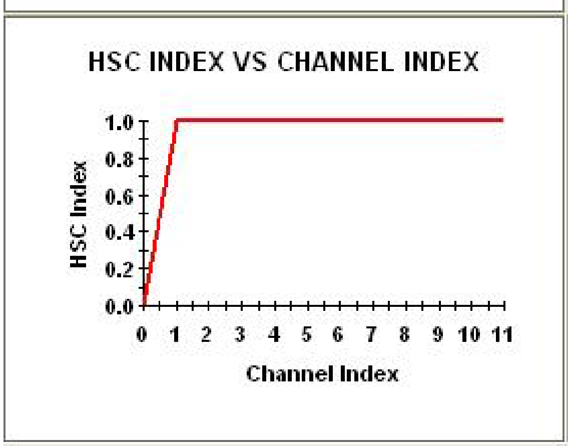




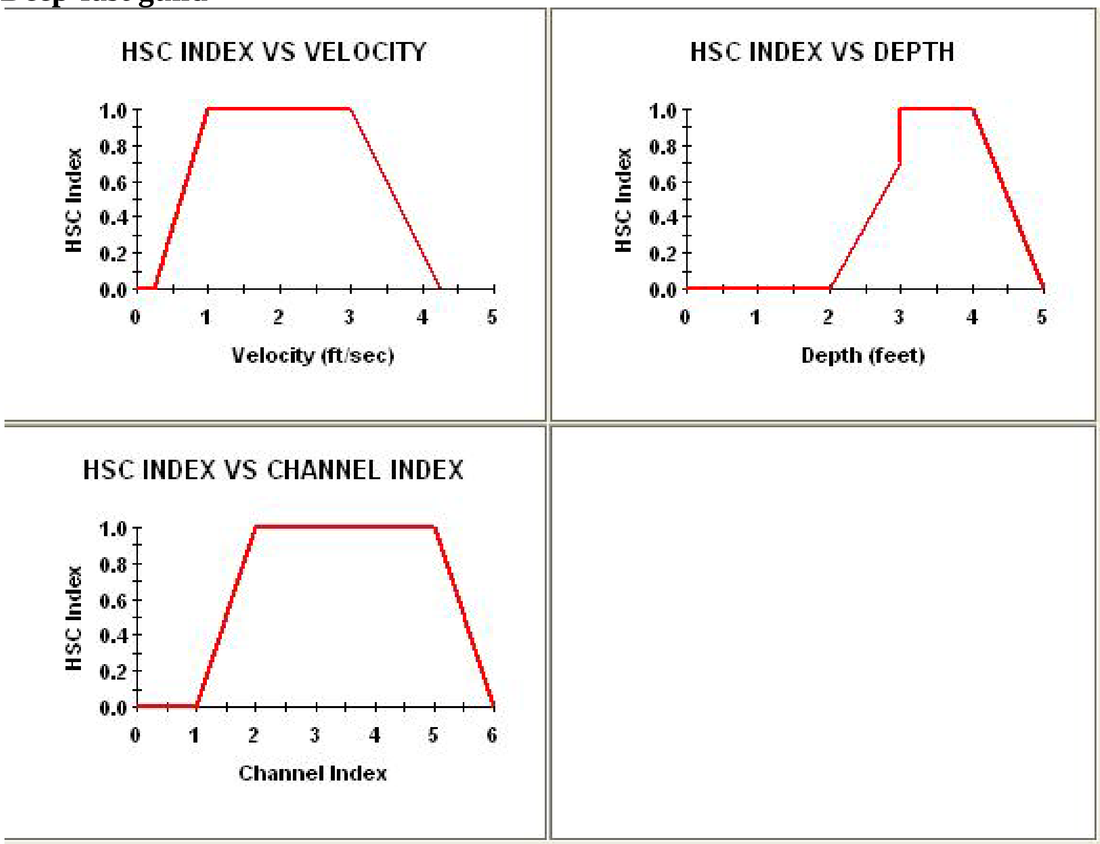
shallow-slow guild



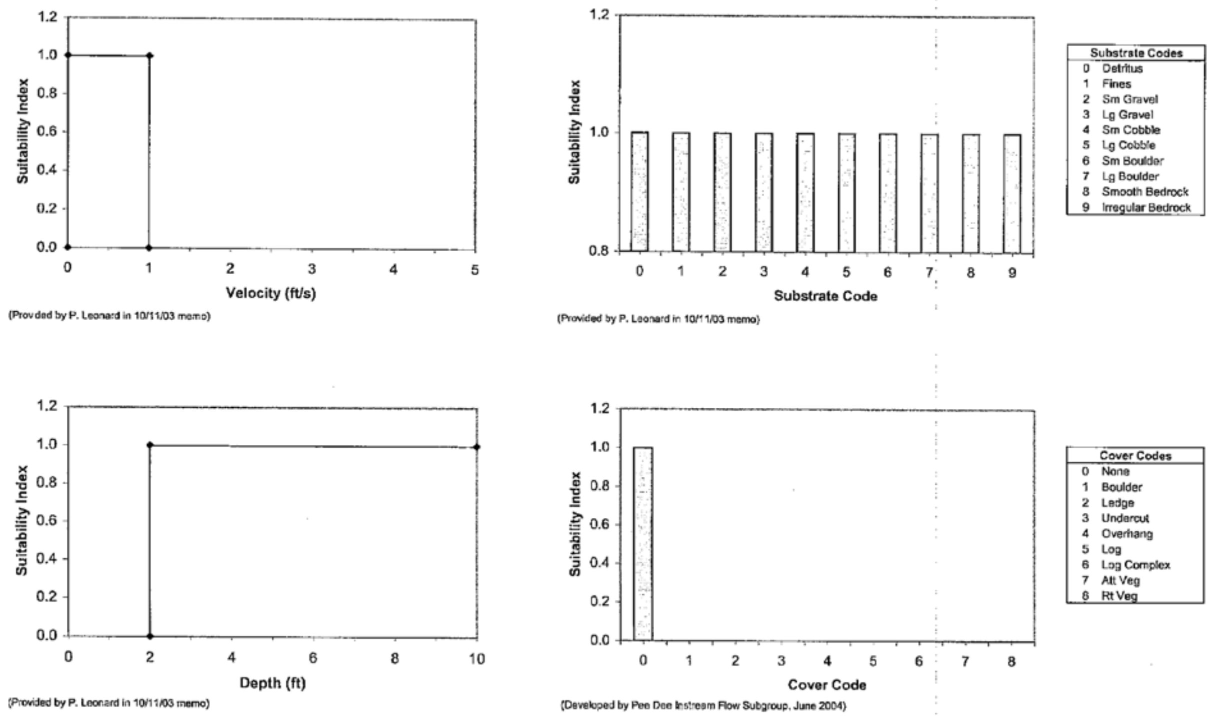




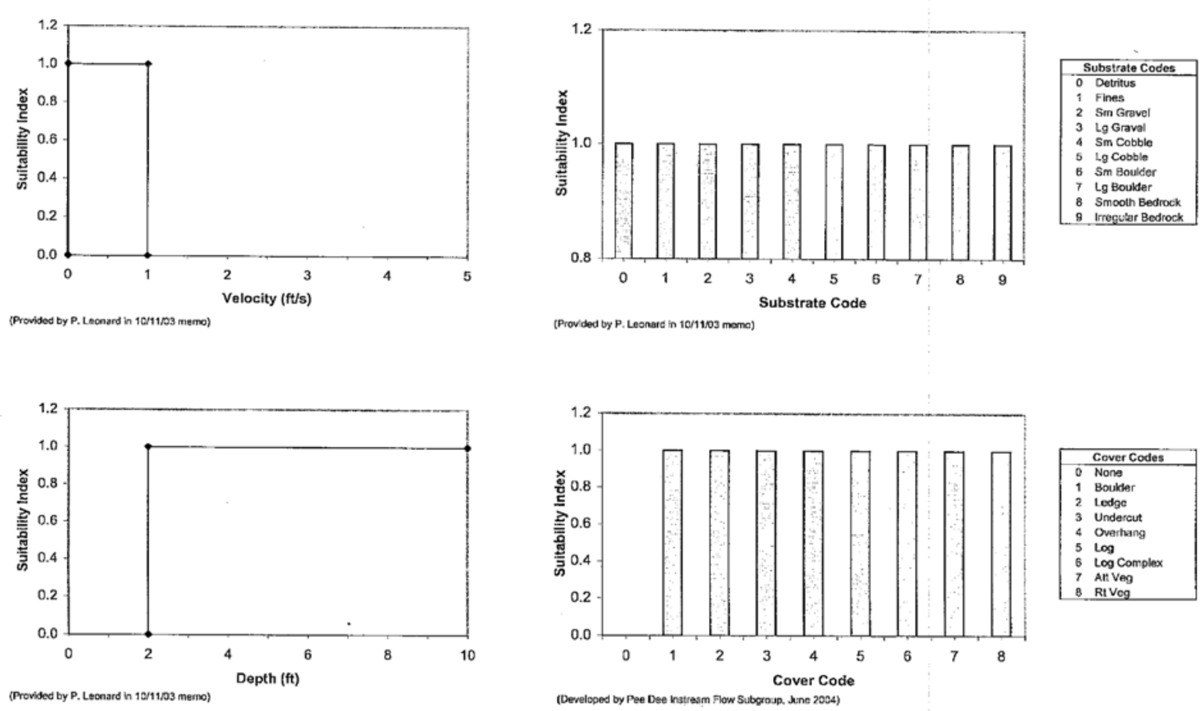
Deep-fast guild



Deep Slow Guild, No Cover
Generic guild habitat suitability



Deep Slow Guild, Cover
Generic guild habitat suitability



American Shad Spawning (*Hightower, et al., 2012*).

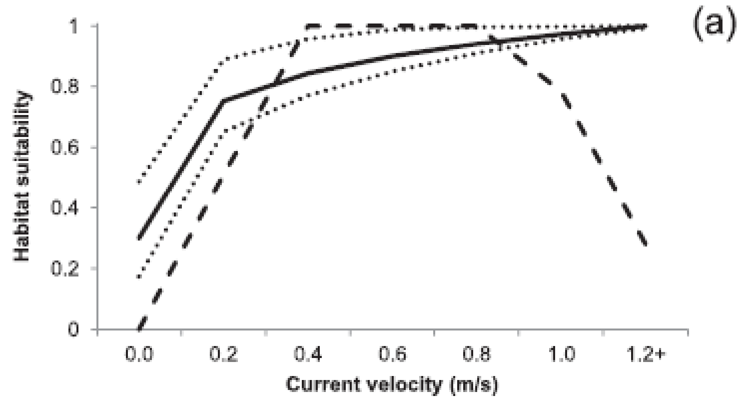


Figure 5. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for current velocity (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.2-m/s velocity bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

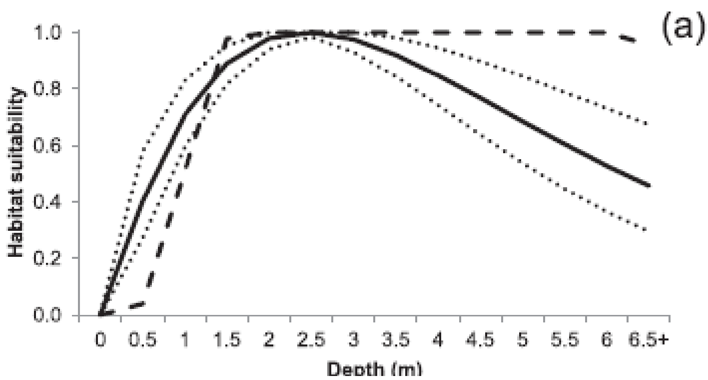


Figure 6. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for water depth in m (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b**) data on habitat use vs. availability, by 0.5-m depth bin. The dashed line shows the suitability curve developed by Stier and Crance (1985).

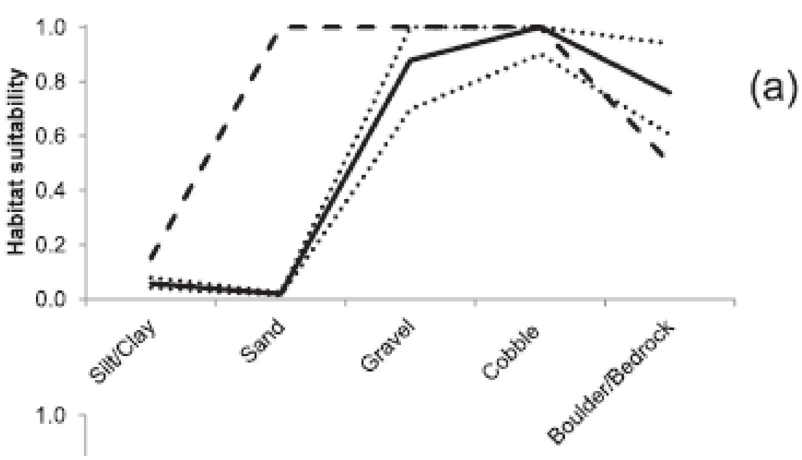


Figure 7. (**a**) Estimated American shad *Alosa sapidissima* spawning-habitat suitability for substrate (median, with dotted lines indicating 95% CI) in southeastern U.S. rivers, based on a resource selection function fitted to (**b** and **c**) data on habitat use vs. availability, by substrate category. The dashed line shows the suitability curve developed by Stier and Crance (1985), using averages for combined categories (silt/clay, boulder/bedrock).

MEMORANDUM

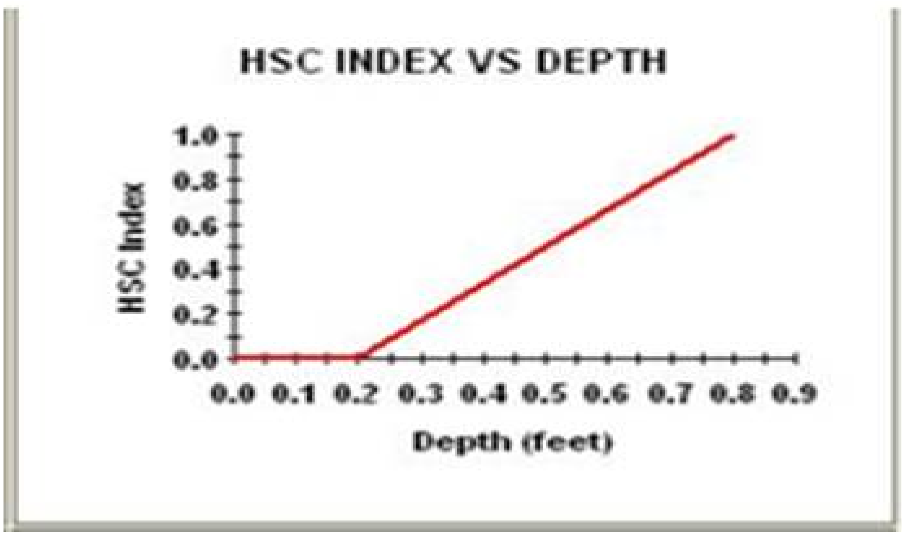
TO: Parr-Fairfield Hydro: Instream Flow/Aquatic Habitat TWC

FROM: Shane Boring

DATE: October 10, 2013

RE: **DEPTH HABITAT SUITABILITY FOR SMALLMOUTH BASS**

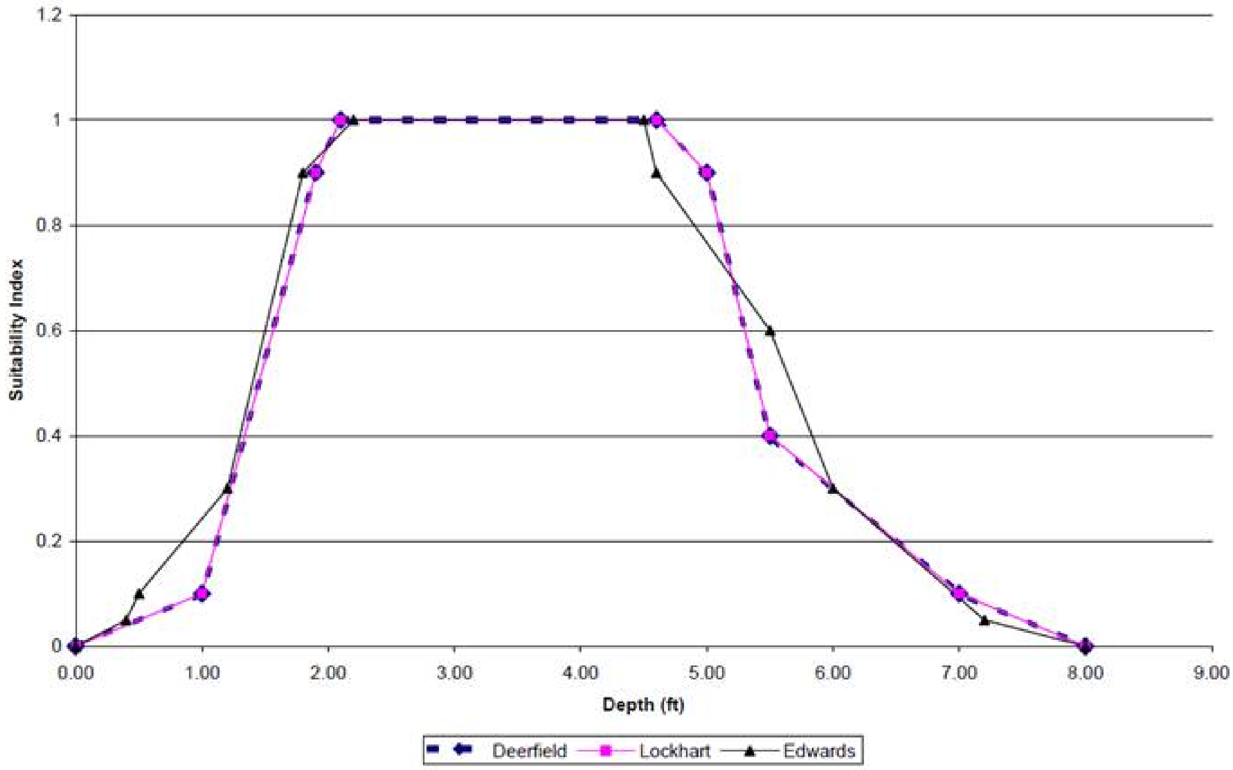
At the July 31, 2013, meeting of the Fisheries Technical Working Committee (TWC), Kleinschmidt presented a memo containing provisional Habitat Suitability Criteria (HSC) for target species (Memo from Brandon Kulik, dated July 9, 2013). The following curve for smallmouth bass spawning HSC index versus depth prompted some discussion, as many of the group stated that it was not reflective of their understanding of smallmouth spawning depth requirements:



There was agreement among the group that a more suitable curve would likely be a “stairstep” with habitat suitability picking up around 0.5 ft, peaking at around 2 ft and beginning to decline around 4.5 ft (the group developed a rough sketch of the curve during the meeting).

Kleinschmidt was subsequently tasked with identifying a curve more reflective of the groups understanding of SMB requirements. To that end, we recommend that the following smallmouth bass depth HSC curve developed for the Deerfield River, MA (NEP, 1990), and later used for the Lockhart Hydro instream flow study (Figure 2), be adopted in lieu of the curve cited in the original memorandum. The Lockhart/Deerfield curve appears to be a slight modification of the more general Edwards Blue Book criteria and is consistent with the TWC’s understanding of smallmouth bass depth requirements for spawning.

Smallmouth Bass, Spawning Habitat Suitability, Depth



Kleinschmidt

DESKTOP FISH ENTRAINMENT STUDY PLAN

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PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

February 2014

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DESKTOP FISH ENTRAINMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. Collaboration and cooperation is essential in the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) comprised of interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The TWC determined that a desktop fish entrainment and mortality study should be conducted to determine the likely effects of Project-induced entrainment and impingement based on the physical characteristics of the Project. This study plan outlines the process for a desktop analysis.

2.0 BACKGROUND AND EXISTING INFORMATION

As noted, the Project is comprised of two developments. The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates continuously to pass Broad River flow. Current minimum flow license articles require that 1,000 cubic feet-per-second (cfs), or average daily natural inflow to Parr Reservoir[1], whichever is less, be provided downstream of Parr Dam from March through May. During the remainder of the year, 800 cfs daily average flow and 150 cfs minimum flow, or natural inflow, whichever is less, are required downstream of the Parr Dam. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations at the Fairfield Pumped Storage Development.

The Fairfield Pumped Storage Development is located directly off of the Broad River. Four earthen dams form the 6,800-acre upper reservoir, Monticello Reservoir. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

The Project area supports warmwater fish communities typical of impounded river reaches in the Piedmont of South Carolina. Recent survey work within the Project area has documented 30 species of fish occurring in Parr Reservoir and 24 species in Monticello Reservoir (Table 1). Although some seasonal variations in community structure have been documented, the fish communities are generally similar between the two reservoirs, with gizzard shad, blue catfish, bluegill, channel catfish and white perch being the dominant species (Normandeau 2007, 2008, 2009; SCANA 2013). No state or federally listed threatened or endangered species have been documented in Monticello or Parr reservoirs, although robust redhorse, which is considered a

[1] Evaporative loss from Parr and Monticello Reservoirs is subtracted from average daily natural inflow to determine flows downstream of Parr Dam.

species of highest conservation concern by the SCDNR (2005), has been documented in limited[2] numbers in both reservoirs.

TABLE 1 FISH SPECIES DOCUMENTED AT PARR AND MONTICELLO RESERVOIRS (SOURCE: NORMANDEAU 2007, 2008, 2009; SCANA 2013)

COMMON NAME	SCIENTIFIC NAME	PARR	MONTICELLO
black crappie	*Pomoxis nigromaculatus*	x	x
blue catfish	*Ictalurus furcatus*	x	x
bluegill	*Lepomis macrochirus*	x	x
channel catfish	*Ictalurus punctatus*	x	x
flat bullhead	*Ameiurus platycephalus*	x	x
flathead catfish	*Pylodictis olivaris*	x	
gizzard shad	*Dorosoma cepedianum*	x	x
golden shiner	*Notemigonus chrysoleucas*	x	x
highfin carpsucker	*Carpiodes velifer*	x	
largemouth bass	*Micropterus salmoides*	x	x
longnose gar	*Lepisosteus osseus*	x	
northern hogsucker	*Hypentelium nigricans*	x	x
notchlip redhorse	*Moxostoma collapsum*	x	x
pumpkinseed	*Lepomis gibbosus*	x	x
quillback	*Carpiodes cyprinus*	x	x
redbreast sunfish	*Lepomis auritus*	x	x
redear sunfish	*Lepomis microlophus*	x	x
robust redhorse	*Moxostoma robustum*	x	x
sandbar shiner	*Notropis scepticus*	x	
shorthead redhorse	*Moxostoma macrolepidotum*	x	x
smallmouth bass	*Micropterus dolomieu*	x	x
snail bullhead	*Ameiurus brunneus*		x
spottail shiner	*Notropis hudsonius*	x	x
threadfin shad	*Dorosoma petenense*	x	x
warmouth	*Lepomis gulosus*	x	
white bass	*Morone chrysops*	x	
white catfish	*Ameiurus catus*	x	x
white perch	*Morone americana*	x	x
whitefin shiner	*Cyprinella nivea*	x	x
yellow bullhead	*Amierus natalis*	x	x
yellow perch	*Perca flavescens*	x	x

[2] To date, 2 robust redhorse have been documented in Monticello Reservoir and 3 robust redhorse have been documented in Parr Reservoir.

3.0 STUDY GOALS AND OBJECTIVES

The goal of the desktop fish entrainment and mortality study is to develop additional information necessary to estimate potential fish entrainment and impingement at the Project. This will provide a basis for understanding the effects of entrainment, impingement and turbine mortality on fisheries resources in the Project area. The study objective is to characterize and provide an order-of-magnitude estimate of entrainment at both developments using existing literature and site-specific information.

4.0 PROJECT NEXUS

Fish that reside in the Project area could be susceptible to impingement on the Project trashracks or entrainment through the Project turbines. Evaluation of the physical characteristics of each Project development along with an evaluation of expected fish behavior at the intake structures utilizing existing information will help in the understanding of the potential for continued Project operations to affect the fishery.

5.0 GEOGRAPHIC SCOPE

As this analysis is a desktop exercise, no field reconnaissance will be implemented. Fish species present within the Project vicinity that are determined to be potentially susceptible to impingement and/or entrainment through the Project will be analyzed in this study.

6.0 METHODOLOGY

Fish impingement and entrainment at the Project may occur when fish that elect to enter into the project intake flow field during periods of operation may become impinged on the trashracks or entrained through the turbines. Fish that are small enough to pass through the projects trashracks will be considered susceptible to entrainment while those physically excluded due to size (i.e. length, width, and/or depth) will be considered as potential candidates for impingement. Not all fish species occurring in the Project reservoirs may be equally susceptible to entrainment or impingement because of their habitat use, behavior and swimming abilities relative to the project intake velocity. As noted, fish entrainment at the Project developments will be assessed through a desktop study. The primary inputs for this analysis will be as follows:

1. Develop an entrainment and turbine mortality database that can be applied to the Parr and Monticello developments.

2. Calculate and estimate fish entrainment rates, seasonally if possible, at each Project development. Entrainment rates are defined as: number of Fish/volume of water entrained.

3. Characterize the species composition of potential fish entrainment.

4. Apply any physical or biological filters that may influence entrainment.

5. Estimate the total annual entrainment for the Project based on normal operation.

6. Estimate potential turbine mortality for fish entrainment based on turbine mortality estimates from similar project studies.

7. Estimate impingement mortality for fish eliminated from entrainment estimates.

These inputs are described in more detail below.

Development of an Entrainment Database

Over seventy site-specific studies of resident fish entrainment at hydroelectric sites in the United States have been reported to date, which provide order-of-magnitude estimates of annual fish entrainment (FERC, 1995). Descriptive information will be gathered from available entrainment studies and will include:

- Location: geographic proximity (preference given to same river basin).
- Project size: discharge capacity and power production.
- Mode of operation - e.g., peaking, run-of-river, etc.
- Biological factors: fish species composition.
- Impoundment characteristics: general water quality, impoundment size, flow regime.
- Physical project characteristics: trash rack spacing, intake velocity, etc.

This information will be assembled into a “matrix” of data to be used as a database for the desktop study. After review of the “matrix”, specific studies that are most applicable to the Project developments will be selected for use in the entrainment database. Key criteria to be used in acceptance of candidate studies may include:

- Similar geographic location, with preference given to projects located in the same river basin.
- Similar station hydraulic capacity.
- Similar station operation (peaking, run-of-river, etc.).

- Biological similarities: fish species, assemblage and water quality.
- Availability and type of entrainment data (netting vs hydroacoustic).

<u>Estimation of Fish Entrainment</u>

Fish entrainment by species for the proposed Project will be estimated on a monthly basis (if possible) to provide an order-of-magnitude fish entrainment estimate. As noted, the entrainment rates will be presented in fish entrained per hour of operation and fish per volume of water passed through project turbines (fish/million cubic feet). The data will be grouped by season, where appropriate, to determine an entrainment density for each season of the year. The seasonal data from each entrainment study will be averaged to develop a seasonal mean entrainment estimate at each Project development.

<u>Species Composition Analysis</u>

Species composition data from the accepted entrainment studies will be analyzed and compiled to determine the fish species typically entrained at other hydroelectric projects. This information will be grouped to yield predicted seasonal estimates of species-specific data for entrained fish to determine:

- Likelihood of entrainment by species.
- Expected relative abundance of each species identified as potentially entrained.
- Prediction of seasonal entrainment by species and size, if applicable.

<u>Application of Physical or Biological Filters</u>

Adjustment of fish entrainment rates based on site-specific characteristics of the Project may be appropriate. Factors potentially affecting entrainment rates that may warrant adjustment of estimates include:

- Trashrack spacing.
- Fish habitat available at the intakes.
- Other site specific factors as determined during the study.

Some limited boat electrofishing will also be conducted in the Fairfield development forebay in Monticello Reservoir and in the Fairfield development tailrace canal in Parr Reservoir for purposes of characterizing the fish communities occurring in the intake vicinities. Sampling will be conducted in the spring and fall of the 2014 and 2015, concurrent with fish tissue sampling required as part of environmental compliance activities for the VC Summer Nuclear Station. All fish encountered will be identified to species, measured for total length, and either returned alive to the river or retained for fish tissue sampling. While ancillary to the entrainment and impingement estimates described above, the sampling will provide qualitative data describing spatial and temporal patterns of fish occurring in the intake zone. Existing fish community data for Parr Reservoir (summarized in the Parr and Fairfield Baseline Fisheries Report) will also be used to better understand spatial and temporal fish distribution trends as part of developing entrainment estimates for both developments.

Total Annual Entrainment Estimate

Total fish entrainment for each Project development will be estimated on an annual basis to provide an order of-magnitude entrainment estimate. The total fish entrainment estimate will be produced for a typical water and operating year.

Turbine Mortality

As fish move through hydroelectric turbines, a percentage are killed due to turbine mortality (i.e. blade strikes, shear forces, and pressure changes, etc.). Turbine passage survival studies have been performed at numerous hydroelectric projects throughout the country. Characteristics of these known project studies will be compared to the characteristics of the Parr and Monticello development turbines and appropriate studies will be selected for the transfer of turbine mortality data. Selected turbine survival rate data will also be obtained from the literature and used to estimate the number of fish lost due to turbine mortality. Important turbine characteristics viewed as general criteria for accepting turbine mortality studies will include but are not limited to:

- Turbine design type.
- Operating head.
- Turbine runner speed.
- Turbine diameter, and peripheral runner velocity.

Species specific turbine mortality rate data available from source studies will also be reviewed and consolidated. Where multiple tests are available for a given fish genus or family, a mean survival rate will be computed. For genus or families where no acceptable data can be identified, the survival rate data from surrogate genus and/or family groups will be utilized.

Once turbine mortality rates are developed from the study database, the rates will be applied to the fish entrainment estimates for the Project. This will be accomplished by multiplying fish entrainment estimates by the composite mortality rates for each family/genus group (where applicable).

<u>Impingement Estimates</u>

Fish eliminated from entrainment estimates due to their size in relation to the trashrack spacing will be considered susceptible to impingement. Swim speed information for these species and size groups will be compared to intake velocities to estimate the potential for impingement. Those species or size groups lacking the ability to avoid impingement will be considered impinged and subsequently killed due to impingement mortality.

7.0 SCHEDULE AND PRODUCTS

Our goal is to complete this study by the end of 2015. Based on review of an earlier draft of the study plan, the TWC identified several “hold points,” associated with the 7 primary study inputs identified in Section 6.0. Specifically, “hold points” were requested following completion of Step 1 (entrainment and turbine mortality database development), Step 3 (characterization of species composition), and Step 5 (estimate of total annual entrainment). At each of these hold points, the TWC will be convened to review the study progress to date prior to proceeding with the next phase of the analysis.

Comments from the TWC will be addressed during each phase of the analysis. Upon completion of the study, a draft report will be prepared and distributed to the TWC for review and comment. The draft report will summarize the results obtained in the study; will contain appropriate tables and figures depicting estimated fish entrainment; and will contain all supporting correspondence among the TWC members. After receipt of all comments, the draft report will be revised to address final comments by TWC members and will be resubmitted as the Final Report.

8.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, Fisheries TWC, and other relicensing stakeholders.

9.0 REFERENCES

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PARR HYDROELECTRIC PROJECT

FERC NO. 1894

RARE, THREATENED AND ENDANGERED SPECIES DESKTOP ASSESSMENT

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt Associates

Lexington, South Carolina
www.KleinschmidtGroup.com

October 2014

Parr Hydroelectric Project

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FERC NO. 1894

RARE, THREATENED AND ENDANGERED SPECIES DESKTOP ASSESSMENT
SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr Hydroelectric Project (Project) (FERC No. 1894) is located along the Broad River in Newberry and Fairfield counties, South Carolina and is owned and operated by South Carolina Electric & Gas Company (SCE&G). The Project consists of two developments, including the Parr Shoals Development and the Fairfield Pumped Storage Development. The project location is depicted in Figure 2-1.

In preparation for relicensing, SCE&G consulted with local, state and Federal agencies and other interested stakeholders to identify potential impacts of project operations on natural resources. A Rare, Threatened and Endangered Species Technical Working Committee (“RT&E TWC” or “TWC”) was formed and is comprised of representatives from the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), South Carolina Department of Natural Resources (SCDNR), South Carolina Department of Health and Environmental Control (SCDHEC), non-governmental organizations (NGOs), SCANA/SCE&G and other interested individuals. In addition to several field surveys for selected species, the TWC agreed upon a literature-based assessment to summarize the status of federally and state listed rare, threatened and endangered species (RT&E) occurring in the Parr Hydroelectric Project vicinity. As outlined in the RT&E Species Study Plan (Appendix A), the objective of this assessment was to identify those species potentially occurring in the Project vicinity, which includes habitats within the Project Boundary and in the downstream reach of the Broad River that is influenced by the Project (Richland County), based on review of occurrence data and habitat requirements. It should be noted that site-specific surveys are being conducted for several species of conservation concern (Table 1-1), and as such, these species are not included in this assessment.

TABLE 1-1 SPECIES OF CONSERVATION CONCERN ADDRESSED BY SITE-SPECIFIC STUDIES

Common Name	Scientific Name	Federal Status[1]	State Status	CWCS[2] Priority Level	Study Plan
Rocky Shoals Spider Lily	*Hymenocallis coronaria*		rare	n/a	Rocky Shoals Spider Lily Study Plan
American Eel	*Anguilla rostrata*	ARS		Highest	American Eel Study Plan
Little River (Broad River spiny) Crayfish	*Cambarus spicatus*	ARS		High	Broad River Spiny Crayfish Study Plan

[1] ARS – At-Risk-Species, Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

[2] Refers to conservation priority level as listed in SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006).

2.0 CONSULTATION HISTORY

During initial consultation, the USFWS provided county-level listings of RT&E species occurring in the two county regions surrounding the Project (Fairfield and Newberry counties; Appendix B). At the May 16, 2013 RT&E TWC meeting, the TWC discussed several species that should be addressed during relicensing (meeting notes are in Appendix C). SCDNR requested that the TWC add eight species to this analysis that are not state or federally-listed, but are considered state conservation priority species (Table 4-3). Based on a review of the initial draft of this report, two additional mussel species that are not state or federally listed but are state conservation priority species (yellow lampmussel and Roanoke slabshell) were also added to this analysis (Table 4-3). The TWC agreed that SCE&G would conduct a literature-based review to determine habitat requirements for each of these species and compare those requirements with typical habitat types known to occur in the study area for this report.

The RT&E TWC met again on October 22, 2013 to discuss the Rare, Threatened and Endangered Species Desktop Assessment Study Plan (study plan in Appendix A; meeting notes in Appendix C). At this meeting, the TWC agreed to extend the study area to include areas of the Broad River downstream of the Project Boundary. More specifically, it was agreed that the study area would include habitats within the Project Boundary (Project Area) (Figure 2-1), as well as the reach of the Broad River from Parr Shoals Dam through Frost Shoals, near Boatwrights Island (Figure 2-2). This area encompasses three counties in South Carolina: Newberry, Fairfield and Richland counties.

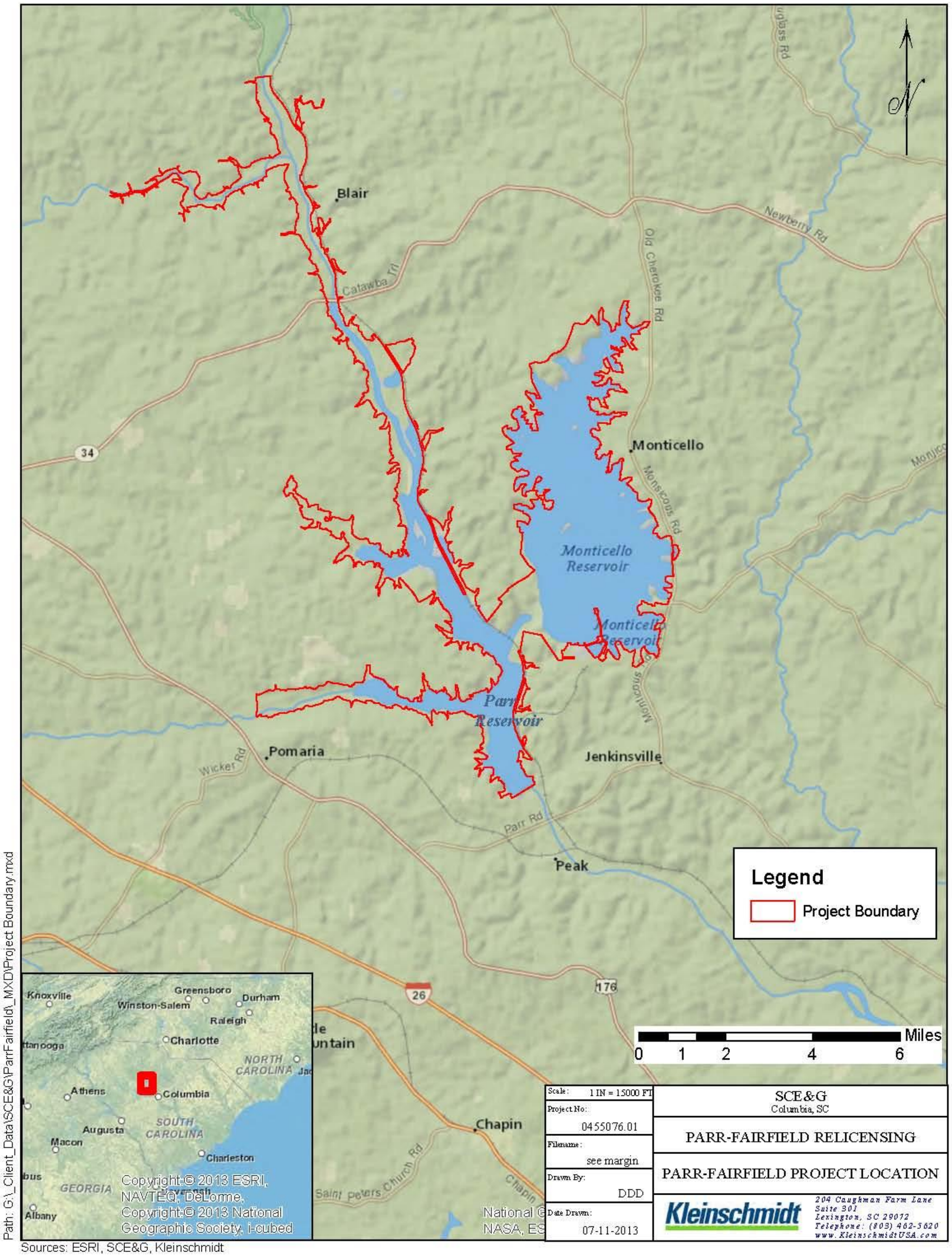
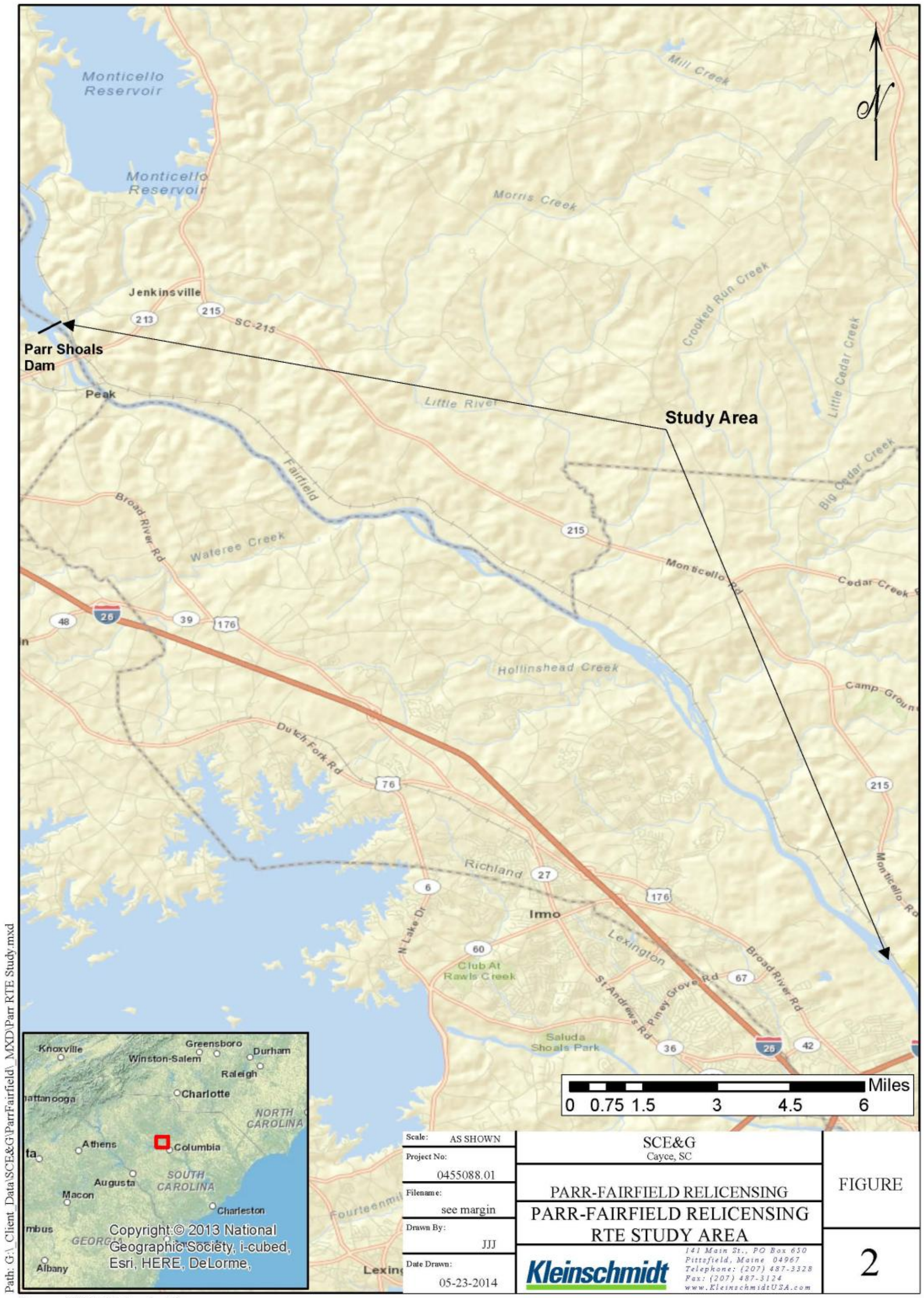


FIGURE 2-1 PARR HYDROELECTRIC PROJECT LOCATION MAP



Source: ESRI, Kleinschmidt

FIGURE 2-2 DOWNSTREAM RT&E STUDY AREA

3.0 METHODOLOGY

As an initial step, the USFWS county-level listings for Newberry, Fairfield and Richland counties were reviewed to identify species potentially occurring in the study area that are federally listed as threatened or endangered under the US Endangered Species Act of 1972 (ESA), or are candidates for such listing. Similarly, SCDNR county-level listings for the three counties were also reviewed to identify species that are state listed under the South Carolina Nongame and Endangered Species Conservation Act of 1974. Bald eagle, which was removed from the federal endangered species list in 2007, was included in the assessment because of its continued protection under the Bald and Golden Eagle Protection Act of 1938. As previously noted, ten species that are considered priority species in the SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006), and are documented as occurring in the three counties of interest, were also added to the analysis (Table 4-3). Known ranges, life history and habitat requirements for each of these species were then summarized and compared to conditions occurring in the study area to determine the potential for occurrence and to identify potential project effects.

4.0 SPECIES DESCRIPTIONS AND ANALYSIS

4.1 FEDERALLY LISTED SPECIES

Ten species that are federally listed as threatened or endangered, or are candidates for such listing, are included on the USFWS county-level listings for the three counties of interest (Table 4-1). None of the federally listed species on Table 4-1 have critical habitat designated in the study area. Life history information and habitat requirements for these species, as well as their status within the study area and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-1 FEDERALLY LISTED AND CANDIDATE SPECIES OCCURRING IN RICHLAND, FAIRFIELD, AND NEWBERRY COUNTIES, SOUTH CAROLINA (SOURCE: USFWS 2013A)

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[1]	STATE STATUS[2]	COUNTIES
Birds				
Bald eagle	*Haliaeetus leucocephalus*	P	T	Newberry, Fairfield, Richland
Red-cockaded woodpecker	*Picoides borealis*	E	E	Richland
Wood stork	*Mycteria americana*	E	E	Newberry, Richland
Fish				
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	E	Richland
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	Richland
Invertebrates				
Carolina heelsplitter	*Lasmigona decorata*	E		Newberry, Fairfield, Richland
Plants				
Canby's dropwort	*Oxypolis canbyi*	E		Richland
Georgia aster	*Symphyotrichum georgianus*	C		Fairfield, Richland
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E		Richland
Smooth coneflower	*Echinacea laevigata*	E		Richland

[1] Federal Status – E (listed as Endangered under ESA); T (listed as Threatened under ESA); C (Candidate for Federal listing); SC (Federal Species of Concern); P (Federally protected).

[2] State Status – E (state listed as endangered); T (state listed as threatened)

4.1.1 BALD EAGLE

The bald eagle was removed from the federal list of threatened species in 2007 (USFWS 2007a) but remains protected as a state endangered species under the South Carolina Nongame and Endangered Species Conservation Act, and federally under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (16 U.S.C.668-668d) (72 FR 37345-37372). Bald eagles are found throughout North America, typically around water bodies, where they feed primarily on fish and carrion. Studies suggest that reservoirs, especially those associated with hydroelectric facilities, are particularly attractive to foraging bald eagles (Brown 1996). Eagles nest in large trees near water and typically repair and use the same nest for several years, (Degraaf and Rudis 1986). In South Carolina, the distribution of eagle nesting has expanded from the coast to encompass more inland areas. This expansion has been attributed to the construction of approximately 491,000 acres of large reservoirs in the state since the early 1900s (Wilde et al. 2003). In South Carolina, the number of estimated nesting pairs has increased from 13 in 1977 to 181 in 2003 (Wilde et al. 2003).

Status in the Study Area

Bald eagles are commonly observed in the study area (SCE&G 2010), with Monticello and Parr reservoirs, as well as the lower Broad River, providing abundant foraging habitat. In addition, nine bald eagle nests are known to occur in the study area and the surrounding vicinity (SCE&G unpublished data) (Figure 4-1).

FIGURE 4-1 EAGLE NEST LOCATIONS IN THE VICINITY OF THE PARR PROJECT

Determination of Effect

Continued operation of the Project is not likely to result in negative effects on eagle foraging or nesting. SCE&G tracks bald eagle nesting in the Project Area and utilizes this information to minimize potential impacts of various shoreline management activities on eagle nests. Specifically, SCE&G refrains from issuing shoreline permits for activities within 660 ft of an active nest during the nesting season (September through May) and 330 ft during the non-nesting season. This policy is in adherence to the USFWS habitat guidelines for nesting bald eagles (USFWS 2007b). SCE&G also frequently consults with USFWS Ecological Services staff regarding proposed activities in the vicinity of known nests.

4.1.2 RED-COCKADED WOODPECKER

The red-cockaded woodpecker (RCW) is endemic to open, mature, and old growth pine ecosystems in the southeastern United States (USFWS 2003). Over 97% of the pre-colonial era RCW population has been eradicated, leaving only roughly 14,000 RCWs living in about 5,600 colonies scattered across eleven states, including South Carolina. RCW decline is generally attributed to a loss of suitable nesting and foraging habitats, including longleaf pine systems, due to logging, agriculture, fire suppression, and other factors (USFWS 2003). Suitable nesting habitat generally consists of open pine forests and savannahs with large, older pines and minimal hardwood midstory or overstory. Living trees, especially older trees that are susceptible to red-heart disease making them more easily excavated, provide the RCWs preferred nesting cavities. Suitable foraging habitat consists of open-canopy, mature pine forests with low densities of small pines, little midstory vegetation, limited hardwood overstory, and abundant bunchgrass and forb groundcover (USFWS 2003).

Status in the Study Area

There are no known reports of RCWs in areas surrounding the Project or along the lower Broad River. Further, there is no known longleaf pine savanna habitat in the study area.

Determination of Effect

Based on the lack of suitable habitat, it is very unlikely that this species occurs in the study area and thus would not be affected by continued operation of the Project.

4.1.3 WOOD STORK

The wood stork is a large, colonial wading bird and is the only stork species that breeds in the United States (USFWS 1996). It was federally listed as endangered in 1984, primarily due to loss of wetland habitat throughout its range, but recently its status has been proposed for downlisting from endangered to threatened due to significant population recovery (USFWS 2012b). It uses a variety of wetlands for nesting, feeding, and roosting. Nesting colonies (rookeries) in South Carolina are typically surrounded by extensive palustrine forested wetlands. Nests are usually located in the upper branches of large black gum or cypress trees, and several nests are typically located in each tree. Like most wading birds, storks feed primarily on small fish. Shallow, open water is required for successful foraging, and depressions where fish become concentrated during periods of falling water levels are particularly attractive sites. Currently, nesting of the species in the United States is thought to be limited to the coastal plain of South Carolina, North Carolina, Georgia, and Florida (Murphy and Hand 2013), which is consistent with recent survey work that found no nesting on the adjacent Saluda Hydroelectric Project (Kleinschmidt 2005).

Status in the Study Area

Periodic foraging of wood storks has been documented in the adjacent Saluda River Basin (Kleinschmidt 2005). Shallow backwaters in the study area, particularly in the upper reaches of the Parr Reservoir, may provide foraging habitat for transient wood storks. Although habitat is present, wood stork use of these areas has not been documented.

Determination of Effect

Project operations are expected to result in no effects on wood storks or their habitat. In fact, fluctuating water levels in Parr Reservoir could enhance foraging habitat by periodically trapping fish in shallow pool areas.

4.1.4 ATLANTIC STURGEON

The Atlantic sturgeon is a large (up to 5.5m in length), long-lived (up to 60 years) anadromous species that was historically present in the Santee Basin at least as far inland as the fall line (Newcomb and Fuller 2001). The Carolina Distinct Population Segment of Atlantic sturgeon, which includes the Santee Basin population, is federally listed as endangered (77 FR 5914), primarily due to overharvesting for flesh and eggs (caviar) during the early to mid-20th Century, as well as habitat degradation and blockage of access to historical spawning grounds (NMFS1998a).

The Atlantic sturgeon is considered estuarine anadromous, spending most of it life in estuarine and ocean environments and undertaking spawning migrations into riverine systems during late-winter and spring months (NMFS 1998a; Marcy et al. 2005). Spawning typically occurs over hard bottoms of clay, rubble, or gravel, with flowing water and temperatures of 14 - 24°C. After spawning, females typically return to estuarine environments within 4 to 6 weeks, while males may remain in the river through the fall. Juveniles of this species remain in the natal rivers for 3 to 5 years before migrating to the ocean (Marcy et al. 2005).

Status in the Study Area

Atlantic sturgeon were historically present at least as far inland as the fall line (Newcomb and Fuller 2001). Current upstream distribution in the Santee Basin is thought to be limited by the lack of passage for Atlantic sturgeon at the Santee Cooper Dams[1]. This information indicates that this species does not occur in the Project study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.5 SHORTNOSE STURGEON

The shortnose sturgeon is federally listed as endangered and is thought to have occurred historically in the reach of the Broad River encompassed by the Project (Welch 2000, Newcomb and Fuller 2001). Shortnose sturgeon are amphidromous (semi-anadromous) spending portions of their life cycle in low salinity estuaries and portions in freshwater rivers (NMFS 1998b; Kynard 1997; Buckley and Kynard 1985). Shortnose sturgeon begin migrating to spawning areas of inland riverine reaches in the spring (typically mid-February through March in South Carolina) when water temperatures rise above 9 °C (Kynard 1997, Hall et al. 1991). Shortnose sturgeon spawning has been documented in the Congaree River near the City of Columbia over

[1] Bill Post (SCDNR), personal communication, April 24, 2014.

substrates of sand, gravel and rock, at temperatures ranging from 9.7-15.6°C, and dissolved oxygen concentrations of 10.6-12.5 mg/L (Collins et al. 2003).

Status in the Study Area

Population groups of shortnose sturgeon are known from downstream of the Santee-Cooper dams in the lower Santee and Cooper rivers (Collins et al. 2003). An additional dam-locked spawning population of shortnose sturgeon has been documented in the Santee-Cooper lakes (with Lake Marion and its tributaries harboring the most significant number of fish) and upstream in the Congaree River. Radio-telemetry studies have documented migration of shortnose sturgeon as far upstream on the Congaree as the Blossom Street Bridge adjacent to the City of Columbia (Finney et al. 2006). However, consultation with SCDNR Diadromous Fish Program staff suggests that this occurrence was based on a small number of observations (2 fish) and that their radiotelemetry data suggest that shortnose sturgeon activity is primarily limited to areas downstream of Granby Lock and Dam[2]. Granby Lock and Dam is located approximately one mile downstream of the Blossom Street Bridge and approximately 5 miles downstream of the Columbia Hydroelectric Project Fishway (fishway). The fishway was designed to provide passage of blueback herring and American shad to historic spawning grounds in the Broad River downstream of Parr Shoals Dam and was intended to be “sturgeon friendly”. Shortnose sturgeon have not been documented upstream of the Blossom Street Bridge in recent history, nor have any been documented passing into the study area through the fishway since annual monitoring began in 2007.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.6 CAROLINA HEELSPLITTER

The Carolina heelsplitter is the only South Carolina freshwater mussel currently listed as federally endangered (Price 2006). Although it was once found in large rivers and streams, the Carolina heelsplitter is now restricted to cool, clean, shallow, heavily shaded streams of moderate gradient. Stable streambanks and channels, with pool, riffle and run sequences, little or

[2] Bill Post (SCDNR), personal communication, April 24, 2014.

no fine sediment, and periodic natural flooding, appear to be required for the Carolina heelsplitter.

Status in the Study Area

Carolina heelsplitter is known to occur in isolated populations distributed in the Savannah, Pee Dee, and Catawba drainages and is not known to occur in the Broad River Basin (Price 2006) or within the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.7 CANBY'S DROPWORT

Canby's dropwort is a perennial plant that grows in coastal plain habitats including wet meadows, wet pineland savannas, ditches, sloughs, and around the edges of cypress-pine ponds (USFWS 2010). The healthiest populations seem to occur in open bays or ponds, which are wet most of the year and have little or no canopy cover. Ideal soils for Canby's dropwort have a medium to high organic content and a high water table. They are also acidic, deep, and poorly drained.

Status in the Study Area

Canby's dropwort is a coastal plain species and thus would not be expected to occur in the portion of Richland County occupied by the study area. This assumption is consistent with result of surveys by Nelson (2006, 2007), which failed to document the species on the adjacent V.C. Summer Nuclear Station site.

Determination of Effect

Because Canby's dropwort is not expected to occur in the study area, continued operation of the Project would likely result in no effect on the species.

4.1.8 GEORGIA ASTER

Georgia aster is classified as a candidate for federal listing as threatened or endangered by the USFWS (2013b). Habitat for this species consists of dry, rocky woodlands, woodland borders, roadbanks, and powerline rights-of-way (Weakley 2012). It is thought to be a relict species of the post oak-savanna communities that existed in the southeast prior to fire suppression.

Status in the Study Area

Although no site-specific occurrence data are available for the study area, Nelson (2006, 2007) found no Georgia aster on the adjacent V.C. Summer Nuclear Station but concluded that suitable habitat exists on the site. Georgia aster is also known from several locations on the nearby Sumter National Forest (USDA 2010).

Determination of Effect

Habitat for Georgia aster may exist within the Project study area; however, potential occurrences would be limited to terrestrial sites, which should not be affected by continued operation of the Project.

4.1.9 ROUGH-LEAF LOOSESTRIFE

Rough-leaved loosestrife generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands, and on shallow organic soils overlaying sand (NatureServe 2013). Rough-leaf loosestrife has also been found on deep peat in the low shrub community of large Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin). The grass-shrub ecotone, where rough-leaf loosestrife is found, is fire-maintained, as are the adjacent plant communities (longleaf pine-scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally occurring fire in these ecotones, results in shrubs increasing in density and height and expanding to eliminate the open edges required by this plant.

Status in the Study Area

The pine pocosin and Carolina bay environments required by this species do not occur in the Piedmont; therefore, rough-leaved loosestrife is extremely unlikely to occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.10 Smooth Coneflower

Smooth coneflower is typically found in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium and calcium rich soils associated with amphibolite, dolomite or limestone (in Virginia), gabbro (in North Carolina and Virginia), diabase (in North Carolina and South Carolina), and marble (in South Carolina and Georgia) (USFWS 2012a). Smooth coneflower occurs in plant communities that have been described as xeric hardpan forests, diabase glades, or dolomite woodlands. Optimal sites are

characterized by abundant sunlight and little competition in the herbaceous layer. Natural fires, as well as large herbivores, historically influenced the vegetation in this species' range. Many of the herbs associated with smooth coneflower are also sun-loving species that depend on periodic disturbances to reduce the shade and competition of woody plants.

Status in the Study Area

The diabase glade habitat required by this species is not known to occur in areas around Monticello and Parr reservoirs or along the lower Broad River. Although no site-specific surveys have been performed, surveys by Nelson (2006, 2007) failed to document smooth coneflower on the adjacent V. C. Summer Nuclear Station project area and concluded that appropriate habitat for the species does not occur on the site.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.2 STATE LISTED SPECIES

Three species that are state-listed as threatened or endangered are included on the SCDNR county-level listings for the three counties of interest (Table 4-2). Life history information and habitat requirements for these species, as well as their status within the study area and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-2 STATE-LISTED SPECIES OCCURRING IN RICHLAND, FAIRFIELD, AND NEWBERRY COUNTIES, SOUTH CAROLINA

COMMON NAME	*SCIENTIFIC NAME*	FEDERAL STATUS[1]	STATE STATUS[2]	COUNTIES
Amphibians				
Pine Barrens tree frog	*Hyla andersonii*		T	Richland
Mammals				
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*		E	Richland
Fish				
Carolina darter	*Etheostoma collis*	SC	T	Fairfield, Richland

[1] Federal Status – E (listed as Endangered under ESA); T (listed as Threatened under ESA); C (Candidate for Federal listing); SC (Federal Species of Concern); P (Federally protected).

[2] State Status – E (state listed as endangered); T (state listed as threatened)

4.2.1 PINE BARRENS TREE FROG

The pine barrens tree frog inhabits the swamps, bogs, and acidic brownwater streams of the New Jersey Pine Barrens, as well as the pocosins (shrub bogs) of the Carolinas (Conant and Collins 1991). This species is intolerant of closed-canopy conditions and is restricted to localized wetlands such as hillside seepage bogs within dry uplands, pine barrens, and headwater swamps and disperses along drainages within these areas (NatureServe 2013). Non-breeding habitat generally is in pine-oak areas adjacent to breeding habitat. Important egg-laying and larval habitats include open cedar swamps and sphagnaceous, shrubby, acidic, seepage bogs on hillsides below pine-oak ridges.

For southeastern populations, typical habitats are characterized by the topography, soils, and vegetation of the Carolina Sandhills, with pocosin or evergreen shrub swamps established along seeps and small streams within the surrounding longleaf pine-oak forest. Breeding habitat in

South Carolina has been described as low vegetation with dense growth of Sphagnum mosses. Cely and Sorrow (1983) found that occurrences in South Carolina appeared to be restricted to the Fall Line Sandhills at elevations ranging between 61 and 122 m.

Status in Study Area

The area surrounding the Project lacks the Carolina sandhills habitat and associated bogs and pocosins required by this species; therefore it is extremely unlikely that Pine Barren tree frog would occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.2.2 Rafinesque's Big-eared Bat

Rafinesque's big-eared bat is a colonial bat species native to the southeastern U.S. Two subspecies are recognized in South Carolina, *Corynorhinus rafinesquii rafinesquii* in the mountains and *Corynorhinus rafinesquii macrotis* along the Coastal Plain (Bunch et al. 2006). Rafinesque's big-eared bat is nocturnal, feeding primarily on moths by echolocation. Coastal plain and sandhills populations of the species utilize I-beam and T-beam bridges for roosting. Roosting in mountainous regions of the state occurs in large hollow trees (typically large tulip poplars), abandoned buildings and mines, rock shelters, and caves. Habitat in the Blue Ridge Mountains includes rock outcrops, mesic and cove hardwood forests, forested bottomlands, bottomland agricultural fields, dry deciduous forests, pine woodlands, and forested riparian areas. Coastal zone and sandhills habitats include black gum stands, bald cypress swap forests, maritime forests, and mature hardwood and mixed forests (Bunch et al. 2006).

Status in the Study Area

The range of Rafinesque's big-eared bat in South Carolina includes the coastal plain and sandhills regions and the extreme northwestern Blue Ridge, with the piedmont representing a gap in the species' distribution (Bunch et al. 2006). As such, it is extremely unlikely that this species would occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area and because it is a terrestrial species.

4.2.3 CAROLINA DARTER

The Carolina darter exists only in the Piedmont region from south-central Virginia through North Carolina into north-central South Carolina (Hayes and Bettinger 2006); it is state-listed as threatened and a federal species of concern. It occurs in small to moderately sized streams in areas of low current velocity, typically in backwaters among submerged tree roots or under leaves, where it feeds primarily on Chironomid larvae and micro-crustaceans. Preferred substrates are usually characterized by mud, sand, and sometimes bedrock (Rohde et al. 2009).

Status in the Study Area

The Carolina darter has been collected at several locations in the lower Broad River, including one that appears to be a tributary to Parr Reservoir (Rohde et al. 2009). However, extensive sampling by SCE&G and SCDNR in both Parr and Monticello reservoirs and in the downstream reach have failed to document this species (Kleinschmidt 2013a), suggesting that it may not occur in the study area or occurs in extremely low numbers not detected by previous sampling.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.3 SELECTED SOUTH CAROLINA CONSERVATION PRIORITY SPECIES

As previously noted, ten species that are considered state conservation priority species were also added to the analysis based on consultation with SCDNR and USFWS staff (Table 4-3). Life history information and habitat requirements for these species, as well as their status within the Project Vicinity and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-3 SELECTED STATE CONSERVATION PRIORITY SPECIES

Common Name	Scientific Name	State Priority Level[1]	Federal Status[2]
Newberry burrowing crayfish	*Distocambarus youngineri*	Highest	ARS
Robust redhorse	*Moxostoma robustum*	Highest	ARS
Piedmont darter	*Percina crassa*	High	
Seagreen darter	*Etheostoma thalassinum*	High	
Highfin carpsucker	*Carpiodes velifer*	Highest	
Quillback	*Carpiodes cyprinus*	High	
Santee chub	*Hybopsis zanema*	High	
Striped bass	*Morone saxatilis*	Moderate	
Yellow lampmussel	*Lampsilis cariosa*	Highest	
Roakoke slabshell	*Elliptio roanokensis*	High	

[1] Refers to conservation priority level as listed in SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006).

[2] ARS – At-Risk-Species. Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

4.3.1 NEWBERRY BURROWING CRAYFISH

The Newberry burrowing crayfish is a terrestrial crayfish of the genus *Distocambarus* and is endemic to South Carolina (Eversole and Welch 2006). Although knowledge of its habitat requirements is limited, Newberry burrowing crayfish has typically been found in poorly drained areas where the ground is saturated during the rainy season (November – March) (Eversole and Welch 2006; Hobbs and Carlson 1985). The species has been documented from a range of site types including low, moist woodlands, a machine-maintained powerline, and a manicured lawn. Sites are generally isolated from floodplains and streams, although some have been found in low moist areas near the headwaters of streams (colluvial valleys). Analyses performed by Welch and Eversole (2002) found a close association between occurrence of Newberry burrowing crayfish and the presence of a perched water-table, as well as presence of Chewacla, Worsham, Toccoa-Cartecay, Enon, and Sedgefield soil types (Eversole and Welch 2006).

Status in the Study Area

Currently, the Newberry burrowing crayfish is known from only 14 sites, all of which are located in Newberry County (Eversole and Welch 2006). The known range of the species encompasses portions of the Tyger, Enoree, Lower Broad, and Saluda River basins. Because this species is generally isolated from floodplains and streams, it is not expected to occur in the Project Area or in the downstream reach of the Broad River influenced by the Project.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.3.2 ROBUST REDHORSE

The robust redhorse is a large, heavy-bodied sucker which was presumed extinct until being "rediscovered" during the initial stages of relicensing at Georgia Power's Sinclair Hydroelectric Project (FERC No. 1951). Fisheries scientists knew little about its life history and habitat requirements. As a result, Georgia Power Company, along with state and federal resource agencies, other hydropower interests, and the Georgia Wildlife Federation, formed the Robust Redhorse Conservation Committee (RRCC) in 1995 to guide recovery efforts for the species in lieu of listing under the ESA. Subsequent research has produced valuable information about the robust redhorse and its habitat requirements. However, much research is still needed, as little is known about the habitat preferences of juvenile robust redhorse.

Based on recent studies, it appears that adult robust redhorse typically inhabit areas of the river where the current is moderately swift. Preferred habitat is riffle areas or in/near outside bends, where depths are greater and accumulations of logs and other woody debris are present (Evans 1997). Spawning typically occurs at water temperatures from 18 to 24° C, usually over gravel substrate in both deep and shallow water (Hendricks 1998).

Status in the Study Area

At this time, natural populations of robust redhorse are not known to exist in the Broad River (Lamprecht and Scott 2013). Stocking of fingerlings began in 2004 at sites both above and below the Parr Shoals Dam (Lamprecht and Scott 2013), and robust redhorse have since been documented in both Parr and Monticello reservoirs, as well as the reach of the Broad River downstream of Parr Shoals Dam (Table 4-4). In addition, robust redhorse use of the fishway at the Columbia Hydroelectric Project has been documented (Kleinschmidt 2009, 2010, 2012, 2013, 2014), suggested that robust redhorse from the Congaree and potentially other areas of the lower Santee Basin are utilizing habitat in the reach of the Broad downstream of Parr Shoals Dam during the spawning season.

Determination of Effect

Habitat for robust redhorse is potentially affected by project flow releases and will be assessed as part of the proposed Instream Flow Incremental Methodology (IFIM) Study.

4.3.3 Piedmont Darter

The piedmont darter is one of two species in the genus *Percina* found in South Carolina (Hayes and Bettinger 2006). It is typically found in cool to warm moderately-sized streams and rivers, usually in riffles with gravel or rock substrates (Rohde et al. 2009). Though a riffle dweller, this darter does not seem to favor extremely strong currents.

Status in the Study Area

The piedmont darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for piedmont darter is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.4 Seagreen Darter

The seagreen darter is restricted to the Santee River drainage of the Carolinas (Hayes and Bettinger 2006). This species inhabits lower elevation tributaries in the mountain regions and is also found over a broad area of the upper piedmont in the Carolinas. It is less frequently found below the fall line in tributaries of the Congaree River. The seagreen darter favors a habitat of rock, rubble or gravel riffles in large creeks and rivers with moderate to swift currents, but has adapted to wide variations in temperature and water clarity.

Status in the Study Area

The seagreen darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for seagreen darter is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.5 HIGHFIN CARPSUCKER

The highfin carpsucker is distributed throughout the Lake Michigan drainage and Mississippi River Basin from Pennsylvania south to Louisiana (Self and Bettinger 2006). It also occurs on the Atlantic Slope from the Cape Fear River to Savannah River drainages and Gulf Slope drainages from Choctawhatchee River, Alabama and Florida to the Pearl River, Louisiana and Mississippi. The Atlantic Slope and Gulf Slope populations likely differ at the species level from those of the Mississippi and Lake Michigan drainages. In South Carolina, the highfin carpsucker occurs in the Broad and Congaree rivers in the upper Santee River Basin and the Savannah River. Historically the highfin carpsucker also occurred in the Pee Dee River; however, that population may have since been extirpated. The highfin carpsucker inhabits rivers in areas with moderate or swift current over sand or a gravel substrate (Rohde et al. 2009).

Highfin carpsucker population size and trends are not well known (Self and Bettinger 2006). There appear to be healthy populations with recruitment in the Broad River, Congaree River, and Savannah River. Preservation of populations in the Santee River is extremely important to the global preservation of the species given declining populations in the Cape Fear River and Pee Dee River (Self and Bettinger 2006).

Status in the Study Area

This species has been documented in both Parr Reservoir and the reach of the Broad River downstream of the Project (Table 4-4).

Determination of Effect

Habitat for highfin carpsucker is potentially affected by project flow releases and will be assessed as part of IFIM Study.

4.3.6 QUILLBACK

The quillback is found in warm, low- to moderate-gradient reaches of most major rivers, including upper portions of associated reservoirs (Lamprecht and Bettinger 2006). Quillback occur over varied substrates in rivers, but seldom over mud. They tend to occupy calm water; however, quillback may shift to swifter and deeper depths during low water. Quillback reportedly spawn in riffles, calm stream reaches and in floodplain bayous, laying eggs on gravel, sand, mud and organic matter. Quillback feed on insect larvae and other benthic organisms.

The quillback is distributed from the Great Lakes region in the St. Lawrence River, Hudson Bay and Mississippi River basins from Quebec to Alberta, Canada; south to Louisiana and west to Wyoming in the United States (Lamprecht and Bettinger 2006). It also occurs on the Atlantic slope from the Delaware River, New York, to the Altamaha River, Georgia. In gulf slope drainages, it occurs from the Apalachicola River in Florida and Georgia to the Pearl River in Louisiana. The southern Atlantic slope populations in South Carolina are reported in the upper portions of the three major South Carolina drainages: the Pee Dee, Santee, and Savannah. Fish from these populations are likely distinct from those of the interior basin and gulf slope drainages (Lamprecht and Bettinger 2006).

Status in the Study Area

Quillbacks have been documented in both Parr and Monticello reservoirs, as well as the downstream reach of the Broad River (Table 4-4).

Determination of Effect

Habitat for quillback is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.7 SANTEE CHUB

The Santee chub is restricted to the Santee River drainage within South Carolina, primarily in the piedmont and Blue Ridge foothills (Hayes and Bettinger 2006). A few populations of Santee chub found in the coastal plain represent an undescribed species known as the “thinlip” chub. Outside of South Carolina, “thinlip” chub is also found in the Cape Fear River drainage of North Carolina. The Santee chub inhabits small to medium sized streams with sand and rocky runs or current-swept pools. This species seems to be able to tolerate more turbid and warm waters than its close relative, the big-eye chub, *Hybopsis amblops*.

Status in the Study Area

Santee chub has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for Santee chub is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.8 STRIPED BASS

The striped bass is an anadromous species native to the Atlantic slope, with natural populations residing in saltwater and migrating to medium to large freshwater rivers annually to spawn. It has been widely introduced or has remnant populations in impounded river systems, with some systems, including the Santee River Basin, supporting naturally-reproducing, damlocked populations (Sessions et al. 2006). In freshwater, they prefer to occupy areas with clean sandy bottoms, fine gravel and rock. Adult striped bass have a thermal tolerance of 6 to 27° C, but seek temperatures between 18 to 25°C when available. During spawning, striped bass occupy shallow rocky and gravely areas with strong turbulent water flow. Striped bass eggs are semibouyant; they drift and sink slowly requiring moderate current to keep the eggs from settling to the bottom and dying before they are hatched in one to three days. Optimum water temperatures for successful striped bass egg hatching and survival is 17 to 18°C (Sessions et al. 2006).

Status in the Study Area

Striped bass are regularly observed passing through the Columbia Hydroelectric Project fishway into the reach of the Broad downstream of Parr Shoals Dam (Kleinschmidt 2009, 2010, 2011, 2012, 2013) and have been documented from the study area during electrofishing (Table 4-4).

Determination of Effect

Habitat for striped bass is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.9 YELLOW LAMPMUSSEL

The yellow lampmussel is a freshwater species that is found primarily in medium to large rivers and streams. Preferred habitat includes a variety of substrates such as silt or sand, gravel bars, and in the bedrock cracks of both large and small rivers and streams (Price 2006b). The range of this species extends from the Ogeechee River in Georgia to Nova Scotia, with distribution in South Carolina spanning the Savannah, Broad, Wateree, Congaree, and Pee Dee River basins (Bogan and Alderman 2008, Price et al. 2009, Kleinschmidt 2013b).

Gravid yellow lampmussels observed in the Congaree River in 2007, were reported to release their glochidia between June and July (Price et al. 2009). These animals are long-term brooders that attract piscivorous hosts with mantle lure display. Broad River host trials indicate that Moronids like striped bass and white bass are likely natural hosts for yellow lampmussel, though Centrarchids may also be viable hosts (Price et al. 2009).

Status in the Study Area

In 2007, 60 sites were surveyed for mussels on the Broad and Congaree rivers from Cayce on the Congaree to 5 river miles south of the North Carolina border on the Broad. Six sites were surveyed between Parr Dam and Columbia Dam, and seven sites were sampled in the Parr Reservoir. However, only nine individuals were collected from three sites located 2-3 river miles downstream of the confluence of the Broad and Saluda rivers (Price *et al*. 2009). Alderman (2006) documented similar numbers of yellow lampmussels from the upper Congaree River, with 3 live individuals documented at five sites between the Broad/Saluda confluence and the Cayce Boat Landing.

In 2012, 13 sites just downstream from the Parr Shoals Dam were surveyed on the northeast side of Hampton Island (Alderman and Alderman 2012). This survey reported two sites where yellow lampmussel was present (CPUE ranging from 0.5-0.57 mussels/surveyor-hour). This location represents the uppermost extent of yellow lampmussel's known range in the Broad River.

Determination of Effect

Alderman and Alderman (2012) reported that the mussel assemblage directly downstream of the Parr Shoals Dam represents the highest freshwater mussel diversity recorded in the Broad River Sub-basin in North and South Carolina upriver from the Columbia Hydrelectric Project. Further, the tailrace is the only location above the Columbia Hydroelectric Project where yellow lampmussel appears to have persisted. Although densities of yellow lampmussel were low, the overall abundance and diversity of mussels observed suggests that the tailrace may actually be serving as a sanctuary for freshwater mussels.

4.3.10 ROANOKE SLABSHELL

The Roanoke slabshell is found in large rivers, but can occasionally be found in small creeks. The Roanoke slabshell is able to tolerate large variations in flow levels and higher water temperatures, making it able to survive in some locations near dams and hydroelectric plants. It has experienced large die offs when the plants generate extremely low flows and cause levels of oxygen to drop (Price 2006).

The host fish for this species are still somewhat speculative, but it is thought that it parasitizes a diadromous fish host. Moreover, host studies conducted for Roanoke slabshell only showed successful transformation on blueback herring (most successful), gizzard shad, and white perch although a suite of taxa (ictalurids, cyprinids, centrarchids, catastomids, and anguillids) were considered (Price et al. 2009).

Status in the Study Area

In 2007, 60 sites were surveyed for mussels on the Broad and Congaree rivers from Cayce to 5 river miles south of the North Carolina border. Six sites were surveyed between Parr Shoals Dam and Columbia Dam seven in Parr Reservoir, and 13 sites below the Columbia Dam near the confluence of the Broad and Saluda rivers. Of these 60 sites, Roanoke slabshell was restricted to 194 live individuals from eight sites below the Columbia Dam (CPUE ranging from 1-62 mussels/surveyor-hour) and one individual from one site in Cherokee County, SC (Price et al. 2009).

In 2012, 13 sites just downstream from the Parr Shoals Dam were surveyed on the northeast side of Hampton Island (Alderman and Alderman 2012). This survey reported nine sites where Roanoke slabshell were present (CPUE ranging from 4-18 mussels/surveyor-hour), representing the healthiest, upper-most, extent of its presently known range in the Broad River (Alderman 2009).

Determination of Effect

As previously noted, Alderman and Alderman (2012) reported that the mussel assemblage found in the Parr tailrace represents the highest freshwater mussel diversity recorded in the Broad River Sub-basin in North and South Carolina upriver from the Columbia Hydrelectric Project. Further, the tailrace was the only location upstream of Columbia Hydroelectric Project dam where Roanoke slabshell has been documented (Alderman and Alderman 2012, Price 2010). Finally, juvenile Roanoke slabshell were documented by Alderman and Alderman (2012), suggesting that reproduction and recruitment are occurring in the tailrace area. These data suggest that the project is unlikely to be resulting in any negative effects to the Roanoke slabshell population in the tailrace, but rather may be serving as a refuge for this and other mussel species.

TABLE 4-4 DOCUMENTED OCCURRENCE OF SELECTED STATE CONSERVATION PRIORITY FISH SPECIES IN MONTICELLO RESERVOIR, PARR RESERVOIR AND THE DOWNSTREAM REACH OF THE BROAD RIVER (SOURCE: NORMANDEAU 2007, 2008, 2009; SCANA 2013; BETTINGER ET AL. 2003; KLEINSCHMIDT 2013A; ALDERMAN AND ALDERMAN 2012)

Common Name	Scientific Name	Parr	Monticello	Broad River
Robust redhorse	*Moxostoma robustum*	x	x	x
Piedmont darter	*Percina crassa*			x
Seagreen darter	*Etheostoma thalassinum*			x
Highfin carpsucker	*Carpiodes velifer*	x		
Quillback	*Carpiodes cyprinus*	x	x	x
Santee chub	*Hybopsis zanema*			x
Striped bass	*Morone saxatilis*			x
Yellow lampmussel	*Lampsilis cariosa*			x
Roanoke slabshell	*Elliptio roanokensis*			x

5.0 SUMMARY

Of the 13 state- and federally-listed and candidate species, habitat requirements and known occurrence data suggest that only the bald eagle likely occurs in the study area with any regularity. Wood storks may periodically utilize portions of the study area of seasonal foraging (primarily by post-dispersal migrants during the summer months); however, this usage is expected to be sporadic and ephemeral. Habitat for Georgia aster has been noted on the adjacent V.C. Summer Nuclear Station site and on nearby U.S. Forest Service lands, suggesting that habitat may also exist within the Project study area. Potential occurrences of Georgia aster would be limited to terrestrial sites, which would not be affected by continued operation of the Project. Finally, several fish species that are not state- or federally-listed, but are classified as priority conservation species have been documented from the study area. Habitat requirements for these species will be assessed as part of the proposed IFIM study. Information from this study will be considered in developing Protection, Mitigation, and Enhancement measures.

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APPENDIX A

RARE, THREATENED & ENDANGERED SPECIES STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

October 2013

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

RARE, THREATENED AND ENDANGERED SPECIES
STUDY PLAN

Prepared for:

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Cayce, South Carolina

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October 2013

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RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Fairfield Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as the licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGOs), and interested individuals. Collaboration and cooperation of stakeholders is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs), including members from among the interested stakeholders, with the objective of achieving consensus regarding the identification and proper treatment of these resource issues in the context of a new license.

In preparation for relicensing, SCE&G formed a Rare, Threatened and Endangered Species Technical Working Committee ("RT&E TWC" or "TWC"), which is comprised of interested stakeholders who are working with SCE&G to identify potential issues, make biological study recommendations, and provide technical and experience-based input related to rare, threatened and endangered (RT&E) species potentially residing in the Project area. SCE&G is planning to conduct a literature-based study to compile existing information on federally and state listed RT&E species in the immediate project area. SCE&G will use this information in developing their license application for Federal Energy Regulatory Commission (FERC).

2.0 STUDY OBJECTIVES

The objective of this study is to characterize the present status of RT&E species at the Parr Fairfield Hydroelectric Project by providing information regarding the availability of RT&E habitat and characterize the known status of RT&E species within the Project boundary and Project vicinity. The presence or absence of select species will be verified through targeted field studies, including the Rocky Shoals Spider Lily Study, the Spiny Crayfish Study, and the Monticello Mussel Study.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

This study will focus on all areas within the FERC Project boundary, including Parr and Monticello reservoirs, the immediate vicinity of the Project in Fairfield and Newberry counties, and the area downstream of Parr Shoals Dam extending to and including Frost Shoals in Richland County. RT&E species that are deemed as potentially occurring within the Project Area and from Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island, along with the known presences of available RT&E habitat, will be evaluated. As this study is a desktop exercise, no field reconnaissance will be implemented. The study is scheduled to commence in 2015.

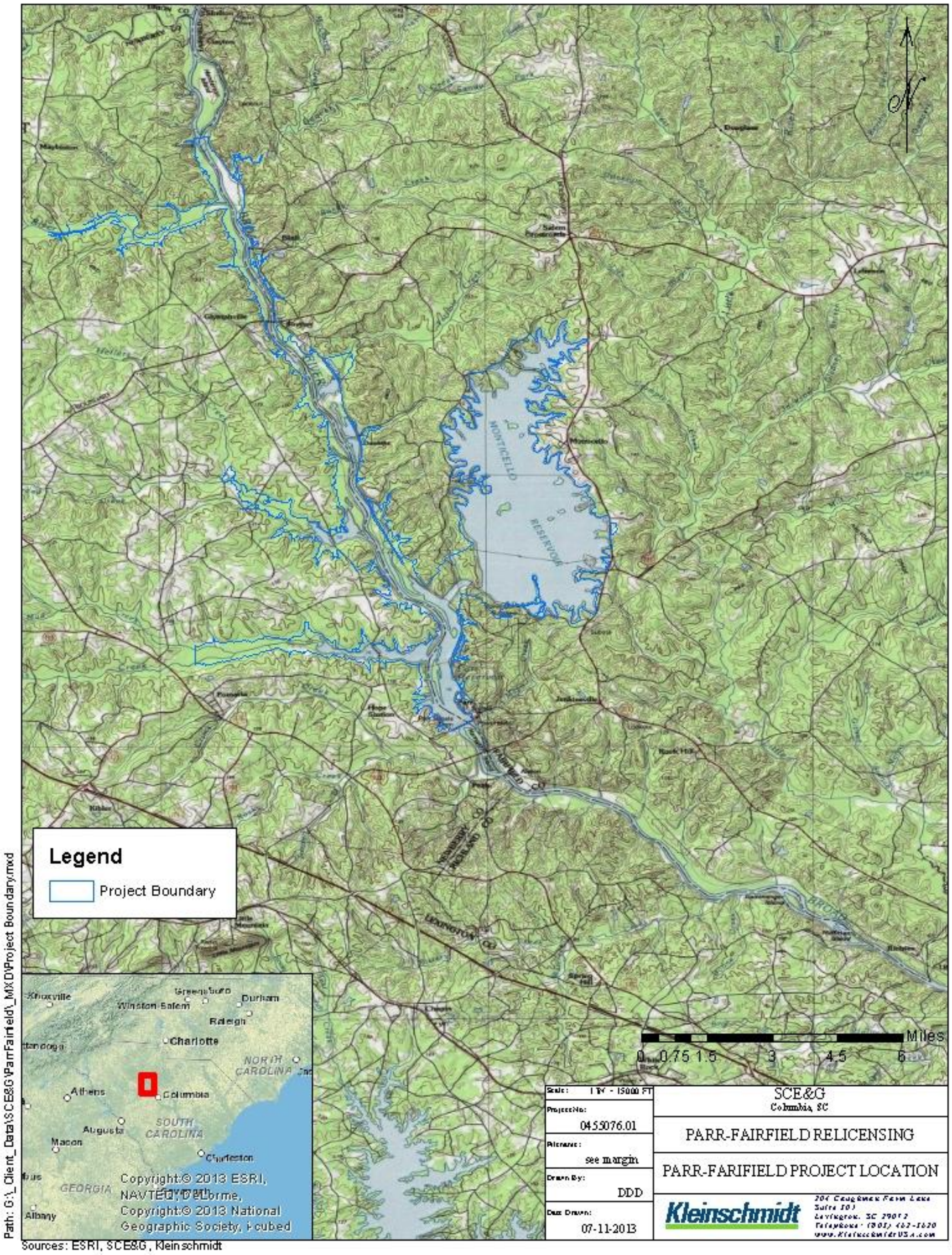

FIGURE 1 PARR-FAIRFIELD PROJECT LOCATION MAP

4.0 COLLECTION METHODS AND ANALYSIS

In order to appropriately characterize the present status of RT&E species in the Project vicinity, information will be collected from various sources, including the South Carolina Department of Natural Resources (SCDNR) and the U.S. Fish and Wildlife Service (USFWS) RT&E databases.

As an initial step, a list of RT&E species documented as occurring in the counties surrounding the Project and downstream (Newberry, Fairfield and Richland) will be compiled based on the USFWS and SCDNR county level listings. Additional key species may be added at the request of TWC members, if agreed to be appropriate. The federal, state and global status of each of these species will be summarized, along with counties of occurrence. As a second step, known ranges of these species, along with occurrence data from the SCDNR Natural Heritage Program and other survey data, will then be used to eliminate species occurring in the counties but not in the Broad River Basin. Habitat requirements of each of the remaining species will then be summarized and compared to available habitat within the Project boundary and the area downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island. This analysis will yield a list of species that potentially occur within the Broad River Basin, and that have suitable habitat within the Project Boundary and downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island.

5.0 SCHEDULE

Research and data collection efforts will begin no later than the spring of 2015. A final report summarizing the study findings including the compiled spreadsheets will be issued within 120 days of the completion of data collection. Study methodology and timing may be adjusted based on consultation with resource agencies and interested stakeholders.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, USFWS, RT&E TWC and other relicensing stakeholders.

APPENDIX B

USFWS COUNTY LEVEL LISTINGS FOR FAIRFIELD, NEWBERRY AND RICHLAND COUNTIES

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Fairfield County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P - CH	Proposed critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Fairfield	Amphibian		None Found	
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Crustacean	Little River (Broad River spiny) crayfish	*Cambarus spicatus*	ARS
	Fish	Blueback herring	*Alosa aestivalis*	ARS
	Insect		None Found	
	Mammal		None Found	
	Mollusk	Carolina heelsplitter	Lasmigona decorata	E
	Plant	Georgia aster	*Symphyotrichum georgianum*	C
	Reptile		None Found	

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Newberry County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P - CH	Proposed critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Newberry	Amphibian	None Found		
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Bird	Wood stork	*Mycteria americana*	E
	Crustacean	Newberry burrowing crayfish (Saluda)	*Distocambarus youngineri*	ARS
	Fish	None Found		
	Insect	None Found		
	Mammal	None Found		
	Mollusk	Savannah lilliput	*Toxolasma pullus*	ARS
	Mollusk	Yellow lance	*Elliptio lanceolata*	ARS
	Plant	None Found		
	Reptile	None Found		

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Richland County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P or P - CH	Proposed for listing or critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Richland	Amphibian	Chamberlain's dwarf salamander	*Eurycea chamberlaini*	ARS
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Bird	Red-cockaded woodpecker	*Picoides borealis*	E
	Crustacean	Little River (Broad River spiny) crayfish	*Cambarus spicatus*	ARS
	Fish	American eel	*Anguilla rostrata*	ARS
	Fish	Atlantic Sturgeon*	*Acipenser oxyrinchus**	E
	Fish	Blueback herring	*Alosa aestivalis*	ARS
	Fish	Robust redhorse	*Moxostoma robustum*	ARS
	Fish	Shortnose sturgeon*	*Acipenser brevirostrum**	E
	Insect	None Found		
	Mammal	None Found		
	Mollusk	Savannah lilliput	*Toxolasma pullus*	ARS
	Plant	Bog spicebush	*Lindera subcoriacea*	ARS
	Plant	Canby's dropwort	*Oxypolis canbyi*	E
	Plant	Carolina-birds-in-a-nest	*Macbridea caroliniana*	ARS
	Plant	Ciliate-leaf tickseed	*Coreopsis integrifolia*	ARS
	Plant	Georgia aster	*Symphyotrichum georgianum*	C
	Plant	Purple balduina	*Balduina atropurpurea*	ARS
	Plant	Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E
	Plant	Smooth coneflower	*Echinacea laevigata*	E
	Plant	Spathulate seedbox	*Ludwigia spathulata*	ARS
	Reptile	Southern hognose snake	*Heterdon simus*	ARS

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

APPENDIX C

STAKEHOLDER CONSULTATION

From:	Vivianne Vejdani
To:	Kelly Miller
Cc:	Bill Marshall; "Richard Christie"
Subject:	RE: draft RT&E Species Desktop Assessment
Date:	Wednesday, July 09, 2014 4:37:08 PM

Hi Kelly,

The plan looks good but I would offer perhaps one general suggestion...the phrase "does not occur within the study area/project area" be replaced by something like "is not likely to occur," in cases where on the ground surveys have not been conducted.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Monday, June 23, 2014 4:34 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes Jr.; Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject: draft RT&E Species Desktop Assessment

All,

Attached is the draft Rare, Threatened and Endangered Species Desktop Assessment. Please review and submit any comments or edits to me by Wednesday, July 9th. Please note that the appendices will be included with the final report.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Hamstead, Byron
To:	Kelly Miller
Cc:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject:	Re: draft RT&E Species Desktop Assessment
Date:	Wednesday, July 09, 2014 4:39:38 PM
Attachments:	20140709_Parr_RTE_TWC_proposal_to_include_two_mussels_for_consideration.docx

All,

The Service proposes that two additional species be included for consideration by the RT&E TWC, *Lampsilis cariosa* and *Elliptio roanokensis*. Attached is a document that aims to provide our basis for this proposal, and information relevant to the objectives of the desktop assessment. Please let me know if you have any questions regarding this information. Additionally, I can send along the 2007 mussel survey data (from Price *et al*. 2009) in GIS file format if you request it. The Service appreciates the opportunity to participate on this Committee.

Thanks,
Byron

Byron Hamstead
Fish and Wildlife Biologist
USFWS Charleston Field Office
176 Croghan Spur Rd., Suite 200
Charleston, SC, 29407

843-727-4707 ext. 205

On Mon, Jun 23, 2014 at 4:33 PM, Kelly Miller <Kelly.Miller@kleinschmidtgroup.com> wrote:

> All,
>
> Attached is the draft Rare, Threatened and Endangered Species Desktop Assessment. Please review and submit any comments or edits to me by Wednesday, July 9th. Please note that the appendices will be included with the final report.
>
> Thanks!
>
> Kelly

Kelly Miller

Regulatory Coordinator

Kleinschmidt

Office: 803.462.5633

www.KleinschmidtGroup.com

From:	Hamstead, Byron
To:	Kelly Miller
Cc:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject:	Re: draft RT&E Assessment in track changes
Date:	Sunday, August 24, 2014 1:36:04 PM
Attachments:	20140824_USFWS_Comments_Parr RTE Desktop Assessment.docx

Hi Kelly,

Please see comments from the USFWS on the RTE desktop assessment. Many thanks for your efforts to include the yellow lampmussel and Roanoke slabshell in your assessment. Please let me know if you have any questions regarding these comments. I will be away from the office for the next two weeks, but I am available via email or my cell: 919.946.0874.

Thanks,
Byron

Byron Hamstead
Fish and Wildlife Biologist
USFWS Charleston Field Office
176 Croghan Spur Rd., Suite 200
Charleston, SC, 29407

843-727-4707 ext. 205

On Wed, Aug 13, 2014 at 10:01 AM, Kelly Miller <Kelly.Miller@kleinschmidtgroup.com> wrote:

> Good morning!
>
> The draft Rare, Threatened and Endangered Species Desktop Assessment has been revised to address comments received by Byron Hamstead and Vivianne Vejdani. These revisions are included in track changes in the attached document. Please review the revised report and if everyone approves of the changes, I will attach the appendices and finalize the document.
>
> Thanks!

Kelly

Kelly Miller

Regulatory Coordinator

Kleinschmidt

Office: 803.462.5633

www.KleinschmidtGroup.com

From:	Shane Boring
To:	Hamstead, Byron
Cc:	Henry Mealing; BARGENTIERI@scana.com; Kelly Miller
Subject:	Final Parr/FF Rare, Threatened and Endangered Species Assessment
Date:	Wednesday, September 24, 2014 4:15:20 PM
Attachments:	20140924_Parr_RTE_Desktop_Assessment.docx USFWS_comment_responses_9-18-2014-_revised.doc

Byron,

Thanks for your comments on the revised RT&E report; they were very constructive. We have addressed the majority of your comments, which you will find in track changes in the attached final version of the report. There were a few comments that we did not agree with for inclusion in the final report, but we believe needed further clarification with you specifically. For those items, we prepared and attached a separate document with our rationale on these items. When we file the RTE report in the Final License Application, we will include your official comments and correspondence as part of the report.

Thanks again for your continued commitment to the relicensing process.

C. Shane Boring
Environmental Scientist
Kleinschmidt
Office: 803.462.5625
www.KleinschmidtGroup.com

AMERICAN EEL ABUNDANCE STUDY PLAN

AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT (FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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AMERICAN EEL (*ANGUILLA ROSTRATA*) ABUNDANCE STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. The developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. Collaboration and cooperation is essential for the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The Fisheries TWC has requested that American eel (*Anguilla rostrata*) studies be performed in 2015 to document the relative abundance of this species in the Broad River, directly downstream of the Parr Shoals Dam.

2.0 RELEVANT LIFE HISTORY INFORMATION

The American eel, *Anguilla rostrata,* is a catadromous species known to occur within river systems in South Carolina. Mature American eels spawn in the ocean and the egg and pre-larval stages mature into the leptocephalus stage, where they drift with ocean currents for approximately a year before metamorphosing into the glass eel stage. Glass eels migrate across the continental shelf, eventually entering estuaries and tidal rivers, where they mature into elvers.

Elvers migrate primarily at night and are able to overcome obstacles that often times prevent passage of other aquatic species. Vertical obstacles, such as a dam, can be traversed by small eels as long as the surface of the structure is textured and remains wet. As the small eels continue to mature into yellow eels, they may gradually move upstream over many years, with the greatest movement occurring during the moderate water temperatures of spring and fall (ASMFC 2000). Upstream migrations of small eels in the southeast appear to increase as water temperatures reach 15^{o}C and continue until water temperatures reach approximately 22 ^{o}C (USFWS 2014 and Haro 1991).

Although the American eel currently does not have special status under state or federal regulations, it has been identified by the South Carolina Department of Natural Resources (SCDNR) as a priority species (SCDNR 2005). The federal status of this species is currently under review by the U.S. Fish and Wildlife Service(USFWS) and has been reviewed by the USFWS and National Marine Fisheries Service (NMFS) several times over the past decade.

3.0 STUDY OBJECTIVE

The objective of this study is to document the relative abundance, size, and movement patterns of the American eel in the Broad River in the immediate area downstream of Parr Dam through the use of elver traps, elver fyke net, and electrofishing methods.

4.0 GEOGRAPHIC SCOPE

The study will focus on the Broad River immediately downstream of Parr Shoals Dam. Three to five elver traps of standard design will be positioned at two sites along the base of the dam located near the west bank and one site on the east bank of the Broad River, directly downstream of the powerhouse. Site selection was based on dam leakage, current flow, and safety for access and sampling. One elver trap will be placed in each area at the start of sampling and two additional traps (for a total of 5 traps) may be added to these areas during the sampling period based on the collection or observations of elvers (in the traps or during electrofishing) in those areas. An elver fyke net will be positioned in the west channel that drains a large portion of the leakage from the Parr Dam. Backpack electrofishing efforts will be performed in the pools and channel areas on the west side of the river and directly downstream of the dam with a focus on areas near each of the elver traps (Figure 1).

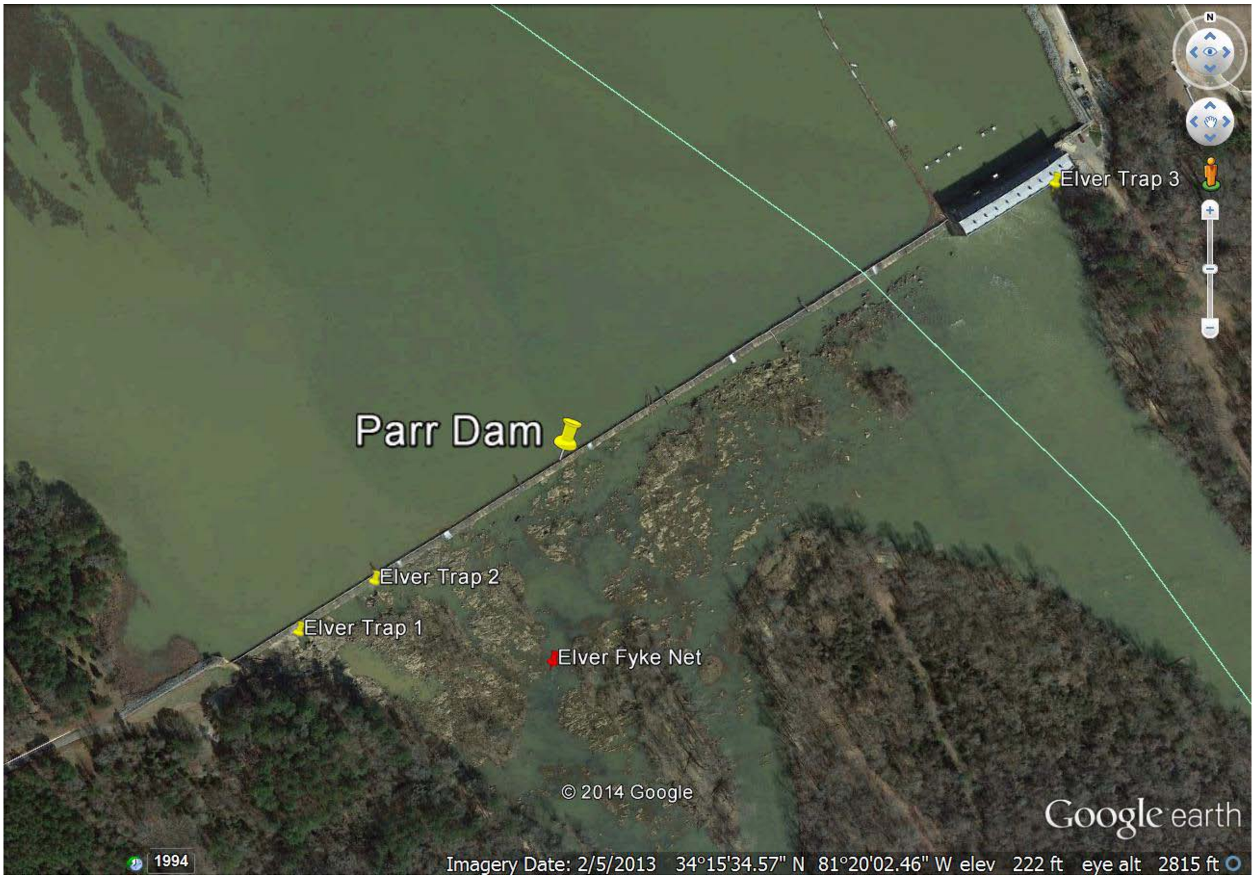

FIGURE 1. PARR PROJECT AMERICAN EEL – ELVER TRAP AND FYKE NET LOCATIONS

5.0 METHODOLOGY AND TEMPORAL SCOPE

Passive collection methods for elvers will consist of a metal ramp lined with landscape fabric climbing substrate (Enkamat or Akwadrain), an attraction flow, and a covered collection bucket with aeration or flow-through water supply. Ramp attraction flow will be provided by either gravity fed or pumped water supply (Figure 2). Elver traps in areas 2 and 3 will be fitted with double ramps that will sample in opposite directions to increase the chances of elvers using the ramp. The area 1 trap will only be fitted with a single ramp. An elver fyke net will also be used to collect eels moving upstream through the west channel area (Figure 3). We have identified an area of laminar flow, level bottom, and depths of approximately 2 to 3 feet that will be ideal for use of a fyke net. Spare equipment will be kept on hand in order to replace damaged or lost traps and nets to reduce “down time” and safely complete the study following subsidence of spill events.

American eel studies performed by the SCDNR on the Broad River, below the Columbia Diversion Dam, have indicated that the greatest frequency of catch occurs during April - June. However, a review of temperature data at the Parr Dam indicates water temperatures of 15^{o}C could occur as early as the beginning of March. Therefore elver ramp traps will be deployed at the end of February 2015 and will be monitored beginning on March 2, 2015 and ending on June 15, 2015. Monitoring will also be performed in the fall during October 5 to November 15, 2015 (Figure 4). Monitoring during the spring period will occur once a week until water temperature reaches 15^{o}C, then traps will be monitored three times a week (Monday, Wednesday, and Friday) until temperatures reach 22^{o}C, and then spring monitoring will be discontinued. The elver traps will be placed back in position on October 5th and monitoring of the traps will occur three times per week until November 15 or until the water temperature drops below 15^{o}C, and monitoring will be discontinued for the year. Trap entrances and attraction flows will be checked and repositioned as needed during each trap check event.

FIGURE 2. EXAMPLE OF A PORTABLE ELVER RAMP TRAP USED AT THE DOMINION PROJECT TAILRACE.

FIGURE 3. EXAMPLE OF AN ELVER FINE MESH FYKE NET PRODUCED BY FILMAR, INC.

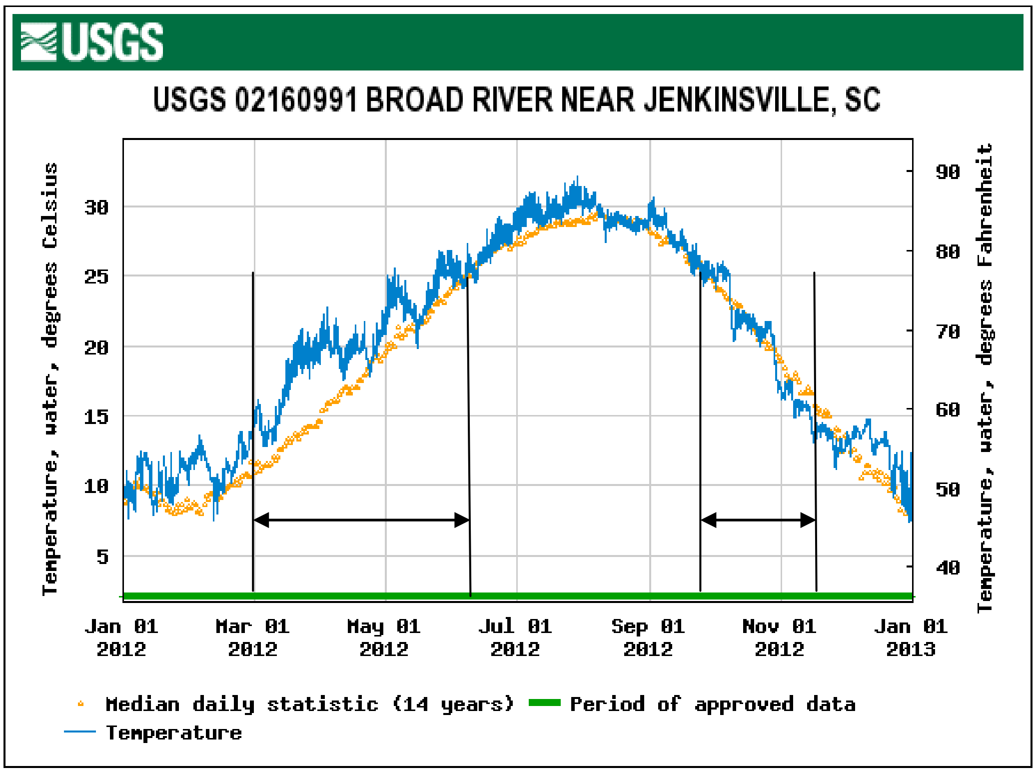

FIGURE 4. BROAD RIVER WATER TEMPERATURE AT PARR DAM – MEDIAN OVER 14 YEARS AND FOR 2012

Backpack electrofishing will be conducted once in late March, April, and May, 2015 and one sample in October during the fall period. Since American eels can be difficult to catch by electrofishing methods, one person will operate the backpack shocker and two additional people will assist in collecting eels during the effort. Backpack shocking will be conducted in the pools and runs located in the west channel side of the dam with a focus on areas close to the traps.

All eels collected will be measured, checked for visual implant elastomer (VIE) tags, recorded, and released to the Broad River upstream of Parr Dam. If the color of the VIE tag cannot be positively determined (especially pink or orange) the eels will be kept and preserved for dissection and color determination.

6.0 PRODUCTS

A final report summarizing the study findings will be issued within 120 days of completion of field work in 2015. Study methodology, timing and duration may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, Fisheries TWC, and other relicensing stakeholders.

8.0 REFERENCES

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MONTICELLO RESERVOIR AND PARR RESERVOIR
WATERFOWL SURVEY STUDY PLAN

MONTICELLO RESERVOIR AND PARR RESERVOIR WATERFOWL SURVEY
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
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January 2014

Monticello Reservoir and Parr Reservoir Waterfowl Survey
Study Plan

Parr Hydroelectric Project
(FERC No. 1894)

Prepared for:

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MONTICELLO RESERVOIR AND PARR RESERVOIR WATERFOWL SURVEY
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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Fairfield Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project.

In preparation for relicensing, SCE&G formed a Fish and Wildlife and Water Quality Resource Conservation Group (RCG) which is comprised of interested stakeholders who are working with SCE&G to identify potential issues, make biological study recommendations, and provide technical and experience-based input related to wildlife resources in the Project area. During issues scoping, the RCG identified the need for a waterfowl survey of Project waters to better understand waterfowl utilization of project waters. Further, this information will be useful in evaluating potential project effects or water level fluctuations on overwintering waterfowl utilizing Parr and Monticello reservoirs.

2.0 STUDY OBJECTIVE

The objective of this study will be to evaluate the abundance and distribution of wintering waterfowl (ducks, geese, swans, and coots) using Parr and Monticello reservoirs, South Carolina.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

This study will focus on all areas of Parr and Monticello reservoirs and will include nine (9) aerial surveys over a period of five (5) months to be executed as follows: 1 in late November, 2 in December, 2 in January, and 2 in February, and 2 in March. Should inclement weather or aircraft unavailability preclude completion of flights during the study period, flights may be added to the end of the survey period, at the discretion of the RCG.

FIGURE 1 AERIAL VIEW OF SURVEY AREAS

4.0 COLLECTION METHODS AND ANALYSIS

Aerial surveys will be conducted from fixed-wing aircraft by qualified waterfowl observers. Observers will identify the species and estimate numbers of all waterfowl (ducks, geese, swans, and coots) observed during aerial surveys. Sightings will be map-referenced at the time of occurrence with additional data collected during each aerial survey including date, beginning and ending times of the survey, local weather conditions (including temperature, wind speed, extent of wetland icing in winter, etc.), and disturbance-related activities taking place during the aerial survey. Actual duration of each aerial survey will be approximately 2.5 hours. Aerial surveys will be conducted at a safe airspeed given the prevailing weather conditions and from a height consistent with Federal Aviation Administration (FAA) regulations. Both reservoirs, in their entirety, will be surveyed for waterfowl use. Specifically with respect to Parr Reservoir, aerial surveys will be conducted from Parr Shoals Dam to the base of Henderson Island and will include a portion of the Enoree River and Broad River Waterfowl areas.

Data will be summarized in both graphical and tabular format. Summaries will include location graphics of waterfowl numbers, as well as tabular summaries and descriptions of temporal changes in waterfowl distributions (species- and/or subfamily-specific). If available and deemed applicable by the RCG, South Carolina Department of Natural Resources hunting use data from the Enoree and Broad River Waterfowl areas, as well as use data from the Recreation Use and Needs Study, may be incorporated into study reporting. Finally, any waterfowl survey data collected by SCDNR for the study area may also be incorporated in the study reporting if deemed applicable in consultation with the RCG.

Notification – the security organization at the Virgil C. Summer Nuclear Station will be notified prior to each aerial survey of Monticello Reservoir (at least a 24 hour notice is preferred).

5.0 SCHEDULE

Waterfowl surveys will be conducted during the winter months (generally late November through mid March) of 2015-2016, 2016-2017, thus spanning two complete overwintering seasons. As previously noted, nine (9) aerial surveys will likely be conducted over a period of five (5) months to be executed as follows: 1 in late November, 2 in December, 2 in January, 2 in February, and 2 in March. Should inclement weather or aircraft unavailability preclude the completion of flights during the study period, flights may be added to the end of the survey period, at the discretion of the RCG.

A brief e-mail, summarizing survey observations, will be distributed to the RCG following each survey. In addition, an annual report summarizing the field season will be issued no later than April 1 following each study season. A more detailed report summarizing all aspects of the study to date will be prepared following the second season (2016-2017) for inclusion in SCE&G's Application for New License (Application). The Application is slated for submission to the FERC in 2018.

Study methodology, timing, and duration may be adjusted based on consultation with the resource agencies and other interested stakeholders. All data collected will be provided in electronic format to agencies and other interested stakeholders.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, and other relicensing stakeholders within the RCG.

RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

RARE, THREATENED AND ENDANGERED SPECIES DESKTOP ASSESSMENT

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

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October 2014

Parr Hydroelectric Project

FERC No. 1894

Rare, Threatened and Endangered Species Desktop Assessment

Prepared for:

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October 2014

PARR HYDROELECTRIC PROJECT
FERC NO. 1894

RARE, THREATENED AND ENDANGERED SPECIES DESKTOP ASSESSMENT
SOUTH CAROLINA ELECTRIC & GAS COMPANY

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FERC NO. 1894

RARE, THREATENED AND ENDANGERED SPECIES DESKTOP ASSESSMENT
SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr Hydroelectric Project (Project) (FERC No. 1894) is located along the Broad River in Newberry and Fairfield counties, South Carolina and is owned and operated by South Carolina Electric & Gas Company (SCE&G). The Project consists of two developments, including the Parr Shoals Development and the Fairfield Pumped Storage Development. The project location is depicted in Figure 2-1.

In preparation for relicensing, SCE&G consulted with local, state and Federal agencies and other interested stakeholders to identify potential impacts of project operations on natural resources. A Rare, Threatened and Endangered Species Technical Working Committee ("RT&E TWC" or "TWC") was formed and is comprised of representatives from the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), South Carolina Department of Natural Resources (SCDNR), South Carolina Department of Health and Environmental Control (SCDHEC), non-governmental organizations (NGOs), SCANA/SCE&G and other interested individuals. In addition to several field surveys for selected species, the TWC agreed upon a literature-based assessment to summarize the status of federally and state listed rare, threatened and endangered species (RT&E) occurring in the Parr Hydroelectric Project vicinity. As outlined in the RT&E Species Study Plan (Appendix A), the objective of this assessment was to identify those species potentially occurring in the Project vicinity, which includes habitats within the Project Boundary and in the downstream reach of the Broad River that is influenced by the Project (Richland County), based on review of occurrence data and habitat requirements. It should be noted that site-specific surveys are being conducted for several species of conservation concern (Table 1-1), and as such, these species are not included in this assessment.

TABLE 1-1 SPECIES OF CONSERVATION CONCERN ADDRESSED BY SITE-SPECIFIC STUDIES

Common Name	Scientific Name	Federal Status[1]	State Status	CWCS[2] Priority Level	Study Plan
Rocky Shoals Spider Lily	*Hymenocallis coronaria*		rare	n/a	Rocky Shoals Spider Lily Study Plan
American Eel	*Anguilla rostrata*	ARS		Highest	American Eel Study Plan
Little River (Broad River spiny) Crayfish	*Cambarus spicatus*	ARS		High	Broad River Spiny Crayfish Study Plan

[1] ARS – At-Risk-Species, Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

[2] Refers to conservation priority level as listed in SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006).

2.0 CONSULTATION HISTORY

During initial consultation, the USFWS provided county-level listings of RT&E species occurring in the two county regions surrounding the Project (Fairfield and Newberry counties; Appendix B). At the May 16, 2013 RT&E TWC meeting, the TWC discussed several species that should be addressed during relicensing (meeting notes are in Appendix C). SCDNR requested that the TWC add eight species to this analysis that are not state or federally-listed, but are considered state conservation priority species (Table 4-3). Based on a review of the initial draft of this report, two additional mussel species that are not state or federally listed but are state conservation priority species (yellow lampmussel and Roanoke slabshell) were also added to this analysis (Table 4-3). The TWC agreed that SCE&G would conduct a literature-based review to determine habitat requirements for each of these species and compare those requirements with typical habitat types known to occur in the study area for this report.

The RT&E TWC met again on October 22, 2013 to discuss the Rare, Threatened and Endangered Species Desktop Assessment Study Plan (study plan in Appendix A; meeting notes in Appendix C). At this meeting, the TWC agreed to extend the study area to include areas of the Broad River downstream of the Project Boundary. More specifically, it was agreed that the study area would include habitats within the Project Boundary (Project Area) (Figure 2-1), as well as the reach of the Broad River from Parr Shoals Dam through Frost Shoals, near Boatwrights Island (Figure 2-2). This area encompasses three counties in South Carolina: Newberry, Fairfield and Richland counties.

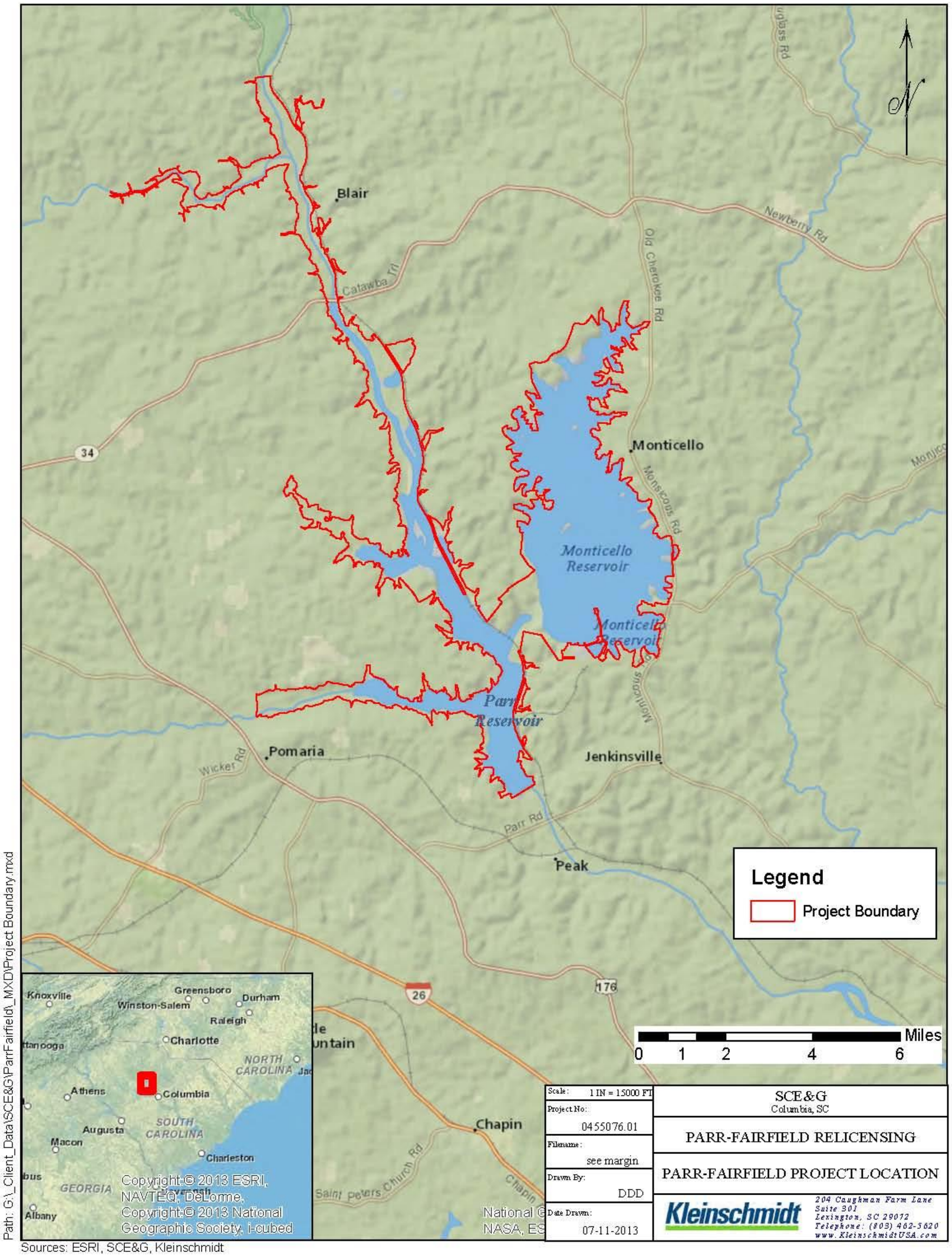
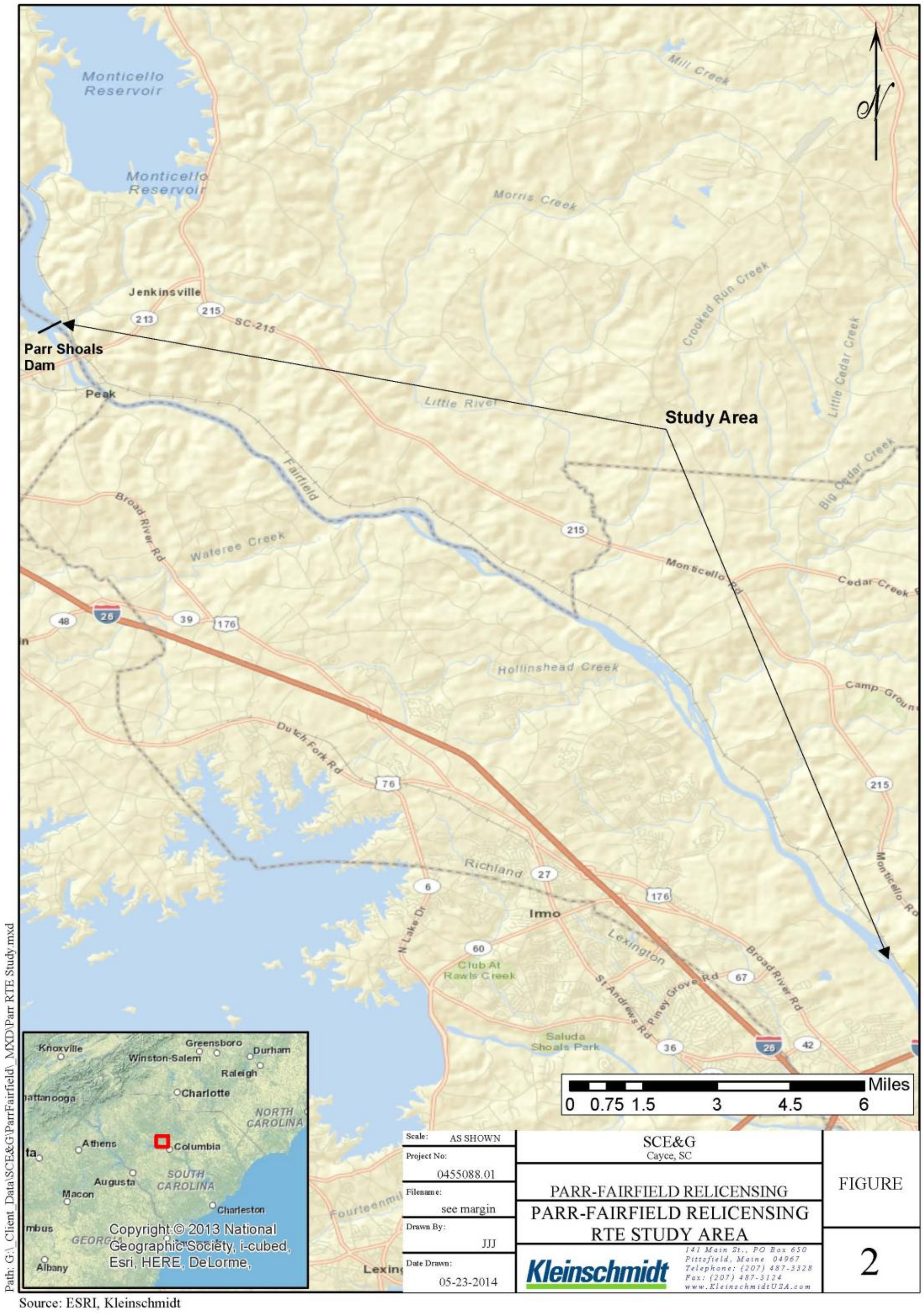


FIGURE 2-1 PARR HYDROELECTRIC PROJECT LOCATION MAP



Source: ESRI, Kleinschmidt

FIGURE 2-2 DOWNSTREAM RT&E STUDY AREA

3.0 METHODOLOGY

As an initial step, the USFWS county-level listings for Newberry, Fairfield and Richland counties were reviewed to identify species potentially occurring in the study area that are federally listed as threatened or endangered under the US Endangered Species Act of 1972 (ESA), or are candidates for such listing. Similarly, SCDNR county-level listings for the three counties were also reviewed to identify species that are state listed under the South Carolina Nongame and Endangered Species Conservation Act of 1974. Bald eagle, which was removed from the federal endangered species list in 2007, was included in the assessment because of its continued protection under the Bald and Golden Eagle Protection Act of 1938. As previously noted, ten species that are considered priority species in the SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006), and are documented as occurring in the three counties of interest, were also added to the analysis (Table 4-3). Known ranges, life history and habitat requirements for each of these species were then summarized and compared to conditions occurring in the study area to determine the potential for occurrence and to identify potential project effects.

4.0 SPECIES DESCRIPTIONS AND ANALYSIS

4.1 FEDERALLY LISTED SPECIES

Ten species that are federally listed as threatened or endangered, or are candidates for such listing, are included on the USFWS county-level listings for the three counties of interest (Table 4-1). None of the federally listed species on Table 4-1 have critical habitat designated in the study area. Life history information and habitat requirements for these species, as well as their status within the study area and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-1 FEDERALLY LISTED AND CANDIDATE SPECIES OCCURRING IN RICHLAND, FAIRFIELD, AND NEWBERRY COUNTIES, SOUTH CAROLINA (SOURCE: USFWS 2013A)

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS[1]	STATE STATUS[2]	COUNTIES
Birds				
Bald eagle	*Haliaeetus leucocephalus*	P	T	Newberry, Fairfield, Richland
Red-cockaded woodpecker	*Picoides borealis*	E	E	Richland
Wood stork	*Mycteria americana*	E	E	Newberry, Richland
Fish				
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	E	Richland
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	Richland
Invertebrates				
Carolina heelsplitter	*Lasmigona decorata*	E		Newberry, Fairfield, Richland
Plants				
Canby's dropwort	*Oxypolis canbyi*	E		Richland
Georgia aster	*Symphyotrichum georgianus*	C		Fairfield, Richland
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E		Richland
Smooth coneflower	*Echinacea laevigata*	E		Richland

[1] Federal Status – E (listed as Endangered under ESA); T (listed as Threatened under ESA); C (Candidate for Federal listing); SC (Federal Species of Concern); P (Federally protected).

[2] State Status – E (state listed as endangered); T (state listed as threatened)

4.1.1 BALD EAGLE

The bald eagle was removed from the federal list of threatened species in 2007 (USFWS 2007a) but remains protected as a state endangered species under the South Carolina Nongame and Endangered Species Conservation Act, and federally under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (16 U.S.C.668-668d) (72 FR 37345-37372). Bald eagles are found throughout North America, typically around water bodies, where they feed primarily on fish and carrion. Studies suggest that reservoirs, especially those associated with hydroelectric facilities, are particularly attractive to foraging bald eagles (Brown 1996). Eagles nest in large trees near water and typically repair and use the same nest for several years, (Degraaf and Rudis 1986). In South Carolina, the distribution of eagle nesting has expanded from the coast to encompass more inland areas. This expansion has been attributed to the construction of approximately 491,000 acres of large reservoirs in the state since the early 1900s (Wilde et al. 2003). In South Carolina, the number of estimated nesting pairs has increased from 13 in 1977 to 181 in 2003 (Wilde et al. 2003).

Status in the Study Area

Bald eagles are commonly observed in the study area (SCE&G 2010), with Monticello and Parr reservoirs, as well as the lower Broad River, providing abundant foraging habitat. In addition, nine bald eagle nests are known to occur in the study area and the surrounding vicinity (SCE&G unpublished data) (Figure 4-1).

FIGURE 4-1 EAGLE NEST LOCATIONS IN THE VICINITY OF THE PARR PROJECT

Determination of Effect

Continued operation of the Project is not likely to result in negative effects on eagle foraging or nesting. SCE&G tracks bald eagle nesting in the Project Area and utilizes this information to minimize potential impacts of various shoreline management activities on eagle nests. Specifically, SCE&G refrains from issuing shoreline permits for activities within 660 ft of an active nest during the nesting season (September through May) and 330 ft during the non-nesting season. This policy is in adherence to the USFWS habitat guidelines for nesting bald eagles (USFWS 2007b). SCE&G also frequently consults with USFWS Ecological Services staff regarding proposed activities in the vicinity of known nests.

4.1.2 RED-COCKADED WOODPECKER

The red-cockaded woodpecker (RCW) is endemic to open, mature, and old growth pine ecosystems in the southeastern United States (USFWS 2003). Over 97% of the pre-colonial era RCW population has been eradicated, leaving only roughly 14,000 RCWs living in about 5,600 colonies scattered across eleven states, including South Carolina. RCW decline is generally attributed to a loss of suitable nesting and foraging habitats, including longleaf pine systems, due to logging, agriculture, fire suppression, and other factors (USFWS 2003). Suitable nesting habitat generally consists of open pine forests and savannahs with large, older pines and minimal hardwood midstory or overstory. Living trees, especially older trees that are susceptible to red-heart disease making them more easily excavated, provide the RCWs preferred nesting cavities. Suitable foraging habitat consists of open-canopy, mature pine forests with low densities of small pines, little midstory vegetation, limited hardwood overstory, and abundant bunchgrass and forb groundcover (USFWS 2003).

Status in the Study Area

There are no known reports of RCWs in areas surrounding the Project or along the lower Broad River. Further, there is no known longleaf pine savanna habitat in the study area.

Determination of Effect

Based on the lack of suitable habitat, it is very unlikely that this species occurs in the study area and thus would not be affected by continued operation of the Project.

4.1.3 WOOD STORK

The wood stork is a large, colonial wading bird and is the only stork species that breeds in the United States (USFWS 1996). It was federally listed as endangered in 1984, primarily due to loss of wetland habitat throughout its range, but recently its status has been proposed for downlisting from endangered to threatened due to significant population recovery (USFWS 2012b). It uses a variety of wetlands for nesting, feeding, and roosting. Nesting colonies (rookeries) in South Carolina are typically surrounded by extensive palustrine forested wetlands. Nests are usually located in the upper branches of large black gum or cypress trees, and several nests are typically located in each tree. Like most wading birds, storks feed primarily on small fish. Shallow, open water is required for successful foraging, and depressions where fish become concentrated during periods of falling water levels are particularly attractive sites. Currently, nesting of the species in the United States is thought to be limited to the coastal plain of South Carolina, North Carolina, Georgia, and Florida (Murphy and Hand 2013), which is consistent with recent survey work that found no nesting on the adjacent Saluda Hydroelectric Project (Kleinschmidt 2005).

Status in the Study Area

Periodic foraging of wood storks has been documented in the adjacent Saluda River Basin (Kleinschmidt 2005). Shallow backwaters in the study area, particularly in the upper reaches of the Parr Reservoir, may provide foraging habitat for transient wood storks. Although habitat is present, wood stork use of these areas has not been documented.

Determination of Effect

Project operations are expected to result in no effects on wood storks or their habitat. In fact, fluctuating water levels in Parr Reservoir could enhance foraging habitat by periodically trapping fish in shallow pool areas.

4.1.4 ATLANTIC STURGEON

The Atlantic sturgeon is a large (up to 5.5m in length), long-lived (up to 60 years) anadromous species that was historically present in the Santee Basin at least as far inland as the fall line (Newcomb and Fuller 2001). The Carolina Distinct Population Segment of Atlantic sturgeon, which includes the Santee Basin population, is federally listed as endangered (77 FR 5914), primarily due to overharvesting for flesh and eggs (caviar) during the early to mid-20th Century, as well as habitat degradation and blockage of access to historical spawning grounds (NMFS1998a).

The Atlantic sturgeon is considered estuarine anadromous, spending most of it life in estuarine and ocean environments and undertaking spawning migrations into riverine systems during late-winter and spring months (NMFS 1998a; Marcy et al. 2005). Spawning typically occurs over hard bottoms of clay, rubble, or gravel, with flowing water and temperatures of 14 - 24°C. After spawning, females typically return to estuarine environments within 4 to 6 weeks, while males may remain in the river through the fall. Juveniles of this species remain in the natal rivers for 3 to 5 years before migrating to the ocean (Marcy et al. 2005).

Status in the Study Area

Atlantic sturgeon were historically present at least as far inland as the fall line (Newcomb and Fuller 2001). Current upstream distribution in the Santee Basin is thought to be limited by the lack of passage for Atlantic sturgeon at the Santee Cooper Dams[1]. This information indicates that this species does not occur in the Project study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.5 SHORTNOSE STURGEON

The shortnose sturgeon is federally listed as endangered and is thought to have occurred historically in the reach of the Broad River encompassed by the Project (Welch 2000, Newcomb and Fuller 2001). Shortnose sturgeon are amphidromous (semi-anadromous) spending portions of their life cycle in low salinity estuaries and portions in freshwater rivers (NMFS 1998b; Kynard 1997; Buckley and Kynard 1985). Shortnose sturgeon begin migrating to spawning areas of inland riverine reaches in the spring (typically mid-February through March in South Carolina) when water temperatures rise above 9 °C (Kynard 1997, Hall et al. 1991). Shortnose sturgeon spawning has been documented in the Congaree River near the City of Columbia over

[1] Bill Post (SCDNR), personal communication, April 24, 2014.

substrates of sand, gravel and rock, at temperatures ranging from 9.7-15.6°C, and dissolved oxygen concentrations of 10.6-12.5 mg/L (Collins et al. 2003).

Status in the Study Area

Population groups of shortnose sturgeon are known from downstream of the Santee-Cooper dams in the lower Santee and Cooper rivers (Collins et al. 2003). An additional dam-locked spawning population of shortnose sturgeon has been documented in the Santee-Cooper lakes (with Lake Marion and its tributaries harboring the most significant number of fish) and upstream in the Congaree River. Radio-telemetry studies have documented migration of shortnose sturgeon as far upstream on the Congaree as the Blossom Street Bridge adjacent to the City of Columbia (Finney et al. 2006). However, consultation with SCDNR Diadromous Fish Program staff suggests that this occurrence was based on a small number of observations (2 fish) and that their radiotelemetry data suggest that shortnose sturgeon activity is primarily limited to areas downstream of Granby Lock and Dam[2]. Granby Lock and Dam is located approximately one mile downstream of the Blossom Street Bridge and approximately 5 miles downstream of the Columbia Hydroelectric Project Fishway (fishway). The fishway was designed to provide passage of blueback herring and American shad to historic spawning grounds in the Broad River downstream of Parr Shoals Dam and was intended to be “sturgeon friendly”. Shortnose sturgeon have not been documented upstream of the Blossom Street Bridge in recent history, nor have any been documented passing into the study area through the fishway since annual monitoring began in 2007.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.6 CAROLINA HEELSPLITTER

The Carolina heelsplitter is the only South Carolina freshwater mussel currently listed as federally endangered (Price 2006). Although it was once found in large rivers and streams, the Carolina heelsplitter is now restricted to cool, clean, shallow, heavily shaded streams of moderate gradient. Stable streambanks and channels, with pool, riffle and run sequences, little or

[2] Bill Post (SCDNR), personal communication, April 24, 2014.

no fine sediment, and periodic natural flooding, appear to be required for the Carolina heelsplitter.

Status in the Study Area

Carolina heelsplitter is known to occur in isolated populations distributed in the Savannah, Pee Dee, and Catawba drainages and is not known to occur in the Broad River Basin (Price 2006) or within the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.7 CANBY'S DROPWORT

Canby's dropwort is a perennial plant that grows in coastal plain habitats including wet meadows, wet pineland savannas, ditches, sloughs, and around the edges of cypress-pine ponds (USFWS 2010). The healthiest populations seem to occur in open bays or ponds, which are wet most of the year and have little or no canopy cover. Ideal soils for Canby's dropwort have a medium to high organic content and a high water table. They are also acidic, deep, and poorly drained.

Status in the Study Area

Canby's dropwort is a coastal plain species and thus would not be expected to occur in the portion of Richland County occupied by the study area. This assumption is consistent with result of surveys by Nelson (2006, 2007), which failed to document the species on the adjacent V.C. Summer Nuclear Station site.

Determination of Effect

Because Canby's dropwort is not expected to occur in the study area, continued operation of the Project would likely result in no effect on the species.

4.1.8 GEORGIA ASTER

Georgia aster is classified as a candidate for federal listing as threatened or endangered by the USFWS (2013b). Habitat for this species consists of dry, rocky woodlands, woodland borders, roadbanks, and powerline rights-of-way (Weakley 2012). It is thought to be a relict species of the post oak-savanna communities that existed in the southeast prior to fire suppression.

Status in the Study Area

Although no site-specific occurrence data are available for the study area, Nelson (2006, 2007) found no Georgia aster on the adjacent V.C. Summer Nuclear Station but concluded that suitable habitat exists on the site. Georgia aster is also known from several locations on the nearby Sumter National Forest (USDA 2010).

Determination of Effect

Habitat for Georgia aster may exist within the Project study area; however, potential occurrences would be limited to terrestrial sites, which should not be affected by continued operation of the Project.

4.1.9 ROUGH-LEAF LOOSESTRIFE

Rough-leaved loosestrife generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands, and on shallow organic soils overlaying sand (NatureServe 2013). Rough-leaf loosestrife has also been found on deep peat in the low shrub community of large Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin). The grass-shrub ecotone, where rough-leaf loosestrife is found, is fire-maintained, as are the adjacent plant communities (longleaf pine-scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally occurring fire in these ecotones, results in shrubs increasing in density and height and expanding to eliminate the open edges required by this plant.

Status in the Study Area

The pine pocosin and Carolina bay environments required by this species do not occur in the Piedmont; therefore, rough-leaved loosestrife is extremely unlikely to occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.1.10 SMOOTH CONEFLOWER

Smooth coneflower is typically found in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium and calcium rich soils associated with amphibolite, dolomite or limestone (in Virginia), gabbro (in North Carolina and Virginia), diabase (in North Carolina and South Carolina), and marble (in South Carolina and Georgia) (USFWS 2012a). Smooth coneflower occurs in plant communities that have been described as xeric hardpan forests, diabase glades, or dolomite woodlands. Optimal sites are

characterized by abundant sunlight and little competition in the herbaceous layer. Natural fires, as well as large herbivores, historically influenced the vegetation in this species' range. Many of the herbs associated with smooth coneflower are also sun-loving species that depend on periodic disturbances to reduce the shade and competition of woody plants.

Status in the Study Area

The diabase glade habitat required by this species is not known to occur in areas around Monticello and Parr reservoirs or along the lower Broad River. Although no site-specific surveys have been performed, surveys by Nelson (2006, 2007) failed to document smooth coneflower on the adjacent V. C. Summer Nuclear Station project area and concluded that appropriate habitat for the species does not occur on the site.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.2 STATE LISTED SPECIES

Three species that are state-listed as threatened or endangered are included on the SCDNR county-level listings for the three counties of interest (Table 4-2). Life history information and habitat requirements for these species, as well as their status within the study area and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-2 STATE-LISTED SPECIES OCCURRING IN RICHLAND, FAIRFIELD, AND NEWBERRY COUNTIES, SOUTH CAROLINA

COMMON NAME	*SCIENTIFIC NAME*	FEDERAL STATUS[1]	STATE STATUS[2]	COUNTIES
Amphibians				
Pine Barrens tree frog	*Hyla andersonii*		T	Richland
Mammals				
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*		E	Richland
Fish				
Carolina darter	*Etheostoma collis*	SC	T	Fairfield, Richland

[1] Federal Status – E (listed as Endangered under ESA); T (listed as Threatened under ESA); C (Candidate for Federal listing); SC (Federal Species of Concern); P (Federally protected).

[2] State Status – E (state listed as endangered); T (state listed as threatened)

4.2.1 PINE BARRENS TREE FROG

The pine barrens tree frog inhabits the swamps, bogs, and acidic brownwater streams of the New Jersey Pine Barrens, as well as the pocosins (shrub bogs) of the Carolinas (Conant and Collins 1991). This species is intolerant of closed-canopy conditions and is restricted to localized wetlands such as hillside seepage bogs within dry uplands, pine barrens, and headwater swamps and disperses along drainages within these areas (NatureServe 2013). Non-breeding habitat generally is in pine-oak areas adjacent to breeding habitat. Important egg-laying and larval habitats include open cedar swamps and sphagnaceous, shrubby, acidic, seepage bogs on hillsides below pine-oak ridges.

For southeastern populations, typical habitats are characterized by the topography, soils, and vegetation of the Carolina Sandhills, with pocosin or evergreen shrub swamps established along seeps and small streams within the surrounding longleaf pine-oak forest. Breeding habitat in

South Carolina has been described as low vegetation with dense growth of Sphagnum mosses. Cely and Sorrow (1983) found that occurrences in South Carolina appeared to be restricted to the Fall Line Sandhills at elevations ranging between 61 and 122 m.

Status in Study Area

The area surrounding the Project lacks the Carolina sandhills habitat and associated bogs and pocosins required by this species; therefore it is extremely unlikely that Pine Barren tree frog would occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.2.2 RAFINESQUE'S BIG-EARED BAT

Rafinesque's big-eared bat is a colonial bat species native to the southeastern U.S. Two subspecies are recognized in South Carolina, *Corynorhinus rafinesquii rafinesquii* in the mountains and *Corynorhinus rafinesquii macrotis* along the Coastal Plain (Bunch et al. 2006). Rafinesque's big-eared bat is nocturnal, feeding primarily on moths by echolocation. Coastal plain and sandhills populations of the species utilize I-beam and T-beam bridges for roosting. Roosting in mountainous regions of the state occurs in large hollow trees (typically large tulip poplars), abandoned buildings and mines, rock shelters, and caves. Habitat in the Blue Ridge Mountains includes rock outcrops, mesic and cove hardwood forests, forested bottomlands, bottomland agricultural fields, dry deciduous forests, pine woodlands, and forested riparian areas. Coastal zone and sandhills habitats include black gum stands, bald cypress swap forests, maritime forests, and mature hardwood and mixed forests (Bunch et al. 2006).

Status in the Study Area

The range of Rafinesque's big-eared bat in South Carolina includes the coastal plain and sandhills regions and the extreme northwestern Blue Ridge, with the piedmont representing a gap in the species' distribution (Bunch et al. 2006). As such, it is extremely unlikely that this species would occur in the study area.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area and because it is a terrestrial species.

4.2.3 CAROLINA DARTER

The Carolina darter exists only in the Piedmont region from south-central Virginia through North Carolina into north-central South Carolina (Hayes and Bettinger 2006); it is state-listed as threatened and a federal species of concern. It occurs in small to moderately sized streams in areas of low current velocity, typically in backwaters among submerged tree roots or under leaves, where it feeds primarily on Chironomid larvae and micro-crustaceans. Preferred substrates are usually characterized by mud, sand, and sometimes bedrock (Rohde et al. 2009).

Status in the Study Area

The Carolina darter has been collected at several locations in the lower Broad River, including one that appears to be a tributary to Parr Reservoir (Rohde et al. 2009). However, extensive sampling by SCE&G and SCDNR in both Parr and Monticello reservoirs and in the downstream reach have failed to document this species (Kleinschmidt 2013a), suggesting that it may not occur in the study area or occurs in extremely low numbers not detected by previous sampling.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.3 SELECTED SOUTH CAROLINA CONSERVATION PRIORITY SPECIES

As previously noted, ten species that are considered state conservation priority species were also added to the analysis based on consultation with SCDNR and USFWS staff (Table 4-3). Life history information and habitat requirements for these species, as well as their status within the Project Vicinity and potential to be affected by continued operation of the Project, are summarized below.

TABLE 4-3 SELECTED STATE CONSERVATION PRIORITY SPECIES

Common Name	Scientific Name	State Priority Level[1]	Federal Status[2]
Newberry burrowing crayfish	*Distocambarus youngineri*	Highest	ARS
Robust redhorse	*Moxostoma robustum*	Highest	ARS
Piedmont darter	*Percina crassa*	High	
Seagreen darter	*Etheostoma thalassinum*	High	
Highfin carpsucker	*Carpiodes velifer*	Highest	
Quillback	*Carpiodes cyprinus*	High	
Santee chub	*Hybopsis zanema*	High	
Striped bass	*Morone saxatilis*	Moderate	
Yellow lampmussel	*Lampsilis cariosa*	Highest	
Roakoke slabshell	*Elliptio roanokensis*	High	

[1] Refers to conservation priority level as listed in SCDNR's Comprehensive Wildlife Conservation Strategy (SCDNR 2006).

[2] ARS – At-Risk-Species. Refers to species that the USFWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted), yet no Federal protections currently exist.

4.3.1 NEWBERRY BURROWING CRAYFISH

The Newberry burrowing crayfish is a terrestrial crayfish of the genus *Distocambarus* and is endemic to South Carolina (Eversole and Welch 2006). Although knowledge of its habitat requirements is limited, Newberry burrowing crayfish has typically been found in poorly drained areas where the ground is saturated during the rainy season (November – March) (Eversole and Welch 2006; Hobbs and Carlson 1985). The species has been documented from a range of site types including low, moist woodlands, a machine-maintained powerline, and a manicured lawn. Sites are generally isolated from floodplains and streams, although some have been found in low moist areas near the headwaters of streams (colluvial valleys). Analyses performed by Welch and Eversole (2002) found a close association between occurrence of Newberry burrowing crayfish and the presence of a perched water-table, as well as presence of Chewacla, Worsham, Toccoa-Cartecay, Enon, and Sedgefield soil types (Eversole and Welch 2006).

Status in the Study Area

Currently, the Newberry burrowing crayfish is known from only 14 sites, all of which are located in Newberry County (Eversole and Welch 2006). The known range of the species encompasses portions of the Tyger, Enoree, Lower Broad, and Saluda River basins. Because this species is generally isolated from floodplains and streams, it is not expected to occur in the Project Area or in the downstream reach of the Broad River influenced by the Project.

Determination of Effect

Continued operation of the Project is expected to result in no effect on this species due to a likely lack of occurrence in the study area.

4.3.2 ROBUST REDHORSE

The robust redhorse is a large, heavy-bodied sucker which was presumed extinct until being "rediscovered" during the initial stages of relicensing at Georgia Power's Sinclair Hydroelectric Project (FERC No. 1951). Fisheries scientists knew little about its life history and habitat requirements. As a result, Georgia Power Company, along with state and federal resource agencies, other hydropower interests, and the Georgia Wildlife Federation, formed the Robust Redhorse Conservation Committee (RRCC) in 1995 to guide recovery efforts for the species in lieu of listing under the ESA. Subsequent research has produced valuable information about the robust redhorse and its habitat requirements. However, much research is still needed, as little is known about the habitat preferences of juvenile robust redhorse.

Based on recent studies, it appears that adult robust redhorse typically inhabit areas of the river where the current is moderately swift. Preferred habitat is riffle areas or in/near outside bends, where depths are greater and accumulations of logs and other woody debris are present (Evans 1997). Spawning typically occurs at water temperatures from 18 to 24° C, usually over gravel substrate in both deep and shallow water (Hendricks 1998).

Status in the Study Area

At this time, natural populations of robust redhorse are not known to exist in the Broad River (Lamprecht and Scott 2013). Stocking of fingerlings began in 2004 at sites both above and below the Parr Shoals Dam (Lamprecht and Scott 2013), and robust redhorse have since been documented in both Parr and Monticello reservoirs, as well as the reach of the Broad River downstream of Parr Shoals Dam (Table 4-4). In addition, robust redhorse use of the fishway at the Columbia Hydroelectric Project has been documented (Kleinschmidt 2009, 2010, 2012, 2013, 2014), suggested that robust redhorse from the Congaree and potentially other areas of the lower Santee Basin are utilizing habitat in the reach of the Broad downstream of Parr Shoals Dam during the spawning season.

Determination of Effect

Habitat for robust redhorse is potentially affected by project flow releases and will be assessed as part of the proposed Instream Flow Incremental Methodology (IFIM) Study.

4.3.3 PIEDMONT DARTER

The piedmont darter is one of two species in the genus *Percina* found in South Carolina (Hayes and Bettinger 2006). It is typically found in cool to warm moderately-sized streams and rivers, usually in riffles with gravel or rock substrates (Rohde et al. 2009). Though a riffle dweller, this darter does not seem to favor extremely strong currents.

Status in the Study Area

The piedmont darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for piedmont darter is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.4 SEAGREEN DARTER

The seagreen darter is restricted to the Santee River drainage of the Carolinas (Hayes and Bettinger 2006). This species inhabits lower elevation tributaries in the mountain regions and is also found over a broad area of the upper piedmont in the Carolinas. It is less frequently found below the fall line in tributaries of the Congaree River. The seagreen darter favors a habitat of rock, rubble or gravel riffles in large creeks and rivers with moderate to swift currents, but has adapted to wide variations in temperature and water clarity.

Status in the Study Area

The seagreen darter has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for seagreen darter is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.5 HIGHFIN CARPSUCKER

The highfin carpsucker is distributed throughout the Lake Michigan drainage and Mississippi River Basin from Pennsylvania south to Louisiana (Self and Bettinger 2006). It also occurs on the Atlantic Slope from the Cape Fear River to Savannah River drainages and Gulf Slope drainages from Choctawhatchee River, Alabama and Florida to the Pearl River, Louisiana and Mississippi. The Atlantic Slope and Gulf Slope populations likely differ at the species level from those of the Mississippi and Lake Michigan drainages. In South Carolina, the highfin carpsucker occurs in the Broad and Congaree rivers in the upper Santee River Basin and the Savannah River. Historically the highfin carpsucker also occurred in the Pee Dee River; however, that population may have since been extirpated. The highfin carpsucker inhabits rivers in areas with moderate or swift current over sand or a gravel substrate (Rohde et al. 2009).

Highfin carpsucker population size and trends are not well known (Self and Bettinger 2006). There appear to be healthy populations with recruitment in the Broad River, Congaree River, and Savannah River. Preservation of populations in the Santee River is extremely important to the global preservation of the species given declining populations in the Cape Fear River and Pee Dee River (Self and Bettinger 2006).

Status in the Study Area

This species has been documented in both Parr Reservoir and the reach of the Broad River downstream of the Project (Table 4-4).

Determination of Effect

Habitat for highfin carpsucker is potentially affected by project flow releases and will be assessed as part of IFIM Study.

4.3.6 QUILLBACK

The quillback is found in warm, low- to moderate-gradient reaches of most major rivers, including upper portions of associated reservoirs (Lamprecht and Bettinger 2006). Quillback occur over varied substrates in rivers, but seldom over mud. They tend to occupy calm water; however, quillback may shift to swifter and deeper depths during low water. Quillback reportedly spawn in riffles, calm stream reaches and in floodplain bayous, laying eggs on gravel, sand, mud and organic matter. Quillback feed on insect larvae and other benthic organisms.

The quillback is distributed from the Great Lakes region in the St. Lawrence River, Hudson Bay and Mississippi River basins from Quebec to Alberta, Canada; south to Louisiana and west to Wyoming in the United States (Lamprecht and Bettinger 2006). It also occurs on the Atlantic slope from the Delaware River, New York, to the Altamaha River, Georgia. In gulf slope drainages, it occurs from the Apalachicola River in Florida and Georgia to the Pearl River in Louisiana. The southern Atlantic slope populations in South Carolina are reported in the upper portions of the three major South Carolina drainages: the Pee Dee, Santee, and Savannah. Fish from these populations are likely distinct from those of the interior basin and gulf slope drainages (Lamprecht and Bettinger 2006).

Status in the Study Area

Quillbacks have been documented in both Parr and Monticello reservoirs, as well as the downstream reach of the Broad River (Table 4-4).

Determination of Effect

Habitat for quillback is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.7 SANTEE CHUB

The Santee chub is restricted to the Santee River drainage within South Carolina, primarily in the piedmont and Blue Ridge foothills (Hayes and Bettinger 2006). A few populations of Santee chub found in the coastal plain represent an undescribed species known as the “thinlip” chub. Outside of South Carolina, “thinlip” chub is also found in the Cape Fear River drainage of North Carolina. The Santee chub inhabits small to medium sized streams with sand and rocky runs or current-swept pools. This species seems to be able to tolerate more turbid and warm waters than its close relative, the big-eye chub, *Hybopsis amblops*.

Status in the Study Area

Santee chub has been documented in the reach of the Broad River downstream of Parr Shoals Dam within the study area (Table 4-4).

Determination of Effect

Habitat for Santee chub is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.8 STRIPED BASS

The striped bass is an anadromous species native to the Atlantic slope, with natural populations residing in saltwater and migrating to medium to large freshwater rivers annually to spawn. It has been widely introduced or has remnant populations in impounded river systems, with some systems, including the Santee River Basin, supporting naturally-reproducing, damlocked populations (Sessions et al. 2006). In freshwater, they prefer to occupy areas with clean sandy bottoms, fine gravel and rock. Adult striped bass have a thermal tolerance of 6 to 27° C, but seek temperatures between 18 to 25°C when available. During spawning, striped bass occupy shallow rocky and gravely areas with strong turbulent water flow. Striped bass eggs are semibouyant; they drift and sink slowly requiring moderate current to keep the eggs from settling to the bottom and dying before they are hatched in one to three days. Optimum water temperatures for successful striped bass egg hatching and survival is 17 to 18°C (Sessions et al. 2006).

Status in the Study Area

Striped bass are regularly observed passing through the Columbia Hydroelectric Project fishway into the reach of the Broad downstream of Parr Shoals Dam (Kleinschmidt 2009, 2010, 2011, 2012, 2013) and have been documented from the study area during electrofishing (Table 4-4).

Determination of Effect

Habitat for striped bass is potentially affected by project flow releases and will be assessed as part of the proposed IFIM Study.

4.3.9 YELLOW LAMPMUSSEL

The yellow lampmussel is a freshwater species that is found primarily in medium to large rivers and streams. Preferred habitat includes a variety of substrates such as silt or sand, gravel bars, and in the bedrock cracks of both large and small rivers and streams (Price 2006b). The range of this species extends from the Ogeechee River in Georgia to Nova Scotia, with distribution in South Carolina spanning the Savannah, Broad, Wateree, Congaree, and Pee Dee River basins (Bogan and Alderman 2008, Price et al. 2009, Kleinschmidt 2013b).

Gravid yellow lampmussels observed in the Congaree River in 2007, were reported to release their glochidia between June and July (Price et al. 2009). These animals are long-term brooders that attract piscivorous hosts with mantle lure display. Broad River host trials indicate that Moronids like striped bass and white bass are likely natural hosts for yellow lampmussel, though Centrarchids may also be viable hosts (Price et al. 2009).

Status in the Study Area

In 2007, 60 sites were surveyed for mussels on the Broad and Congaree rivers from Cayce on the Congaree to 5 river miles south of the North Carolina border on the Broad. Six sites were surveyed between Parr Dam and Columbia Dam, and seven sites were sampled in the Parr Reservoir. However, only nine individuals were collected from three sites located 2-3 river miles downstream of the confluence of the Broad and Saluda rivers (Price *et al*. 2009). Alderman (2006) documented similar numbers of yellow lampmussels from the upper Congaree River, with 3 live individuals documented at five sites between the Broad/Saluda confluence and the Cayce Boat Landing.

In 2012, 13 sites just downstream from the Parr Shoals Dam were surveyed on the northeast side of Hampton Island (Alderman and Alderman 2012). This survey reported two sites where yellow lampmussel was present (CPUE ranging from 0.5-0.57 mussels/surveyor-hour). This location represents the uppermost extent of yellow lampmussel’s known range in the Broad River.

Determination of Effect

Alderman and Alderman (2012) reported that the mussel assemblage directly downstream of the Parr Shoals Dam represents the highest freshwater mussel diversity recorded in the Broad River Sub-basin in North and South Carolina upriver from the Columbia Hydrelectric Project. Further, the tailrace is the only location above the Columbia Hydroelectric Project where yellow lampmussel appears to have persisted. Although densities of yellow lampmussel were low, the overall abundance and diversity of mussels observed suggests that the tailrace may actually be serving as a sanctuary for freshwater mussels.

4.3.10 ROANOKE SLABSHELL

The Roanoke slabshell is found in large rivers, but can occasionally be found in small creeks. The Roanoke slabshell is able to tolerate large variations in flow levels and higher water temperatures, making it able to survive in some locations near dams and hydroelectric plants. It has experienced large die offs when the plants generate extremely low flows and cause levels of oxygen to drop (Price 2006).

The host fish for this species are still somewhat speculative, but it is thought that it parasitizes a diadromous fish host. Moreover, host studies conducted for Roanoke slabshell only showed successful transformation on blueback herring (most successful), gizzard shad, and white perch although a suite of taxa (ictalurids, cyprinids, centrarchids, catastomids, and anguillids) were considered (Price et al. 2009).

Status in the Study Area

In 2007, 60 sites were surveyed for mussels on the Broad and Congaree rivers from Cayce to 5 river miles south of the North Carolina border. Six sites were surveyed between Parr Shoals Dam and Columbia Dam seven in Parr Reservoir, and 13 sites below the Columbia Dam near the confluence of the Broad and Saluda rivers. Of these 60 sites, Roanoke slabshell was restricted to 194 live individuals from eight sites below the Columbia Dam (CPUE ranging from 1-62 mussels/surveyor-hour) and one individual from one site in Cherokee County, SC (Price et al. 2009).

In 2012, 13 sites just downstream from the Parr Shoals Dam were surveyed on the northeast side of Hampton Island (Alderman and Alderman 2012). This survey reported nine sites where Roanoke slabshell were present (CPUE ranging from 4-18 mussels/surveyor-hour), representing the healthiest, upper-most, extent of its presently known range in the Broad River (Alderman 2009).

Determination of Effect

As previously noted, Alderman and Alderman (2012) reported that the mussel assemblage found in the Parr tailrace represents the highest freshwater mussel diversity recorded in the Broad River Sub-basin in North and South Carolina upriver from the Columbia Hydrelectric Project. Further, the tailrace was the only location upstream of Columbia Hydroelectric Project dam where Roanoke slabshell has been documented (Alderman and Alderman 2012, Price 2010). Finally, juvenile Roanoke slabshell were documented by Alderman and Alderman (2012), suggesting that reproduction and recruitment are occurring in the tailrace area. These data suggest that the project is unlikely to be resulting in any negative effects to the Roanoke slabshell population in the tailrace, but rather may be serving as a refuge for this and other mussel species.

TABLE 4-4 DOCUMENTED OCCURRENCE OF SELECTED STATE CONSERVATION PRIORITY FISH SPECIES IN MONTICELLO RESERVOIR, PARR RESERVOIR AND THE DOWNSTREAM REACH OF THE BROAD RIVER (SOURCE: NORMANDEAU 2007, 2008, 2009; SCANA 2013; BETTINGER ET AL. 2003; KLEINSCHMIDT 2013A; ALDERMAN AND ALDERMAN 2012)

Common Name	Scientific Name	Parr	Monticello	Broad River
Robust redhorse	*Moxostoma robustum*	x	x	x
Piedmont darter	*Percina crassa*			x
Seagreen darter	*Etheostoma thalassinum*			x
Highfin carpsucker	*Carpiodes velifer*	x		
Quillback	*Carpiodes cyprinus*	x	x	x
Santee chub	*Hybopsis zanema*			x
Striped bass	*Morone saxatilis*			x
Yellow lampmussel	*Lampsilis cariosa*			x
Roanoke slabshell	*Elliptio roanokensis*			x

5.0 SUMMARY

Of the 13 state- and federally-listed and candidate species, habitat requirements and known occurrence data suggest that only the bald eagle likely occurs in the study area with any regularity. Wood storks may periodically utilize portions of the study area of seasonal foraging (primarily by post-dispersal migrants during the summer months); however, this usage is expected to be sporadic and ephemeral. Habitat for Georgia aster has been noted on the adjacent V.C. Summer Nuclear Station site and on nearby U.S. Forest Service lands, suggesting that habitat may also exist within the Project study area. Potential occurrences of Georgia aster would be limited to terrestrial sites, which would not be affected by continued operation of the Project. Finally, several fish species that are not state- or federally-listed, but are classified as priority conservation species have been documented from the study area. Habitat requirements for these species will be assessed as part of the proposed IFIM study. Information from this study will be considered in developing Protection, Mitigation, and Enhancement measures.

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APPENDIX A

RARE, THREATENED & ENDANGERED SPECIES STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

RARE, THREATENED AND ENDANGERED SPECIES
STUDY PLAN

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

October 2013

PARR HYDROELECTRIC PROJECT
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RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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(FERC NO. 1894)

RARE, THREATENED AND ENDANGERED SPECIES STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Fairfield Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina (Figure 1).

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as the licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGOs), and interested individuals. Collaboration and cooperation of stakeholders is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs), including members from among the interested stakeholders, with the objective of achieving consensus regarding the identification and proper treatment of these resource issues in the context of a new license.

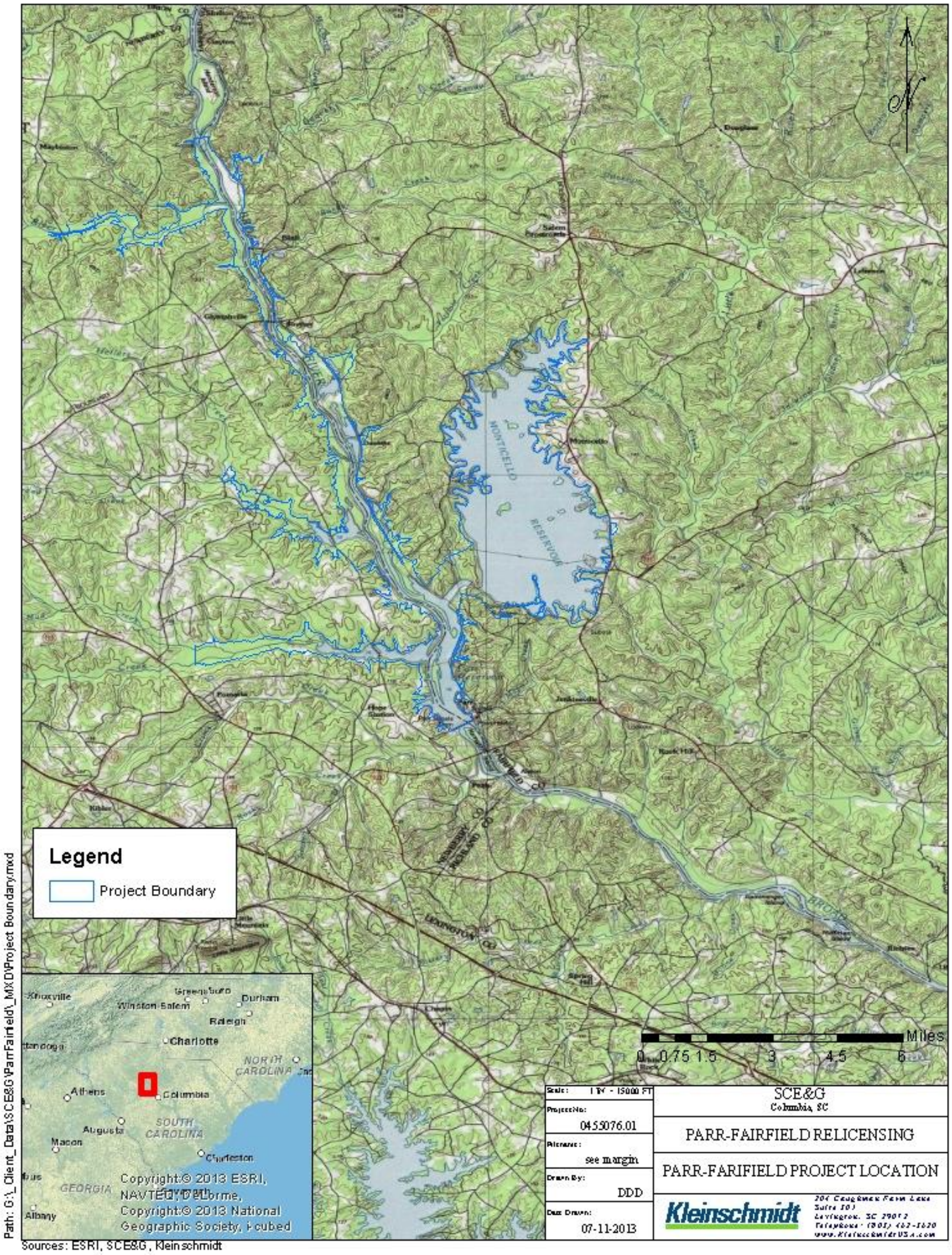
In preparation for relicensing, SCE&G formed a Rare, Threatened and Endangered Species Technical Working Committee ("RT&E TWC" or "TWC"), which is comprised of interested stakeholders who are working with SCE&G to identify potential issues, make biological study recommendations, and provide technical and experience-based input related to rare, threatened and endangered (RT&E) species potentially residing in the Project area. SCE&G is planning to conduct a literature-based study to compile existing information on federally and state listed RT&E species in the immediate project area. SCE&G will use this information in developing their license application for Federal Energy Regulatory Commission (FERC).

2.0 STUDY OBJECTIVES

The objective of this study is to characterize the present status of RT&E species at the Parr Fairfield Hydroelectric Project by providing information regarding the availability of RT&E habitat and characterize the known status of RT&E species within the Project boundary and Project vicinity. The presence or absence of select species will be verified through targeted field studies, including the Rocky Shoals Spider Lily Study, the Spiny Crayfish Study, and the Monticello Mussel Study.

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

This study will focus on all areas within the FERC Project boundary, including Parr and Monticello reservoirs, the immediate vicinity of the Project in Fairfield and Newberry counties, and the area downstream of Parr Shoals Dam extending to and including Frost Shoals in Richland County. RT&E species that are deemed as potentially occurring within the Project Area and from Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island, along with the known presences of available RT&E habitat, will be evaluated. As this study is a desktop exercise, no field reconnaissance will be implemented. The study is scheduled to commence in 2015.



Sources: ESRI, SCE&G, Kleinschmidt

FIGURE 1 PARR-FAIRFIELD PROJECT LOCATION MAP

4.0 COLLECTION METHODS AND ANALYSIS

In order to appropriately characterize the present status of RT&E species in the Project vicinity, information will be collected from various sources, including the South Carolina Department of Natural Resources (SCDNR) and the U.S. Fish and Wildlife Service (USFWS) RT&E databases.

As an initial step, a list of RT&E species documented as occurring in the counties surrounding the Project and downstream (Newberry, Fairfield and Richland) will be compiled based on the USFWS and SCDNR county level listings. Additional key species may be added at the request of TWC members, if agreed to be appropriate. The federal, state and global status of each of these species will be summarized, along with counties of occurrence. As a second step, known ranges of these species, along with occurrence data from the SCDNR Natural Heritage Program and other survey data, will then be used to eliminate species occurring in the counties but not in the Broad River Basin. Habitat requirements of each of the remaining species will then be summarized and compared to available habitat within the Project boundary and the area downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island. This analysis will yield a list of species that potentially occur within the Broad River Basin, and that have suitable habitat within the Project Boundary and downstream of the Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island.

5.0 SCHEDULE

Research and data collection efforts will begin no later than the spring of 2015. A final report summarizing the study findings including the compiled spreadsheets will be issued within 120 days of the completion of data collection. Study methodology and timing may be adjusted based on consultation with resource agencies and interested stakeholders.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, USFWS, RT&E TWC and other relicensing stakeholders.

APPENDIX B

USFWS COUNTY LEVEL LISTINGS FOR FAIRFIELD, NEWBERRY AND RICHLAND COUNTIES

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Fairfield County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P - CH	Proposed critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Fairfield	Amphibian	None Found		
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Crustacean	Little River (Broad River spiny) crayfish	*Cambarus spicatus*	ARS
	Fish	Blueback herring	*Alosa aestivalis*	ARS
	Insect	None Found		
	Mammal	None Found		
	Mollusk	Carolina heelsplitter	Lasmigona decorata	E
	Plant	Georgia aster	*Symphyotrichum georgianum*	C
	Reptile	None Found		

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Newberry County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P - CH	Proposed critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Newberry	Amphibian	None Found		
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Bird	Wood stork	*Mycteria americana*	E
	Crustacean	Newberry burrowing crayfish (Saluda)	*Distocambarus youngineri*	ARS
	Fish	None Found		
	Insect	None Found		
	Mammal	None Found		
	Mollusk	Savannah lilliput	*Toxolasma pullus*	ARS
	Mollusk	Yellow lance	*Elliptio lanceolata*	ARS
	Plant	None Found		
	Reptile	None Found		

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species - Richland County

*	Contact National Marine Fisheries Service (NMFS) for more information on this species
**	The U.S. Fish and Wildlife Service (FWS) and NMFS share jurisdiction of this species
ARS	At-Risk Species - Species that the FWS has been petitioned to list and for which a positive 90-day finding has been issued (listing may be warranted); information is provided only for conservation actions as no Federal protections currently exist.
BGEPA	Federally protected under the Bald and Golden Eagle Protection Act
C	FWS or NMFS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list these species
CH	Critical Habitat
E	Federally Endangered
P or P - CH	Proposed for listing or critical habitat in the Federal Register
S/A	Federally protected due to similarity of appearance to a listed species
T	Federally Threatened

COUNTY	CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Richland	Amphibian	Chamberlain’s dwarf salamander	*Eurycea chamberlaini*	ARS
	Bird	Bald eagle	*Haliaeetus leucocephalus*	BGEPA
	Bird	Red-cockaded woodpecker	*Picoides borealis*	E
	Crustacean	Little River (Broad River spiny) crayfish	*Cambarus spicatus*	ARS
	Fish	American eel	*Anguilla rostrata*	ARS
	Fish	Atlantic Sturgeon*	*Acipenser oxyrinchus**	E
	Fish	Blueback herring	*Alosa aestivalis*	ARS
	Fish	Robust redhorse	*Moxostoma robustum*	ARS
	Fish	Shortnose sturgeon*	*Acipenser brevirostrum**	E
	Insect	None Found		
	Mammal	None Found		
	Mollusk	Savannah lilliput	*Toxolasma pullus*	ARS
	Plant	Bog spicebush	*Lindera subcoriacea*	ARS
	Plant	Canby's dropwort	*Oxypolis canbyi*	E
	Plant	Carolina-birds-in-a-nest	*Macbridea caroliniana*	ARS
	Plant	Ciliate-leaf tickseed	*Coreopsis integrifolia*	ARS
	Plant	Georgia aster	*Symphyotrichum georgianum*	C
	Plant	Purple balduina	*Balduina atropurpurea*	ARS
	Plant	Rough-leaved loosestrife	*Lysimachia asperulaefolia*	E
	Plant	Smooth coneflower	*Echinacea laevigata*	E
	Plant	Spathulate seedbox	*Ludwigia spathulata*	ARS
	Reptile	Southern hognose snake	*Heterdon simus*	ARS

These lists should be used only as a guideline, not as the final authority. The lists include known occurrences and areas where the species has a high possibility of occurring. Records are updated as deemed necessary and may differ from earlier lists.

For a list of State endangered, threatened, and species of concern, please visit https://www.dnr.sc.gov/species/index.html.

APPENDIX C

STAKEHOLDER CONSULTATION

From:	Vivianne Vejdani
To:	Kelly Miller
Cc:	Bill Marshall; "Richard Christie"
Subject:	RE: draft RT&E Species Desktop Assessment
Date:	Wednesday, July 09, 2014 4:37:08 PM

Hi Kelly,

The plan looks good but I would offer perhaps one general suggestion...the phrase "does not occur within the study area/project area" be replaced by something like "is not likely to occur," in cases where on the ground surveys have not been conducted.

From: Kelly Miller [mailto:Kelly.Miller@KleinschmidtGroup.com]
Sent: Monday, June 23, 2014 4:34 PM
To: Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall; Bill Stangler (CRK@congareeriverkeeper.org); Byron Hamstead (Byron_hamstead@fws.gov); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); Kelly Miller; QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes Jr.; Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject: draft RT&E Species Desktop Assessment

All,

Attached is the draft Rare, Threatened and Endangered Species Desktop Assessment. Please review and submit any comments or edits to me by Wednesday, July 9th. Please note that the appendices will be included with the final report.

Thanks!
Kelly

Kelly Miller
Regulatory Coordinator
Kleinschmidt
Office: 803.462.5633
www.KleinschmidtGroup.com

From:	Hamstead, Byron
To:	Kelly Miller
Cc:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject:	Re: draft RT&E Species Desktop Assessment
Date:	Wednesday, July 09, 2014 4:39:38 PM
Attachments:	20140709_Parr_RTE_TWC_proposal_to_include_two_mussels_for_consideration.docx

All,

The Service proposes that two additional species be included for consideration by the RT&E TWC, *Lampsilis cariosa* and *Elliptio roanokensis*. Attached is a document that aims to provide our basis for this proposal, and information relevant to the objectives of the desktop assessment. Please let me know if you have any questions regarding this information. Additionally, I can send along the 2007 mussel survey data (from Price *et al*. 2009) in GIS file format if you request it. The Service appreciates the opportunity to participate on this Committee.

Thanks,
Byron

Byron Hamstead
Fish and Wildlife Biologist
USFWS Charleston Field Office
176 Croghan Spur Rd., Suite 200
Charleston, SC, 29407

843-727-4707 ext. 205

On Mon, Jun 23, 2014 at 4:33 PM, Kelly Miller <Kelly.Miller@kleinschmidtgroup.com> wrote:

> All,
>
> Attached is the draft Rare, Threatened and Endangered Species Desktop Assessment. Please review and submit any comments or edits to me by Wednesday, July 9th. Please note that the appendices will be included with the final report.
>
> Thanks!
>
> Kelly

Kelly Miller

Regulatory Coordinator

Kleinschmidt

Office: 803.462.5633

www.KleinschmidtGroup.com

From:	Hamstead, Byron
To:	Kelly Miller
Cc:	Alison Jakupca; BARGENTIERI@scana.com; Bill Marshall (marshallb@dnr.sc.gov); Bill Stangler (CRK@congareeriverkeeper.org); Chad Altman (altmankc@dhec.sc.gov); David Eargle (eargleda@dhec.sc.gov); Gerrit Jobsis (gjobsis@americanrivers.org); Henry Mealing; Jay Maher; Jim Glover (gloverjb@dhec.sc.gov); Karla Reece (Karla.Reece@noaa.gov); QUATTLEBAUM, MILTON; rammarell@scana.com; Randy Mahan (randolph.mahan@scana.com); randy mahan (rmahan@sc.rr.com); Sam Stokes (stokess@dnr.sc.gov); Scott Castleberry (castlews@dhec.sc.gov); Shane Boring; Steve Summer; Tom McCoy (thomas_mccoy@fws.gov); Vivianne Vejdani
Subject:	Re: draft RT&E Assessment in track changes
Date:	Sunday, August 24, 2014 1:36:04 PM
Attachments:	20140824_USFWS_Comments_Parr RTE Desktop Assessment.docx

Hi Kelly,

Please see comments from the USFWS on the RTE desktop assessment. Many thanks for your efforts to include the yellow lampmussel and Roanoke slabshell in your assessment. Please let me know if you have any questions regarding these comments. I will be away from the office for the next two weeks, but I am available via email or my cell: 919.946.0874.

Thanks,
Byron

Byron Hamstead
Fish and Wildlife Biologist
USFWS Charleston Field Office
176 Croghan Spur Rd., Suite 200
Charleston, SC, 29407

843-727-4707 ext. 205

On Wed, Aug 13, 2014 at 10:01 AM, Kelly Miller <Kelly.Miller@kleinschmidtgroup.com> wrote:

> Good morning!
>
> The draft Rare, Threatened and Endangered Species Desktop Assessment has been revised to address comments received by Byron Hamstead and Vivianne Vejdani. These revisions are included in track changes in the attached document. Please review the revised report and if everyone approves of the changes, I will attach the appendices and finalize the document.
>
> Thanks!

Kelly

Kelly Miller

Regulatory Coordinator

Kleinschmidt

Office: 803.462.5633

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From:	Shane Boring
To:	Hamstead, Byron
Cc:	Henry Mealing; BARGENTIERI@scana.com; Kelly Miller
Subject:	Final Parr/FF Rare, Threatened and Endangered Species Assessment
Date:	Wednesday, September 24, 2014 4:15:20 PM
Attachments:	20140924 Parr RTE Desktop Assessment.docx USFWS comment responses 9-18-2014- revised.doc

Byron,

Thanks for your comments on the revised RT&E report; they were very constructive. We have addressed the majority of your comments, which you will find in track changes in the attached final version of the report. There were a few comments that we did not agree with for inclusion in the final report, but we believe needed further clarification with you specifically. For those items, we prepared and attached a separate document with our rationale on these items. When we file the RTE report in the Final License Application, we will include your official comments and correspondence as part of the report.

Thanks again for your continued commitment to the relicensing process.

C. Shane Boring
Environmental Scientist
Kleinschmidt
Office: 803.462.5625
www.KleinschmidtGroup.com

ROCKY SHOALS SPIDER LILY STUDY PLAN

ROCKY SHOALS SPIDER LILY (*HYMENOCALLIS CORONARIA*) STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

October 2013

ROCKY SHOALS SPIDER LILY
(Hymenocallis coronaria)
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC No. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

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October 2013

ROCKY SHOALS SPIDER LILY
***(HYMENOCALLIS CORONARIA)* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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ROCKY SHOALS SPIDER LILY
***(HYMENOCALLIS CORONARIA)* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

The Parr Fairfield Hydroelectric Project (FERC No. 1894) (“Parr Fairfield Project” or “Project”), owned and operated by the South Carolina Electric & Gas Company (“SCE&G” or “Licensee”), is seeking a new license from the Federal Energy Regulatory Commission (“FERC”), as their current license is set to expire on June 30, 2020. The Parr Fairfield Project consists of two developments, including the Parr Hydro Development and the Fairfield Pumped Storage Development, located in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G as licensee and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWCs) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license. A Rare, Threatened & Endangered Species TWC (“RT&E TWC” or “TWC”) was formed to address potential RT&E related issues associated with the Project. It is comprised of stakeholders including the U.S. Fish and Wildlife Service (“USFWS”), the National Marine Fisheries Service (“NMFS”), the South Carolina Department of Health and Environmental Control (“SCDHEC”) and the South Carolina Department of Natural Resources (“SCDNR”), among others. During issues scoping, the TWC identified a South Carolina state species of concern, the Rocky Shoals Spider Lily (*Hymenocallis coronaria*) as occurring in the Broad River, downstream of the Parr Shoals Dam (Parr Dam). TWC members requested a survey to document the presence of this species in reaches downstream of the Project Area.

2.0 RELEVANT LIFE HISTORY INFORMATION

The Rocky Shoals Spider Lily (*Hymenocallis coronaria*), a recognized species of concern for South Carolina, is an aquatic, perennial flowering plant easily identified by its large white flowers. The plant develops from a bulb and grows to be approximately 3 feet tall. *H. coronaria* requires a specialized habitat of swift, shallow flowing water over rocks and direct sunlight (Davenport, 2007). The Broad River downstream of the Parr Dam contains shoal areas which provide the necessary habitat for this species. During winter months, plant bulbs and seeds stay buried in the rocky riverbed until May, when leaves begin to emerge above the water surface. During this time, flower stalks begin to develop and the short blooming season occurs from mid-May through June (Davenport, 2007).

3.0 STUDY OBJECTIVES

The objective of this study is to assess the status of *H. coronaria* within the area of Project influence by identifying and documenting all populations in the portion of the Broad River from Parr Dam extending to and including Frost Shoals, near Boatwright Island.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

As the life history information indicates, *H. coronaria* populations may occur at various shoals along the Broad River downstream of the Parr Dam. For this reason, the survey area will include the stretch of the Broad River downstream of the Parr Dam extending to and including Frost Shoals, near Boatwright Island. The survey reach is depicted in yellow in Figure 1.

The study will occur during the flowering season over two to three days in May or June, depending on flows and weather.

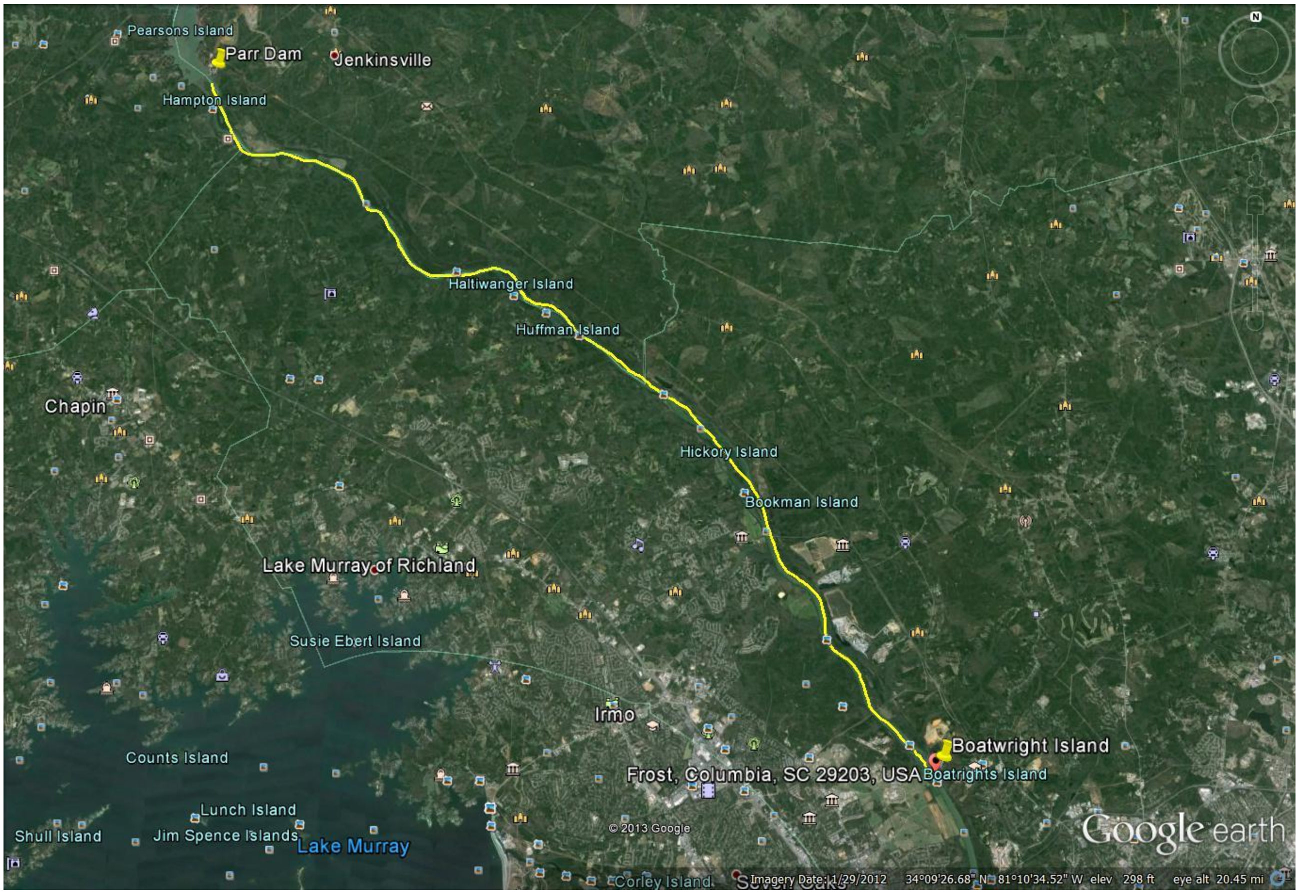

FIGURE 1 ROCKY SHOALS SPIDER LILY SURVEY REACH

5.0 COLLECTION METHODS AND ANALYSIS

The survey will take place during the flowering season of the *H. coronaria*, which occurs from late spring to early summer. A survey crew(s) will deploy in kayaks or canoes at the base of the Parr Dam and paddle downstream, observing the area for populations of *H. coronaria*. The main stem river channel, side channel areas and island complexes will be thoroughly surveyed. The crew(s) will paddle approximately halfway down the survey reach on Day 1. The group will then reconvene at the take-out location from Day 1 on Day 2 and paddle the remainder of the study area. When populations are sighted, the crew will document the exact location of the plants using GPS. The basal area of plants or clumps of plants will be measured and recorded. Elevation data for documented plants or clumps of plants will be obtained either during this survey or during the IFIM Survey.

6.0 SCHEDULE

It is anticipated that data collection will occur in the spring of 2015. Due to the variability in flows and meteorlogic conditions, the exact survey dates will be determined at a later date and announced two weeks in advance to the TWC members. If 2015 has extensive high flow conditions that would not allow for an effective assessment, the study will be postponed until the spring of 2016.

Within 90 days of the close of field work, a final report summarizing the study findings will be issued. Study methodology, duration and timing may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during the discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, SCDHEC, USFWS, RT&E TWC, and other relicensing stakeholders.

8.0 REFERENCES

Davenport, L. J. (2007). "Cahaba Lily." *The Encyclopedia of Alabama*. [Online] URL: http://www.encyclopediaofalabama.org/face/Article.jsp?id=h-967. Accessed August 7, 2013.

BROAD RIVER SPINY CRAYFISH STUDY PLAN

BROAD RIVER SPINY CRAYFISH
CAMBARUS SPICATUS
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
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January 2014

BROAD RIVER SPINY CRAYFISH
CAMBARUS SPICATUS
STUDY PLAN

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***CAMBARUS SPICATUS* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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***CAMBARUS SPICATUS* STUDY PLAN**

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894)(Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

During issues scoping, the TWC identified the potential need for a crayfish survey dependent upon discussions with U.S. Fish and Wildlife Service ("USFWS"). Based upon communications with the USFWS on June 6, 2013, the Broad River Spiny Crayfish (*Cambarus spicatus*), a South Carolina species of special concern, may be located within the Project area. As such, crayfish surveys were recommended to document the presence of this species within the Project area and downstream of the Parr Shoals Dam.

2.0 RELEVANT LIFE HISTORY INFORMATION

As noted, the Broad River Spiny Crayfish (*Cambarus spicatus*) is a species of concern in South Carolina. Eversole (1990) identified *C. spicatus* as having a distribution limited to lotic environments in the Broad River drainage basin. *C. spicatus* collections in the vicinity of the Project occurred within the Little River, a tributary to the Broad River, in Fairfield County. Although *C. spicatus* collections are limited, individuals were primarily associated with leaf litter and other organic debris located along the banks of streams. Preferred substrates have been found to be comprised primarily of sand and tend to be unstable in nature with a lack of rooted aquatic vegetation. Current information indicates that *C. spicatus* reproduces during the summer months (Eversole, 1990). *C. spicatus* was described by Hobbs (1956) as gray-green with cream, pink, purple and brown highlights. The chelae (the "claw" or "pincer") are green with orange tips and a double row of tubercles. Individuals range from about 60 mm (2.4 inches) to 78 mm (3.1 inches) in length.

3.0 STUDY OBJECTIVES

The objective of this survey is to assess the status of *C. spicatus* in the portion of the Broad River located within the Project boundary and an accessible area downstream of the Parr Shoals Dam.

4.0 GEOGRAPHIC AND TEMPORAL SCOPE

Based upon the life history information identified above, sampling sites will be located along the margins of the Broad River and associated tributaries, in areas of leaf litter/detritus, if possible. At least three sampling areas are proposed to be included as a part of this survey. General locations are listed in Table 1 and in Figure 1, below. These locations are approximate and actual sampling sites will be determined in consultation with USFWS prior to start of survey.

TABLE 1 BROAD RIVER CRAYFISH SAMPLING LOCATIONS

	SAMPLING AREAS
1.	Main Reservoir
2.	Broad River Downstream of Parr Shoals Dam
3.	Hwy 34 Boat Ramp

The study season will extend from September 1 through November 1, 2015.

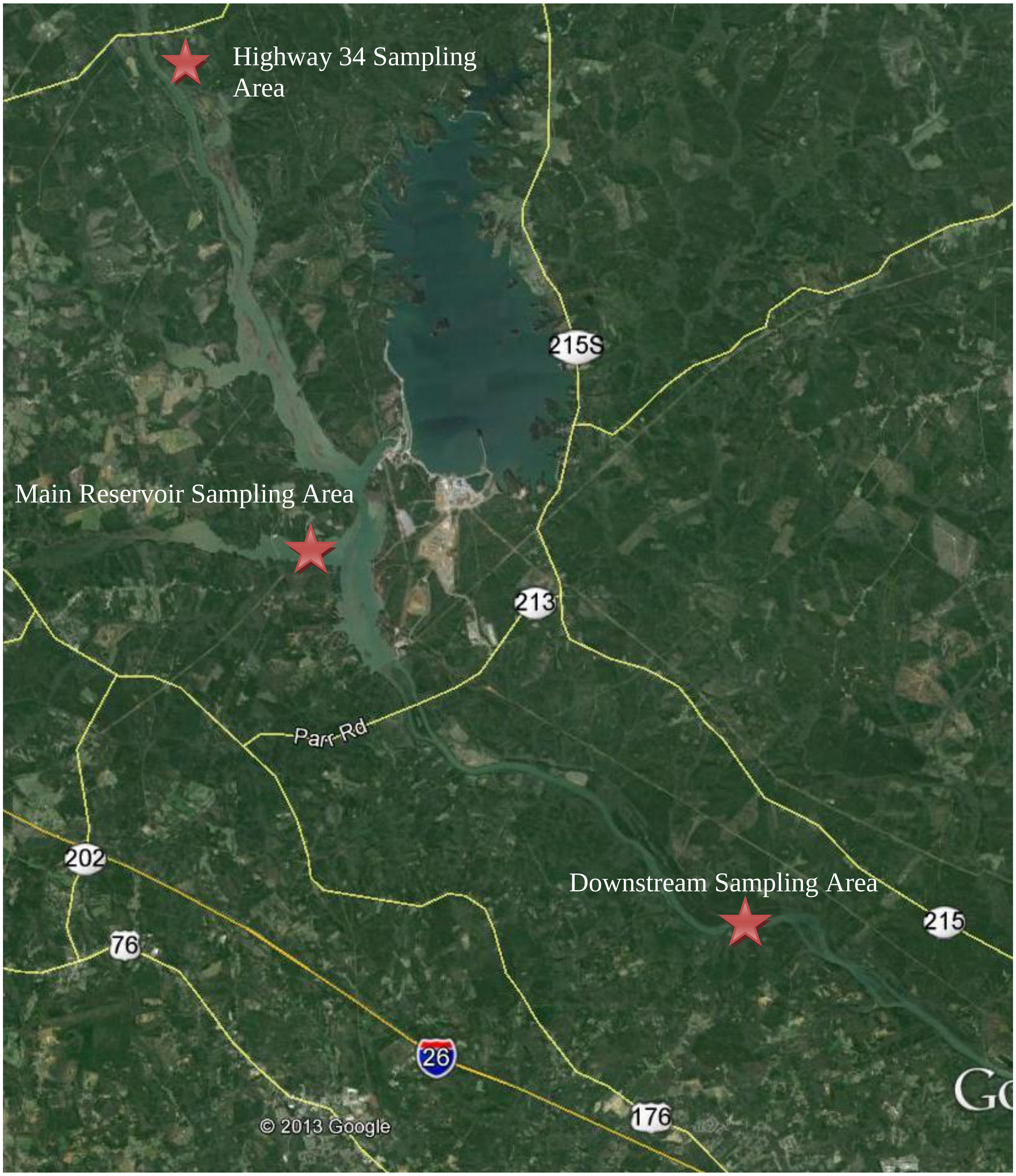

FIGURE 1 CRAYFISH SAMPLING AREAS

5.0 COLLECTION METHODS AND ANALYSIS

Passive trap methods will be utilized for this study. Traps will consist of double-entry, galvanized wire mesh minnow traps with 1" opercula. Traps will be baited with canned fish and will be re-baited when the traps are checked. A one-pound weight will be placed in the traps to ensure that they remain submerged. Traps will be deployed along shoreline, in areas of detritus and/or leaf litter, if possible. The number of traps per area will be determined during sample location reconnaissance. Traps will also be placed in locations where water depth is sufficient to ensure that they remain inundated. They will also be positioned such that they are not readily noticeable in an effort to decrease disturbance and vandalism. In the event of vandalism or theft, the trap will be replaced as soon as possible and the collection site location may be adjusted to prevent future vandalism.

The traps will be checked every 3 to 4 days beginning September 1. Based on collection results in September, the sampling days may be adjusted in October, as appropriate. Data recorded for each collection event will include: location (including site description and GPS coordinates), date, name of water body, basic water quality parameters (temperature, DO and conductivity), trap retrieval and deployment times, the total number of crayfish collected, the number of males and females. For the purposes of identification, only Form I males will be collected from the sample; other individuals will be released. Collected materials will be fixed in 5% neutral formalin, washed in tap water and preserved in 70% ethyl alcohol. Samples will be transported to a qualified astacologist for species identification.

6.0 SCHEDULE

Site location reconnaissance will be conducted in consultation with USFWS prior to start of survey. Crayfish traps will be deployed at the sampling locations on or around September 1, 2015 and will be allowed to sample for approximately eight weeks. The traps will be checked every 3 to 4 days in September and adjusted as appropriate in October.

A final report summarizing the study findings will be issued within 120 days of completion of field work. Study methodology, timing and duration may be adjusted based on consultation with resource agencies and interested stakeholders.

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, RT&E TWC, and other relicensing stakeholders.

8.0 REFERENCES

Eversole, Arnold G. 1990. Status Report on *Cambarus (Puncticambarus) spicatus* Hobbs, *Distocambarus (Fitzcambarus) youngineri* Hobbs, and *Procambarus (Pennides) echinatus* Hobbs. Completion Report. 21 pp.

Hobbs, H. H., Jr. 1956a. A new crayfish of the genus Procambarus from South Carolina (Decapoda:Astacidae). J. Wash. Acad. Sci. 46(1):117-121.

NatureServe. 2013. *Cambarus spicatus* Hobbs, Broad River Spiney Crayfish. (Available Online)[URL]: http://www.natureserve.org/

Price, Jennifer. Undated. Broad River Spiny Crayfish *Cambarus spicatus*. 2pp.

APPENDIX A

BROAD RIVER SPINY CRAYFISH STUDY – STUDY SITE SELECTION NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
Parr Hydroelectric Project (FERC No.1894)

MEETING NOTES

Rare, Threatened and Endangered Species TWC
Broad River Spiny Crayfish Study – Study Site Selection Notes

July 23, 2014

Final CSB 092214

ATTENDEES:

Shane Boring – Kleinschmidt
Byron Hamstead – USFWS
Milton Quattlebaum – SCANA Environmental Services

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

The group met with the purpose of selecting collection spots for the Broad River spiny crayfish (BRSC) as part of one of the proposed relicensing studies for the Parr Hydroelectric Project. The group launched from the Cannon's Creek ramp on Parr Reservoir and examined habitats from Cannon's Creek upstream to approximately 1 mile above the Highway 34 Bridge by boat. The group also examined habitat along Haltiwanger Island downstream of Parr Dam on foot. Prime collection areas included backwater areas with the presence of course woody debris and reasonable access for sampling.

Byron indicated that he was less impressed with habitats observed in Parr Reservoir, although some level of sampling was warranted in that area. The group determined that habitat in the vicinity of Haltiwanger Island in general lack the course woody debris and had higher velocities than are likely suitable for BRSC. Byron expressed an interest in exploring the area in the vicinity of the mouth of Little River for potential access since that is the area closest to where BRSC has been documented. The group made several attempts to examine Little River in that area, but were unable to find an access point. Shane and Milton noted that they would contact local landowners and attempt to facilitate an access point. Byron reiterated his desire to focus on the Little River mouth area.

Based on the field examinations and identifying a local landowner that would allow access to the Little River area, five sampling sites were identified, which are shown below in Figure 1 and Table 1. Two of the selected sites will be established at the Bookman Station Property to accommodate the USFWS request for additional sampling in the Vicinity of the Little River site located downstream of Parr Dam. A minimum of 3 traps will be deployed at each collection site.

Kleinschmidt

Figure 1. Broad River Spiny Crayfish Sampling Sites

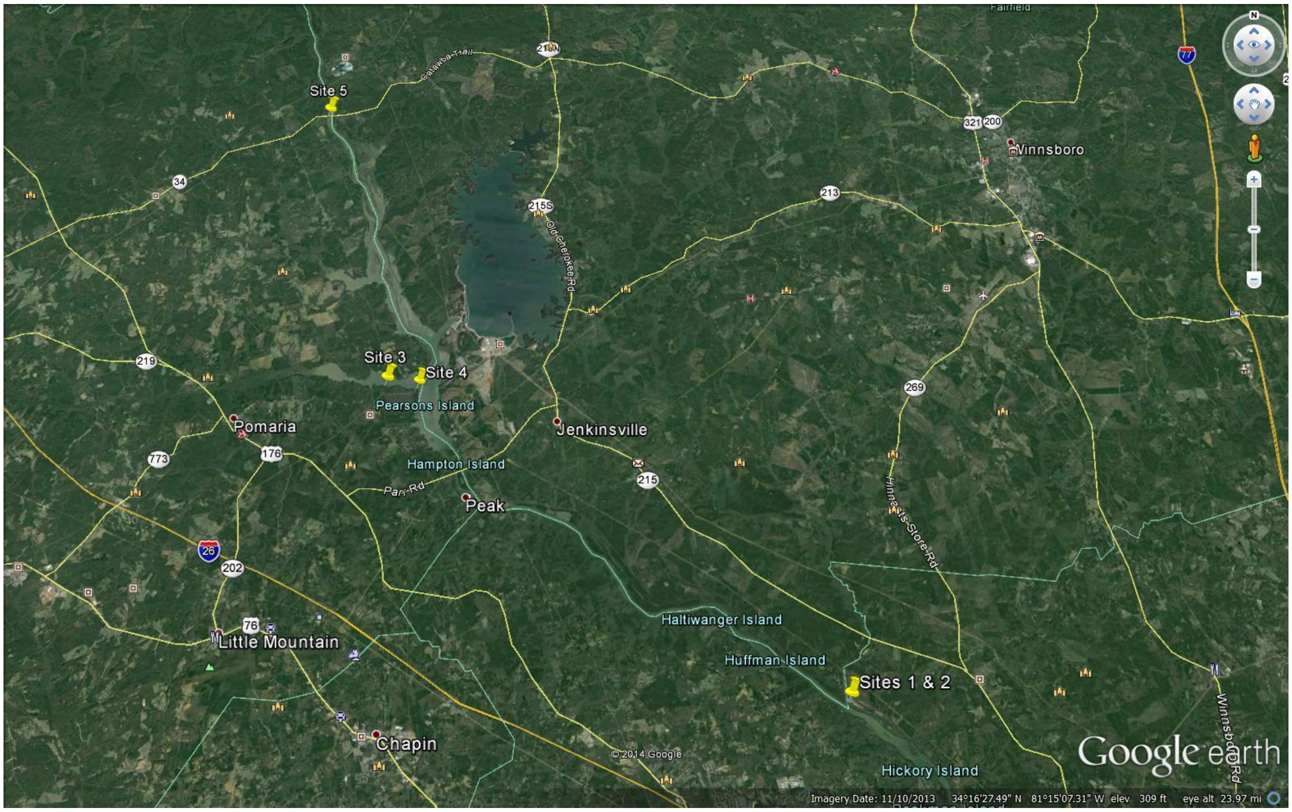

Table 1. Broad River Spiny Crayfish Sites

Site No.	Latitude/Longitude	Description/Notes
1	34°10'33.79"N, 81°10'41.48"W	Sites downstream of Parr Dam at mouth of Little River. Will be accessed from Bookman Station, LLC property. Two set of 3 traps will be positioned sufficiently apart in appropriate habitat to represent 2 sites.
2		
3	34°16'53.04"N, 81°21'35.93"W	Cove directly across from Cannon's Creek launch.
4	34°16'49.39"N, 81°20'48.05"W	Noted by USFWS as a shallow area with more overhead forest cover than other habitat in reservoir.
5	34°23'37.73"N, 81°23'55.93"W	Vicinity of Highway 34 Bridge.

ACTION ITEMS:

- Include these notes in the Final BRSC sampling plan and revise the Plan to note the listed sampling locations and number of sampling traps to be used.

RECREATION USE AND NEEDS STUDY PLAN

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(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
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January 2014
Revised October 2014

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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RECREATION USE AND NEEDS STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Parr Hydro Development forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally operates to continuously pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations.

The Fairfield Pumped Storage Development is located directly off of the Broad River and forms the 6,800-acre upper reservoir, Monticello Reservoir, with four earthen dams. As noted, Parr Reservoir serves as the lower reservoir for pumped storage operations. The Fairfield Development has a licensed capacity of 511.2 MW and is primarily used for peaking operations, reserve generation, and power usage.

2.0 PURPOSE OF THE STUDY

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

As a part of this process, SCE&G is proposing to perform an assessment of existing and future recreational use, opportunities, and needs for the Project. The assessment is designed to provide information pertinent to the current and future availability and adequacy of SCE&G owned and managed recreation sites and specific informal recreation areas at Monticello Reservoir and the Parr Reservoir. The overall study plan objective is to identify current and potential recreational use, opportunities, and needs at the Project by addressing the following goals and objectives:

Goal 1: *Characterize the existing recreational use of SCE&G's recreation sites on Monticello Reservoir and Parr Reservoir. This will be accomplished by meeting the following objectives:*

i. Identify recreation points, inventory the services and facilities offered at each, and assess the general condition of each site (including whether the site provides barrier free access).
ii. Identify the patterns of use at each site (type, volume, and daily patterns of use).

Goal 2: *Characterize existing use of waterfowl areas (Broad River Waterfowl Area, Enoree River Waterfowl area) and SCE&G recreation lands by hunters during designated hunting seasons. This will be accomplished by meeting the following objectives:*

i. Identify the patterns of use within the Project boundary (type, volume, and daily/seasonal patterns of use).

Goal 3: *Identify future recreational needs relating to public recreation sites on Monticello Reservoir and Parr Reservoir. This will be accomplished by meeting the following objectives:*

i. Identify existing user needs and preferences, including perceptions of crowding at recreation sites.
ii. Estimate future recreational use of existing recreation sites.
iii. Identify future needs for new recreation sites and facilities.

3.0 STUDY AREA

SCE&G designated recreation sites and informal recreation areas on Monticello Reservoir (Figure 1) and Parr Reservoir (Figure 2) that will be included in this assessment include the following:

TABLE 1 RECREATION SITES TO BE ASSESSED

MONTICELLO RESERVOIR RECREATION SITES & INFORMAL AREAS	PARR RESERVOIR RECREATION SITES & INFORMAL AREAS
1. Scenic Overlook (SCE&G-maintained portion)	1. Cannon's Creek Boat Ramp
2. Hwy 215 Boat Ramp	2. Heller's Creek Boat Ramp
3. Hwy 99 Boat Ramp	3. Broad River Waterfowl Area (vehicle counter only)
4. Recreation Lake Access Area	4. Hwy 34 Boat Ramp (vehicle counter only)
5. Informal fishing area, east side of Hwy 99	5. Enoree River Waterfowl Area (vehicle counter only)
	6. Enoree River Bridge Informal Access Area (vehicle counter only)

FIGURE 1 MONTICELLO RESERVOIR RECREATION STUDY SITES

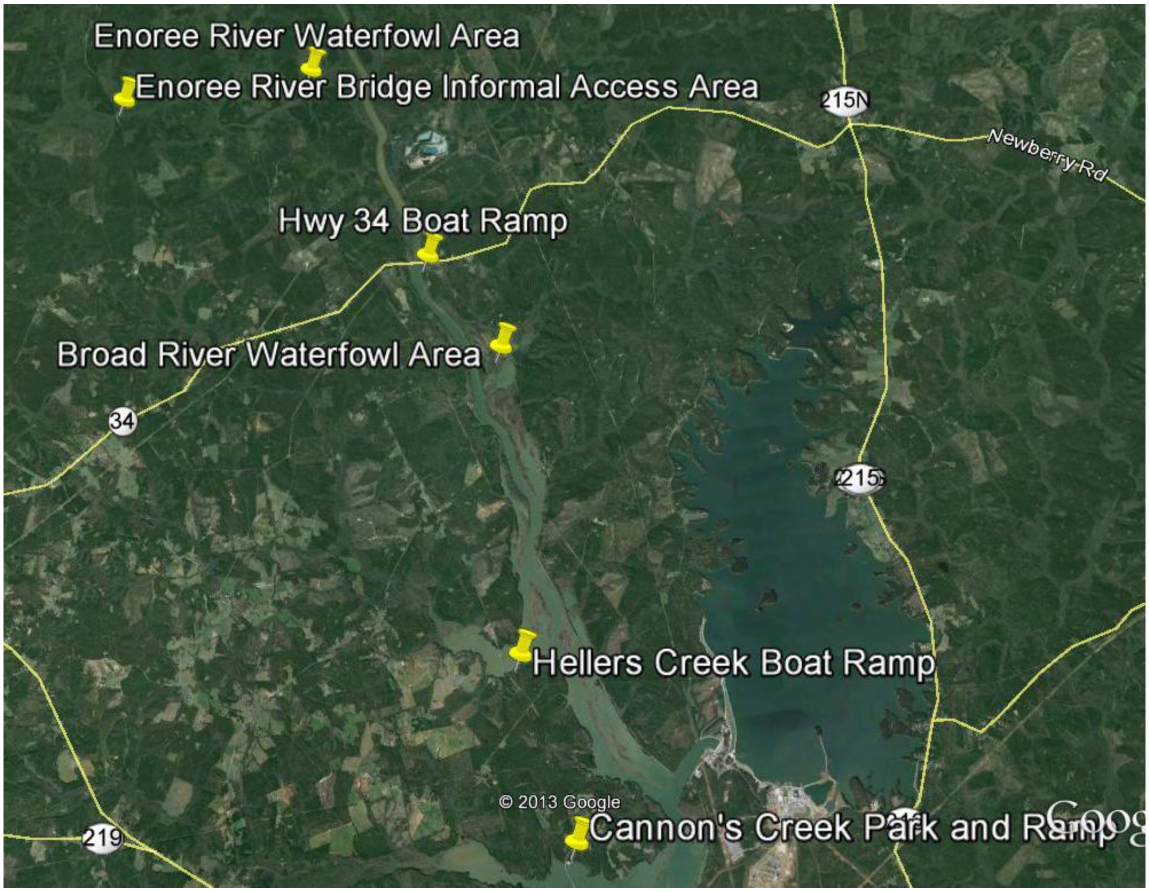

FIGURE 2 PARR RESERVOIR RECREATION STUDY SITES

4.0 STUDY SEASON

Study seasons will vary by study area based upon current knowledge of use patterns. Study seasons should capture specific seasonal activities, including hunting during legal seasons and on-water recreational use during the peak season (typically defined as Memorial Day to Labor Day). As hunting season dates vary annually based upon SCDNR board decisions, only approximate date ranges for specific targeted mail-in survey activities are provided within this study plan. Exact dates for waterfowl survey activities will be determined when study season dates are published, anticipated being mid-summer 2014. Study season specifics are further described below.

4.1 MONTICELLO RESERVOIR

Primary interview activities will occur from April 1 through Labor Day, 2015. Additional interviews will be conducted from February 1 through March 31, 2016 in order to capture recreational activity on the Reservoir during early crappie season. Specific targeted survey activities with mail-in surveys, as described in Section 5.5, will occur during the Canada Geese hunting season (approximately September 1 through September 30, depending on yearly SCDNR approved seasons).

4.2 PARR RESERVOIR

Primary interview activities, as described in Section 5.0, will occur from April 1 through Labor Day, 2015, to encompass turkey hunting season, as well as the peak recreation season. Specific targeted survey activities with mail-in surveys, as described in Section 5.5, will occur during Migratory Waterfowl Seasons, including Canada Geese hunting season (approximately September 2015 through January 2016, depending on yearly SCDNR approved seasons).

5.0 DATA COLLECTION METHODS

A variety of data collection techniques will be used to obtain the information necessary to meet the study objectives. Table 2 identifies the information needed to address each objective and the data collection methods to be used. Both primary and secondary data will be utilized. Primary data will entail site inventories, user counts, and use surveys (exit interviews). Secondary data will include U.S. Bureau of Census data, the South Carolina Statewide Comprehensive Outdoor Recreation Plan (SCORP), SC Recreation Participation & Preference Study, and other relevant, readily available literature. Additional input will be solicited from the Lake & Land Management and Recreation Resource Conservation Group (RCG), Recreation TWC, and target "focus groups" of especially knowledgeable individuals, offering knowledge of the recreation resources and needs of the lake and river.

TABLE 2 RECREATION USE AND NEEDS STUDY PLAN OBJECTIVES AND EFFORTS

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 1: Characterize existing recreational use of recreation sites on Monticello Reservoir and the Parr Reservoir		
Identify formal recreation sites, inventory the services and facilities offered at each, and assess the general condition and ADA compliance of each site	• Physical inventory of all boat ramps, grills, shelters, restrooms, parking capacity, etc., at each site • General assessment of site condition to include maintenance, basic rehabilitation needs, etc. • Visitors' assessment of site conditions • Identification of activities that occur at each site • ADA compliance assessment	• Recreation Site Inventory • Survey of Recreation Site Users
Identify the patterns of use at each site (type, volume, and daily patterns of use)	• Utilize vehicle counts as an estimation of people • Estimate of # people/vehicle • Estimate of # vehicles/site • Parking capacity	• Traffic Counter Data • Surveyor Counts of Vehicles at Recreation Sites • Survey of Recreation Site Users - # of people per vehicle and length of visit • Recreation Site Inventory - # of parking spaces • County data from Scenic Overlook

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 2: Characterize existing use of waterfowl areas (Broad River Waterfowl Area, Enoree River Waterfowl area) and SCE&G recreation lands by hunters during designated hunting seasons.		
Identify the patterns of use within the Project boundary (type, volume, and daily/seasonal patterns of use).	• Estimation of # hunters/site or waterfowl area	• Counts of Vehicles at Recreation Sites/waterfowl areas • Mail-in questionnaire specific to hunting use at the Project • SCDNR waterfowl use data • SCDNR hunting permit data

OBJECTIVES	INFORMATION NEEDED	SOURCE
Goal 3: Identify future recreational needs relating to public recreation sites on Monticello Reservoir and Parr Reservoir		
Identify existing user needs and preferences, including perceptions of crowding at recreation sites	• User preferences and opinions of needs and crowding at sites • Condition assessment	• Survey of Recreation Site Users • Recreation Site Inventory
Estimate future recreational use of existing recreation sites	• Current inventory and use data from Goals 1 and 2 • Population projections for the project area • Recreational use trends	• Results of Goals 1 and 2 • U.S. Bureau of Census Data • SC Division of Research & Statistics (Budget and Control Board) • SCORP, SC Recreation Participation & Preference Study, or other readily available literature
Identify future needs for new recreation sites and facilities	• Population projections • Recreation use trends • "focus group" (stakeholders) knowledge of recreation resources and needs	• SC Div. of Research & Statistics • SCORP, SC Recreation Participation & Preference Study, Palmetto Conservation Foundation trail use data, or other literature • Recreation TWC and Lake and Land Management & Recreation RCG

The capacity, availability, and overall condition of existing recreation sites will be assessed through review of existing information and an on-site inventory (Section 5.1). Recreational use of SCE&G's public recreation sites (Table 2) during the appropriate recreation season (as described in 4.0) will be estimated using a combination of data including traffic count, survey data, spot counts, and additional collection methods as described in Section 5.2, 5.3, 5.4, and 5.5. Methods for estimating recreational use are described in Section 6.0.

5.1 RECREATION SITE INVENTORY

Data on the types of amenities, activities supported, and the parking capacity of recreation sites at the Project, and the land area each site encompasses will be obtained from two sources. First, existing information regarding recreation sites such as FERC Form 80's and existing GIS data layers will be referenced. Second, a site visit will be made to collect data on the type, number, and size of facilities (restrooms, parking areas, boat ramps, picnic shelters and tables, etc.) located at each site. The general condition of recreation facilities will be recorded along with a qualitative assessment of whether the site is considered "barrier free". A copy of the inventory form is provided in Appendix A.

Upon completion of the inventory, all data will be uploaded into a database; anticipated to be a GIS database. The database will be structured so that it can be used in a variety of formats (brochure, maps, web pages, etc.) and can be updated as recreation sites are modified, added, or changed in any way.

5.2 TRAFFIC COUNTS

Traffic counters will be installed to record the number of vehicles that enter and exit the public recreation areas. Traffic count data will be collected for an entire year in order to capture the various hunting seasons. On Monticello Reservoir, traffic counters will be installed at the lake access point of the Scenic Overlook, the Hwy 215 Boat Ramp, the Hwy 99 Boat Ramp, Recreation Lake Access Area, and the Hwy 99 informal fishing area. At Parr Reservoir, traffic counters will be installed at Cannon's Creek Boat Ramp, Heller's Creek Boat Ramp, Broad River Waterfowl Area, Hwy 34 Boat Ramp, Enoree River Waterfowl Area, and the Enoree River Bridge informal area.

5.3 PUBLIC RECREATION AREA VISITOR EXIT INTERVIEWS

The preferences and perceptions of people using SCE&G’s recreation sites and informal areas are important inputs in management decisions regarding the adequacy and availability of existing recreation sites. Information from recreation site users will be obtained via an onsite survey from April 1 through Labor Day, 2015, and from February 1 through March 31, 2016, on Monticello Reservoir and from April 1 through Labor Day, 2015, for Parr Reservoir.

Exit surveys will be administered to collect user characteristics (origin, gender, age, group size, etc.), the type of land-based and water-based recreation activities individuals are participating in, length of stay, perceptions of crowdedness, and conditions of recreation sites at the Project. Visitor demographic information will also be collected. Surveys will be conducted at the following locations:

Monticello Reservoir

- Scenic Overlook
- Hwy 215 Boat Ramp
- Hwy 99 Boat Ramp
- Recreation Lake Access Area
- Hwy 99 informal Fishing Area

Parr Reservoir

- Cannon's Creek Boat Ramp
- Heller's Creek Boat Ramp

The data collected will be used to provide a general pattern of recreation use and assist in the development of recreation use estimates at access sites. The data will also provide recreation user inputs on "crowdedness" and potential facility needs. The survey will be pre-tested in the field prior to implementation and revisions will be incorporated, as necessary. If any significant revisions to the survey or study protocol are deemed necessary subsequent to field pre-testing, the TWC will be notified.

Two survey versions will be implemented – one for Monticello Reservoir and one for Parr Reservoir. The two survey versions will be very similar to each other and will contain similar questions. Draft questionnaires are provided in Appendix B.

A draft sampling plan (Appendix C) has been prepared in consultation with the TWC utilizing stratified random sampling in order to complete at least 30 days of interviewing at each recreation site. Sampling days are made up of weekends, weekdays and holidays. Weekends will be sampled at a greater rate than weekdays, to account for the heavier use that typically occurs during those periods. Moreover, all major national holidays that fall within the recreation season have been included in the sampling plan (i.e., Memorial Day weekend, July 4th weekend, and Labor Day weekend)(Table 3). Furthermore, as the sampling season approaches, the TWC will be consulted on the potential for including special event days with the holidays.

TABLE 3 LIST OF HOLIDAYS TO BE INCLUDED IN THE 2015 RUNS EXIT INTERVIEW SAMPLING PLAN

DATE	HOLIDAY
May 23, 2015	Saturday before Memorial Day
May 24, 2015	Sunday before Memorial Day
May 25, 2015	Memorial Day
July 3, 2015	Friday before Independence Day
July 4, 2015	Independence Day
July 5, 2015	Sunday after Independence Day
September 5, 2015	Saturday before Labor Day
September 6, 2015	Sunday before Labor Day
September 7, 2015	Labor Day

All survey clerks will be trained thoroughly as a means of quality control. Survey clerks will be provided with detailed information on the study schedule, appropriate materials to aid in data collection, and direction on appropriate interviewing techniques and attire. Interviewers will also be provided with an incentive for survey respondents to complete the survey.

5.4 SPOT COUNTS

Spot counts will be conducted at the public recreation sites identified in Section 5.3 once per interview period, concurrent with exit interviews. Specifically, spot counts will document the number of visitors and/or vehicles present at that visit and help to characterize site use. Information recorded during spot counts will include: date, time, and weather; amount of vehicle and vehicle/trailer parking capacity in use; number and type of activities observed at the site; and state license plate data. Spot count data will be used in parallel with traffic counter data.

5.5 ADDITIONAL USER DATA COLLECTION EFFORTS

Waterfowl hunting typically occurs during the fall and winter months. Waterfowl hunters represent a unique group of users whose preferences and perceptions may differ from those using recreation sites during the summer months. The preferences and perceptions of waterfowl hunters will be identified through use of a panel of waterfowl hunters.

Kleinschmidt will work with the Recreation TWC to identify waterfowl organizations whose hunters use the Project. A panel will be assembled from willing participants of the respective organizations. Should not enough participants be available from the organizations, additional individual hunters may be sought out to serve on the panel. A small group of hunters will be invited to participate in a group meeting, similar to a focus group, to identify the opportunities and needs of waterfowl hunters using Project access areas. The information collected will be similar to that of the access site survey. Kleinschmidt will recruit the hunters, develop a meeting format and materials, and will conduct the meeting. It is anticipated that the meeting will occur during the waterfowl hunting season.

Additionally, mail-in surveys similar to the access site survey will be distributed at the Broad River[1] and Enoree River Waterfowl Areas, on Parr Reservoir during waterfowl hunting season. On Monticello Reservoir, mail-in surveys will be distributed on vehicles parked at the Hwy 215 boat ramp and the Hwy 99 boat ramp during Canada Geese season. The study seasons for Monticello Reservoir and Parr Reservoir, as discussed in Section 4.0, will capture the turkey hunting season through exit interview activities.

Representation of those utilizing the Project during local fishing tournaments are anticipated to be represented during access site exit interviews, as registration, check-in and weigh-in typically occurs at access areas.

[1] In lieu of distributing mail-in surveys on parked vehicles at the Broad River Waterfowl Area, mail-in surveys may be provided to SCDNR to distribute to hunters winning the opportunity to hunt at this site through the SCDNR Public Lottery Hunt program.

6.0 ANALYSIS

The following sections provide a description of the approach for estimating existing and future recreational use, recreation site capacity and use density percentages, and recreation needs.

6.1 CURRENT RECREATION USE ESTIMATES

The reported estimates of recreation will be presented in "recreation days". The FERC defines a recreation day as one visit by a person to a development for purposes of recreation during any 24-hour period. The weekday, weekend, and holiday average recreation days will be calculated for each Monticello Reservoir and Parr Reservoir recreation site utilizing the traffic counters and recreation site survey data. The average number of people at each site within the morning and afternoon periods will be estimated within each day type and converted to a daily estimate. Daily estimates for each day type will be expanded to represent the study period and summed for a total estimate for each recreation site.

6.2 FUTURE RECREATION USE ESTIMATES

Estimated projections of future recreation use at Monticello Reservoir and Parr Reservoir will be developed using the average annual increase in population growth over the past 10 years, as reported by the Census Bureau or the State Division of Research and Statistics, for Newberry, Fairfield and Richland counties[2]. The estimates will be augmented with discussion of trends reported in the SCORP (2014) and the SC Recreation Participation & Preference Study (2005). Estimated projections will be provided in 5 year intervals for the anticipated term of the license up to 50 years into the future (through year 2070).

While it is acknowledged that future changes in the supply of recreation resources, either in their quantity, accessibility, and/or quality may influence future demand and use, the demand analysis undertaken for this study does not attempt to predict what these future changes might consist of or how they might specifically affect levels of use at Project facilities. Therefore, the demand analysis results should be viewed as a general guide of potential future recreation pressure developed for planning purposes only.

[2] Although Richland County is not within the FERC Project boundary, it is believed that a significant number of those who recreate at the Project reside within Richland County.

6.3 RECREATION SITE CAPACITY

For purposes of this study, the carrying capacity for a recreation site is defined as the number of vehicles and boat trailers that can be parked at a recreation site at one time, based on the number of available parking spaces associated with each site. For paved parking areas, this will be achieved by counting the number of designated parking spaces available at the recreation site. For gravel parking areas, the number of available parking spaces for each recreation site will be estimated by measuring the area (sq ft) available for parking and estimating the number of vehicles that could be parked at the location, if optimal space were utilized. These estimates will be based on parking capacity standards for vehicle length, width, and available turn around space.

6.4 RECREATION SITE USE DENSITY

The use density of recreation sites will be estimated by comparing the average observed number of vehicles at the sites on sampled weekday, weekend, and holiday days with the available parking capacity for each recreation site. The average observed number of vehicles divided by the parking capacity will provide an estimated use density for each site.

6.5 RECREATION NEEDS ASSESSMENT

The need for recreation and site development or modification of existing recreation resources will be assessed based on the inventory, condition, capacity, and exit interview survey results. The needs assessment will focus on the existing condition and user opinions of recreation sites, whether a particular site provides "barrier free" access, and the ability of sites to meet current and anticipated future recreation demand pressures. Consideration will also be given to site opportunities and constraints, as well as support facilities such as signage and maintenance. The need for new recreational sites, facilities, and shoreline will be determined through assessment of the information collected and the input of stakeholders on the Recreation TWC and Lake & Land Management RCG.

7.0 SCHEDULE

The proposed schedule for completion of the Recreation Use and Needs Study is as follows:

TASK	DATE
Mobilization for field work (includes field clerk hiring, training, etc.)	March 2015
Survey development and pre-testing	March 2015
Installation of Traffic Counters	March 31, 2015
Interview survey collection (Monticello Reservoir)	April 1-September 7 (Labor Day, 2015); and February 1 - March 31, 2016[3]
Interview survey collection (Parr Reservoir)	April 1 -September 7 (Labor Day, 2015)
Waterfowl survey activities	Throughout 2015 and early 2016 during appropriate seasons.
Early data entry, cleaning, and processing	Early October 2015
Determine if additional data collection is needed	December 2015[4]
Conduct analyses	April - July 2016
Submit draft report	July 2016
Finalize report	July/August 2016

8.0 REFERENCES

South Carolina Department of Parks, Recreation and Tourism, Recreation, Planning and Engineering Office. 2008. South Carolina Statewide Comprehensive Outdoor Recreation Plan.

University of South Carolina. 2005. South Carolina Recreation Participation & Preference Study. Prepared for the South Carolina Department of Parks, Recreation and Tourism. (Online) [URL]: http://www.scprt.com/files/RPE/2005%20Rec%20Study.pdf

[3] The recreation season has been extended into 2016 on Monticello Reservoir in order to capture use data during the early crappie season, from February 1 through March 31, 2016.

[4] If additional data collection is required, data collection methods, results and analyses, developed and assessed in cooperation with the Recreation RCG, will be provided in an addendum to the report.

APPENDIX A

SITE INVENTORY FORM

SOUTH CAROLINA ELECTRIC & GAS COMPANY

RECREATION ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SCE&G Public Site Inventory Form

Inspected by: ________ Date: _______

Site Name: ___________________________

Site Address: ____

City: _____________________ State: _SC_ Zip Code: ___________

Facility Type:

_____ Primitive Camp _____ Picnic Area ____ Day Use

_____ Overlook Site _____ Informal Site ____ Launch Ramp

Road Access:

_____ Paved access......................................______ # of lanes

_____ Unpaved access..................................______ # of lanes – (Circular entrance/exit)

Operations:

_____ Manned _____ Seasonal (From_____To_____)

_____ Unmanned _____ Year Round

_____ Fee ($) .... (Site_____; Parking;_____)

Site Amenities:

#	Type	#	Type
_____	Picnic Tables	_____	Potable Water
_____	Grills	_____	Boat Fuel
_____	Firepit/ring	_____	Trash Cans
_____	Boat Pump Out	_____	Docks
_____	Trails (specify use_____________: Miles_____)	_____	Playground
_____	Shelter	_____	Showers
_____	Designated Swim Area	_____	Concession
_____	Store	_____	Marina (# of slips_____)
_____	Dumping Station		

Parking Lots:

Type	Estimated # Paved	Estimated # Gravel		
ADA Spaces	_____	_____	_____	Spaces delineated?
Regular Spaces	_____	_____	_____	Curbs?
Vehicle & trailer spaces	_____	_____		

Sanitation Facilities:

	Flush	(BF*?)	Portable	(BF?)	Showers	(BF?)
Unisex	_____	(_____)	_____	(_____)	_____	(_____)
Women	_____	(_____)	_____	(_____)	_____	(_____)
Men	_____	(_____)	_____	(_____)	_____	(_____)

**BF - Barrier Free*

Campground/Campsite:

	RV sites	Cabins	Tent sites	Primitive sites
# of sites	______	______	______	______
On site parking	______	______	______	______
Water front	______	______	______	______
Barrier Free	______	______	______	______

Boat Launch Facilities:

_____ Hard surface _____ Unimproved (informal) _____ # of Lanes

_____ Gravel _____ Carry In _____ Boat Prep Area?

Courtesy/Fishing Docks:

Courtesy/Fishing	Dimensions	Barrier Free
__________	________________	______________________
__________	________________	______________________
__________	________________	______________________
__________	________________	______________________
__________	________________	______________________

Notes:

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Picture Number From _____ To ____

APPENDIX B

RECREATION SITE QUESTIONNAIRES

Monticello Reservoir Public Access Site Questionnaire

Clerk:_______________ **Site:** _______________ **Date:** ______________ **Time:** __________ **am/pm**

Weather: ☐ **Sunny** ☐ **Partly Cloudy** ☐ **Cloudy** ☐ **Light Rain** ☐ **Heavy Rain**

RESPONDENT GENDER: ☐ **Male** ☐ **Female**
RESPONDENT REFUSED INTERVIEW: ☐
NUMBER OF PEOPLE IN VEHICLE:
RESPONDENT DOES NOT SPEAK ENGLISH: ☐
VEHICLE HAS A BOAT TRAILER: ☐
RESPONDENT IS NOT 18 YEARS OR OLDER: ☐
RESPONDENT HAS BEEN INTERVIEWED AT THIS SITE PREVIOUSLY: ☐

THE FIRST FEW QUESTIONS ASK ABOUT YOUR EXPERIENCE HERE TODAY

1. Including yourself, how many people are in your party today? *(Fill in blank.)*

   _____ people in party

2. What time did you arrive ***at Monticello Reservoir*** today? *(Fill in blank.)*

   __________ am / pm

3. What is the primary recreation activity that you participated in today ***at Monticello Reservoir***? *(Please read the list to respondents. Check only one main activity in the first column.)*

   What other activities did you participate in today ***at Monticello Reservoir***? *(Check all that apply in the second column.)*

Check only one main activity	*Check all other activities*	*Types of Activities*
		FISHING:
☐	☐	***boat fishing***
☐	☐	***pier/dock fishing***
☐	☐	***bank fishing***
		BOATING:
☐	☐	***motor boating***
☐	☐	***pontoon/party boating***
☐	☐	***sailing***
☐	☐	***canoeing/kayaking***
☐	☐	***windsurfing***
☐	☐	***paddleboarding***
		OTHER:
☐	☐	***bicycling***
☐	☐	***tent or vehicle camping***
☐	☐	***horseback riding***
☐	☐	***walking/hiking/backpacking***
☐	☐	***sightseeing***
☐	☐	***hunting***
☐	☐	***nature study/wildlife viewing/photography***
☐	☐	***swimming***
☐	☐	***picnicking***
☐	☐	***sunbathing***
☐	☐	***other:***___________________________________

Check only *<u>one</u> main activity*	*Check all other activities*	*Types of Activities*
	☐	***None***

4. Did you spend any time ***on the water on Monticello Reservoir*** today? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 6.)*

5A. Did you recreate on any of the ***islands on Monticello Reservoir*** today?

☐ YES
☐ NO *(If no, skip to Question 6.)*

5B. What activities did you participate in ***while on the island(s)***? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

☐ sunbathing	☐ bank fishing	☐ hunting
☐ camping	☐ walking/hiking	☐ sightseeing
☐ nature study/wildlife viewing/photography	☐ swimming	☐ picnicking
☐ other (please specify: ____)		

6. On a scale from 1 to 5, with 1 being light, 3 being moderate, and 5 being heavy, how would you rate the crowdedness ***at this recreation site*** today? *(Circle one number.)*

Light		***Moderate***		***Heavy***
1	2	3	4	5

7A. On a scale from 1 to 5, with 1 being poor and 5 being excellent, how would you rate the overall condition ***of this recreation site*** today? *(Circle one number.)*

Poor				***Excellent***
1	2	3	4	5

7B. Why did you choose to come to ***this recreation site*** today? (*Fill in the blank.)*

____

____

____

____

7C. Are there any additional facilities needed ***at this recreation site***? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 8.)*

7D. What do you recommend? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

☐ access road	☐ bank fishing area	☐ boat dock
☐ boat launch	☐ camping area	☐ fish cleaning station
☐ fishing pier/dock	☐ lighting	☐ parking lot
☐ picnic tables/shelter	☐ restrooms	☐ signs & information
☐ swimming area	☐ trails	☐ trash cans
☐ RV camping	☐ tent camping	☐ bilingual signs & information
☐ other (please specify: ______________________________)		

7E. Are there any other improvements that you would recommend for this site?

☐ YES
☐ NO *(If no, skip to Question 8.)*

7F. What improvements do you recommend? *(Fill in the blank.)*

____

____

____

____

8. What was your primary reason for choosing to recreate ***at Monticello Reservoir*** today verses another lake or area? *(Fill in blank.)*

____

____

____

9. What ***other lakes*** do you recreate at? *(Fill in blank.)*

____

____

____

____

I HAVE JUST A FEW MORE QUESTIONS

10. Do you own a permanent or seasonal lakefront residence ***on Monticello Reservoir***? What is your zip code? *(Check one box and fill in the blank for zip code.)*

- ☐ YES – Permanent Home→ ZIP CODE: ____________
- ☐ YES – Seasonal Home → ZIP CODE: ____________
- ☐ NO - Non-lakefront resident → ZIP CODE: ____________

11. In what year were you born? *(Fill in blank.)*

___________ YEAR

12. Do you have any additional comments about the recreation facilities at ***Monticello Reservoir***? (*Please fill in blank and be as specific as possible.*)

____

____

____

____

____

____

THANK YOU FOR YOUR HELP! WE APPRECIATE YOUR TIME TODAY!

Parr Reservoir/Broad River Public Access Site Questionnaire

Clerk:________________ **Site:** ________________ **Date:** _______________ **Time:** ___________ **am/pm**

Weather: ☐ **Sunny** ☐ **Partly Cloudy** ☐ **Cloudy** ☐ **Light Rain** ☐ **Heavy Rain**

RESPONDENT GENDER: ☐ **Male** ☐ **Female**
NUMBER OF PEOPLE IN VEHICLE:
VEHICLE HAS A BOAT TRAILER: ☐
RESPONDENT REFUSED INTERVIEW: ☐
RESPONDENT DOES NOT SPEAK ENGLISH: ☐
RESPONDENT IS NOT 18 YEARS OR OLDER: ☐
RESPONDENT HAS BEEN INTERVIEWED AT THIS SITE PREVIOUSLY: ☐

THE FIRST FEW QUESTIONS ASK ABOUT YOUR EXPERIENCE HERE TODAY

1. Including yourself, how many people are in your party today? *(Fill in blank.)*

   _____ people in party

2. What time did you arrive ***at Parr Reservoir*** today? *(Fill in blank.)*

   __________ am / pm

3. What is the primary recreation activity that you participated in today ***at Parr Reservoir***? *(Please read the list to respondents. Check only one main activity in the first column.)*

   What other activities did you participate in today ***at Parr Reservoir***? *(Check all that apply in the second column.)*

Check only one main activity	*Check all other activities*	*Types of Activities*
		FISHING:
☐	☐	***boat fishing***
☐	☐	***pier/dock fishing***
☐	☐	***bank fishing***
		BOATING:
☐	☐	***motor boating***
☐	☐	***canoeing/kayaking***
		OTHER:
☐	☐	***tent or vehicle camping***
☐	☐	***horseback riding***
☐	☐	***walking/hiking/backpacking***
☐	☐	***Sightseeing***
☐	☐	***Hunting***
☐	☐	***nature study/wildlife viewing/photography***
☐	☐	***Swimming***
☐	☐	***Picnicking***
☐	☐	***Sunbathing***
☐	☐	***other:***____________________________________
	☐	***None***

4. On a scale from 1 to 5, with 1 being light, 3 being moderate, and 5 being heavy, how would you rate the crowdedness ***at this recreation site*** today? *(Circle one number.)*

Light		***Moderate***		***Heavy***
1	2	3	4	5

5A. On a scale from 1 to 5, with 1 being poor and 5 being excellent, how would you rate the overall condition ***of this recreation site*** today? *(Circle one number.)*

Poor				***Excellent***
1	2	3	4	5

5B. Why did you choose to come to ***this recreation site*** today? (*Fill in the blank.)*

____

____

____

____

5C. Are there any additional facilities needed ***at this recreation site***? *(Check one box.)*

☐ YES
☐ NO *(If no, skip to Question 6.)*

5D. What do you recommend? *(Do not read this list. Allow respondent to answer and check all that apply and/or fill in the blanks.)*

☐ access road	☐ bank fishing area	☐ boat dock
☐ boat launch	☐ camping area	☐ fish cleaning station
☐ fishing pier/dock	☐ lighting	☐ parking lot
☐ picnic tables/shelter	☐ restrooms	☐ signs & information
☐ swimming area	☐ trails	☐ trash cans
☐ RV camping	☐ tent camping	☐ bilingual signs & information
☐ other (please specify: ____)		

5E. Are there any other improvements that you would recommend for this site?

☐ YES
☐ NO *(If no, skip to Question 6.)*

5F. What improvements do you recommend? *(Fill in the blank.)*

____

____

____

____

I HAVE JUST A FEW MORE QUESTIONS

6. Do you own a permanent or seasonal residence ***on the Broad River***? What is your zip code? *(Check one box and fill in the blank for zip code.)*

- ☐ YES – Permanent Home→ ZIP CODE: ____________
- ☐ YES – Seasonal Home → ZIP CODE: ____________
- ☐ NO - Non-lakefront resident → ZIP CODE: ____________

7. In what year were you born? *(Fill in blank.)*

___________ YEAR

8. Do you have any additional comments about the recreation facilities on ***Parr Reservoir***? (*Please fill in blank and be as specific as possible.*)

____

____

____

____

____

____

THANK YOU FOR YOUR HELP! WE APPRECIATE YOUR TIME TODAY!

DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

Kleinschmidt

Lexington, South Carolina
www.KleinschmidtUSA.com

October 2013

DOWNSTREAM RECREATIONAL FLOW ASSESSMENT
STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
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October 2013

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

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DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

The Parr Hydro Development, in particular, forms Parr Reservoir along the Broad River. The Development consists of a 37-foot-high, 200-foot-long concrete gravity spillway dam with a powerhouse housing generating units with a combined licensed capacity of 14.9 MW. Parr Hydro operates in a modified run-of-river mode and normally continuously operates to pass Broad River flow. The 13-mile-long Parr Reservoir has a surface area of 4,400 acres at full pool and serves as the lower reservoir for pumped-storage operations at the Fairfield Pumped Storage Development.

The Project is currently involved in a relicensing process which involves cooperation and collaboration between SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established several Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

Accordingly, SCE&G organized a Recreation TWC (Appendix A), comprised of interested stakeholders who will collaborate with SCE&G to identify and make recommendations related to recreational needs and opportunities in the Project area. The TWC has requested that a study be designed and implemented that would assess flows downstream of the Parr Shoals Dam (Parr Dam) that provide quality recreational experiences and identify preferred flows for recreational activities, primarily as they relate to wade-angling, canoeing and kayaking.

2.0 PURPOSE OF THE STUDY

To fulfill the needs identified by the TWC, this study will serve to assess potential and identify preferred recreational flows downstream of the Parr Dam primarily as they relate to wade-angling, canoeing and kayaking. This study encompasses the following goals and objectives:

Goal 1: *Characterize currently available recreational opportunities on the Broad River, downstream of the Parr Dam, as they relate to wade-angling, canoeing and kayaking. This will be accomplished by meeting the following objectives:*

i. Utilize the information collected during focus group activities to identify the current patterns of non-motorized boating use on the Broad River, below the Parr Dam, by location and volume, and the quality of those activities.
ii. Estimate preferred flows and seasonal distribution associated with reasonable and safe recreational use of the Broad River, below Parr Dam, for target activities.

Goal 2: *Evaluate potential issues related to portage around Parr Dam. This will be accomplished by meeting the following objectives:*

i. Identify the need among paddlers for portage opportunities around Parr Dam through focus group discussions.

3.0 STUDY AREA

The Project boundary, as defined by FERC, does not encompass the Broad River below the Parr Dam. However, operation of the Parr Development affects and could serve to enhance recreational opportunities below Parr Dam. As noted, SCE&G currently operates the Parr Dam in a modified run-of-river capacity.

For this study, the geographic scope will begin at the base of the Parr Dam and encompass limited downstream areas of the Broad River (Figure 1). Focus group discussions will be directed toward recreational wading and boating flow opportunities as they relate to representative hydraulic conditions (i.e. runs, pools, and rapids) in identified reaches of the Broad River. Should Phase 2 be implemented, as discussed below, the specific areas of any on-water evaluations/verifications within the study reach will be chosen with regards to access and in consultation with the TWC/focus group.

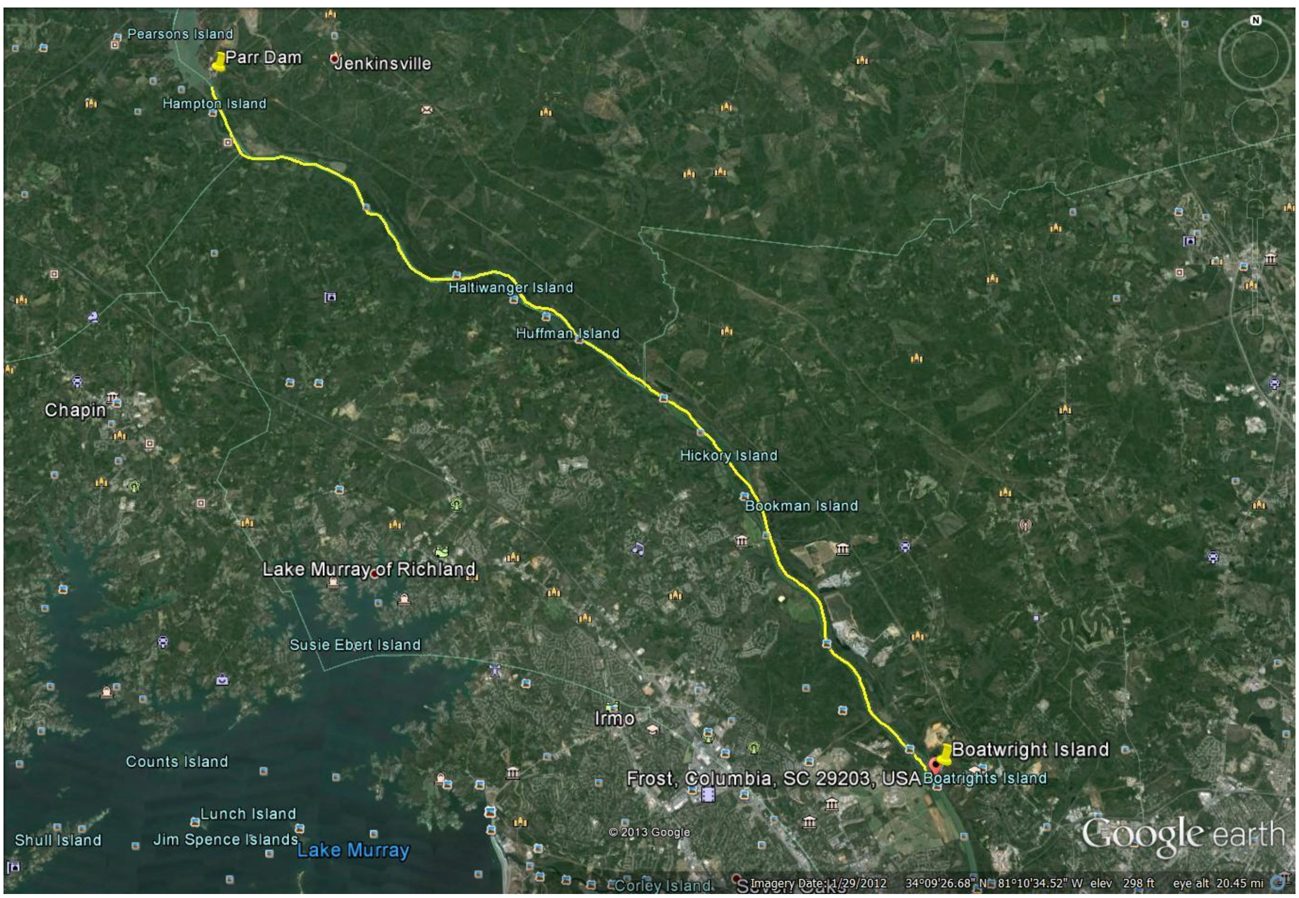

FIGURE 1 DOWNSTREAM RECREATIONAL FLOW ASSESSMENT STUDY REACH

4.0 METHODOLOGY

Information gathered for this study will be used to examine the suitability of the Broad River, downstream of the Parr Dam, for different recreational activities under various flow ranges. The study may involve a one or two-phase approach, depending upon the outcome of Phase 1, to meet the goals of the study through the objectives identified above. Phase 1 will involve convening a panel of experienced anglers, paddlers, NGOs and agency staff familiar with the study reaches to assess the feasibility and potential quality of particular flow ranges for specified on-water activities. Pertinent existing information will also be reviewed as it relates to this effort. Phase 2 will involve an on-site evaluation with members of the TWC and/or focus group convened during Phase 1, if the information gleaned during Phase 1 activities does not serve to meet study goals.

In addition to these efforts, the planned Project Recreation Use and Needs Study will provide information regarding recreational opportunities, patterns and levels of use on the Broad River, primarily above the Parr Dam. This data may be utilized in association with the data gathered from Phase 1 and, potentially, Phase 2 efforts.

4.1 PHASE 1 - FOCUS GROUP AND EXISTING INFORMATION REVIEW

A panel of knowledgeable and experienced parties will be formed to collect and disseminate information regarding recreation opportunities and potential flow effects on recreation on the Broad River downstream of the Parr Dam. The panel will include local paddlers/outfitters, anglers, canoe/kayak clubs, and members of the TWC. Focus group discussions will be conducted to identify and document characteristics of the Broad River within the Study Area with respect to the nature, seasonal distribution, and quality of target on-water activities and preferred river flows.

Existing information about the Broad River channel, hydrology, and flow data for the Broad River in the vicinity of the Project, will be compiled and reviewed to determine if there is any information or data pertinent to this effort. Literature searches will be conducted via the web, libraries, and SCE&G and agency and NGO collections.

4.2 PHASE 2 - SITE RECONNAISSANCE

Contingent upon discussions with the TWC and panel members under Phase 1, a site reconnaissance may be necessary to augment existing information and for the field verification of preferred recreational flows. Critical areas for evaluation will be pre-determined in consultation with the TWC. Information gained from mesohabitat studies may also aid in the identification of instream hydraulic alterations and may provide useful information for selecting on-water evaluation areas. The TWC and panel will observe and assess the quality of target recreational activities at the pre-determined locations and at the preferred flow ranges determined as part of the Phase 1 analysis.

5.0 DELIVERABLES

A draft and final report will be prepared for this effort. The draft report will be reviewed internally by the Recreation TWC and the Lake and Land Management and Recreation Resource Conservation Group (RCG). Comments and edits from the TWC will be incorporated into a Final Report for the relicensing effort. The report will include an executive summary, an introduction, objectives, methods and the resulting recommendations for recreational flows.

6.0 SCHEDULE

The proposed schedule for completion of the Downstream Recreational Flow Assessment is as follows:

TASK	DATE
Focus Group Meeting 1 and Literature Review	September – October 2014
Focus Group Meeting 2	September 2015
Phase 2 Panel Reconnaissance	October - November 2015
Submit Draft Report	2016
TWC Review	2016
Submit Final Report	2016

7.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, RT&E TWC, and other relicensing stakeholders.

8.0 REFERENCES

South Carolina Department of Parks, Recreation and Tourism, Recreation, Planning and Engineering Office. 2008. South Carolina Statewide Comprehensive Outdoor Recreation Plan.

University of South Carolina. 2005. South Carolina Recreation Participation & Preference Study. Prepared for the South Carolina Department of Parks, Recreation and Tourism. (Online) [URL]: http://www.scprt.com/files/RPE/2005%20Rec%20Study.pdf

Whitaker, Doug, Bo Shelby, and John Gangemi. 2005. Flows and Recreation: A Guide to Studies for River Professionals. October 2005.

DOWNSTREAM NAVIGATIONAL FLOW ASSESSMENT STUDY PLAN

DRAFT
DOWNSTREAM NAVIGATIONAL FLOW ASSESSMENT STUDY PLAN

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
Cayce, South Carolina

Prepared by:

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December 2013

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(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

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The Project is currently engaged in a relicensing process which involves cooperation and collaboration among SCE&G, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals. The collaboration and cooperation is essential to the identification of and treatment of operational, economic, and environmental issues associated with a new operating license for the Project. SCE&G has established Technical Working Committees (TWC's) with members from among the interested stakeholders with the objective of achieving consensus regarding the identification and proper treatment of these issues in the context of a new license.

The Recreation TWC has requested that flows downstream of the Parr Shoals Dam (Parr Dam) be assessed during planned Instream Flow Incremental Methodology (IFIM) studies to determine if downstream flows currently facilitate one-way navigation at an identified point of constriction in the Broad River, downstream of the Project. Although the primary purpose of the IFIM study is to develop an understanding of key habitat-flow relationships for aquatic species in the Broad River, the IFIM study also provides an appropriate means of determining consistency with navigational goals under various flow scenarios.

2.0 STUDY OBJECTIVE

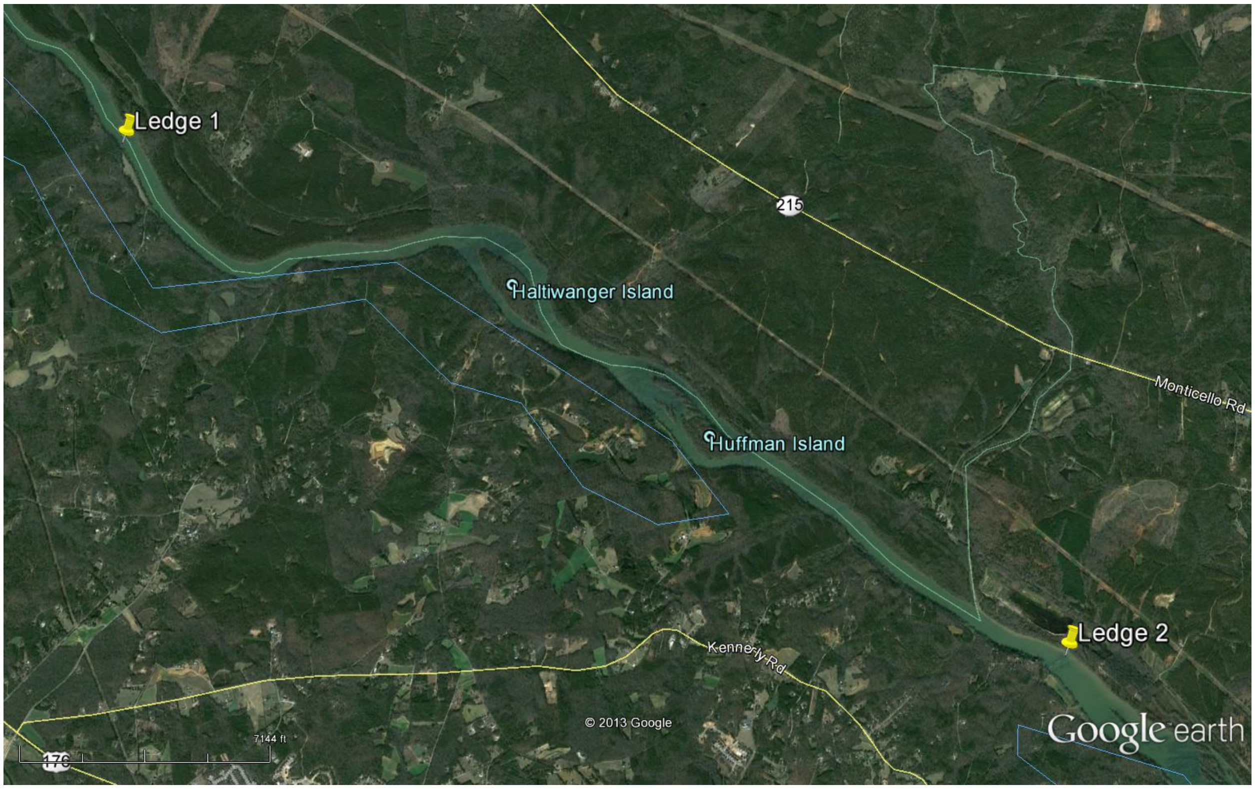
The objective of the navigational analysis is to assess the flow levels within the Broad River, at identified points of constriction, needed to facilitate one-way navigation. The criteria for one-way navigation can be defined as a "minimum depth of one foot across a channel 10 feet wide or across 10 percent of the total stream width, whichever is greater. Minimum depth does not need to occur across a continuous 10 percent of the stream width, but each point of passage must be at least 10 feet wide." One-way navigation criteria are based on the passage of a 14 foot Jon-boat without a motor in the downstream direction only (SCWRC, 1988).

Although not included within scope of this study, two-way navigation is defined as a "minimum depth of two feet across a channel 20 feet wide or across 20 percent of total stream width, whichever is greater. Minimum depth does not need to occur across a continuous 20 percent of stream width, but each point of passage must be at least 10 feet wide." Two-way navigation criteria are based on the passage of a 14 foot Jon-boat with a motor in either direction (SCWRC, 1988).

3.0 GEOGRAPHIC AND TEMPORAL SCOPE

The navigational analyses will evaluate flows within the Broad River at points of navigational constriction downstream of the Parr Dam. Recreation TWC participants initially identified two points of potential constriction. These points, identified as "Ledge 1" and "Ledge 2", were further investigated during Parr mesohabitat studies and are defined below. See Figure 1 for location of the two points of navigational constriction.

FIGURE 1 POTENTIAL POINTS OF NAVIGATIONAL CONSTRICTION



Ledge 1. Ledge 1 is located at a lat/long of 81°15’46.507”W, 34°12’49.999”N, approximately 2.4 miles upstream of Haltiwanger Island. Field investigations have identified a navigational passage point on river right (looking downstream) that is approximately 45 ft wide with an approximate elevation change of 1.5 feet. Please see Figure 2; the passage point is within the red circle.

FIGURE 2 LEDGE 1 IDENTIFICATION AND AREA OF NAVIGATIONAL PASSAGE

Ledge 2. Ledge 2 is located 1.3 miles upstream of Hickory Island and approximately 0.5 miles downstream of the mouth of Little River. Ledge 2 has a lat/long of 81°10'15.941"W, 34°10'18.154"N, and an approximate elevation change of 1.5 to 2.0 feet. Field investigations have identified a navigational passage point on river right (looking downstream) that is approximately 60 ft wide. Please see Figure 3; the passage point is within the red circle.

FIGURE 3 LEDGE 2 IDENTIFICATION AND AREA OF NAVIGATIONAL PASSAGE

The navigational analyses will be conducted during the summer of 2015 concurrent with IFIM study efforts.

4.0 METHODOLOGY

IFIM study transects will include the representative locations of navigational constriction identified in Section 3.0, to allow the characterization of hydraulics (wetted depth and width) during a range of flows. The transect locations will be field blazed with flagging, recorded via GPS, or other appropriate means. The study sites will be mapped sufficiently to quantify the areas represented by the transects. Consistent with IFIM survey protocol, transect headpin and tailpin ends will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. A measuring tape accurate to 0.1-foot will be secured at each transect to enable repeat field measurements, if necessary. Stream bed and water elevations tied to a local datum will be surveyed to the nearest 0.1-foot using standard optical surveying instrumentation and methods. If USGS gage data is not available, a staff gage may be placed at the study site to confirm stable flow during measurements. Survey activities are anticipated to take place at a flow of 400 cfs. A water level logger will also be placed at the transect locations to gather water surface elevation data under various flow events. Water surface elevations will be used to develop stage-discharge relationships for the site and the stage-discharge relationships will be assessed on whether one-way navigation is achieved.

Information obtained during survey activities will be included within the draft IFIM report that will be submitted to the study team for review and comment. The report will document the methods and results as encountered in the field. Supporting data will be presented in graphic and tabular form and appendices will include cross-sectional survey data and reference photographs of study sites.

The methodology for this analysis may be revised or supplemented based on consultation with the Instream Flow TWC and other interested stakeholders, or if field efforts so dictate.

5.0 SCHEDULE AND REPORTING

Data will be gathered during the IFIM study, anticipated to occur in 2015. A final report summarizing IFIM study findings, including an analysis of impediments to one-way navigation under various flow conditions, will be issued subsequent to the completion of field work.

6.0 USE OF STUDY RESULTS

Study results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the South Carolina Department of Natural Resources, USFWS, the Instream Flows TWC, and other relicensing stakeholders.

7.0 REFERENCES

South Carolina Water Resources Commission (SCWRC). 1988. Instream Flow Study Phase II: Determination of Minimum Flow Standards to Protect Instream Uses in Priority Stream Segments: A Report to the South Carolina General Assembly. Available Online. [URL]: http://scwaterlaw.sc.gov/Instream%20Flow%20Study%20ph2.pdf. Accessed August 2013.

PARR SHORELINE MANAGEMENT PLAN OUTLINE

SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

Prepared for:

South Carolina Electric & Gas Company
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Prepared by:

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December 2014

Shoreline Management Plan
Parr Reservoir

Parr Hydroelectric Project
(FERC No. 1894)

Prepared for:

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December 2014

SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

PREAMBLE FOR RELICENSING PROCESS

Since initiating the Parr Fairfield Hydroelectric Project (FERC No. 1894) (Project) relicensing process, South Carolina Electric & Gas Company (SCE&G) has held initial consultations with resource agencies and other interested stakeholders and has subsequently formed the Lake and Land Management and Recreation Resource Conservation Group (RCG) and the Lake and Land Management Technical Working Committee (TWC), a sub-group to the RCG. RCG members have agreed that the mission of the Lake & Land Management and Recreation Resource Conservation Group should, in part, be to develop a consensus based Shoreline Management Plan (SMP) that identifies appropriate shoreline activities within the Project boundary and guidelines that provide a structure that helps to ensure these activities are conducted in a manner to avoid or minimize environmental impacts. In depth reviews of, and the resulting proposal for changes to, the existing SMP have been undertaken by the TWC. TWC members have worked together to develop the enclosed draft outline for a revised SMP. TWC members will continue to work together through this relicensing to populate the SMP outline in a consensus-based manner with the goal of developing an SMP consistent with project purposes and one that addresses the needs of the public.

SHORELINE MANAGEMENT PLAN
PARR RESERVOIR

PARR HYDROELECTRIC PROJECT
(FERC NO. 1894)

SOUTH CAROLINA ELECTRIC & GAS COMPANY

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SOUTH CAROLINA ELECTRIC & GAS COMPANY

EXECUTIVE SUMMARY

[*Summarize the purpose of the SMP, goals and objectives of the SMP, brief description of project purpose and project history and operations, a brief description of shoreline classifications, brief description of the types of permitted uses]*

1.0 INTRODUCTION

[General Project Details and History of the Shoreline Management Plan. Include an updated Map of the Project]

2.0 PURPOSE AND SCOPE OF THE SHORELINE MANAGEMENT PLAN

[Discuss the purpose of the SMP and balance that it assists in providing between developmental, recreational and environmental issues]

3.0 HISTORY OF THE SHORELINE MANAGEMENT PLAN

[Include discussion on the history of the Project and a discussion of the history of development surrounding the Project. Also discuss FERC approval of the current SMP.]

3.1 CURRENT SMP DOCUMENT AND SHORELINE CLASSIFICATIONS

3.2 PROJECT BOUNDARY

4.0 SHORELINE MANAGEMENT PLAN GOALS AND OBJECTIVES

[Discuss specific goals related to the relicensing process, and consultation that has taken place]

4.1 CONSULTATION

4.1.1 RECREATION/LAKE AND LAND MANAGEMENT RESOURCE CONSERVATION GROUP

4.1.2 LAKE AND LAND MANAGEMENT TECHNICAL WORKING COMMITTEE

4.1.3 MEETING SCHEDULE

5.0 LAND USE CLASSIFICATIONS

[Identify and define the various land use classifications]

5.1 PROJECT OPERATIONS

5.2 PUBLIC RECREATION

5.2.1 ISLANDS AND SHOALS

5.2.2 WILDLIFE MANAGEMENT AREAS

5.3 NON-DEVELOPMENT AREAS

6.0 LAND USE PRESCRIPTIONS

[*Discuss the land management prescriptions, as administered through the permitting handbook, and the guiding principles regarding the management of SCE&G-owned lands within each classification*]

6.1 PROJECT OPERATIONS

6.2 PUBLIC RECREATION

6.2.1 ISLANDS AND SHOALS

6.2.2 WILDLIFE MANAGEMENT AREAS

6.3 NON-DEVELOPMENT AREAS

7.0 SHORELINE ACTIVITIES REQUIRING SCE&G APPROVAL

[Discuss the activities and structures requiring approval through SCE&G's permitting program]

7.1 AUTHORIZED ACTIVITIES REQUIRING APPROVAL THROUGH THE PERMITTING HANDBOOK

7.2 PROHIBITED STRUCTURES AND ACTIVITIES

8.0 PERMITTING PROCESS FOR SHORELINE ACTIVITIES OR STRUCTURES

8.1 SHORELINE PERMITTING PROCEDURES

8.1.1 SHORELINE VEGETATION MANAGEMENT

8.1.2 ACCESS PATH

8.1.3 WATER WITHDRAWAL

9.0 SCE&G PERMITTING FEE POLICIES

[FERC allows SCE&G the right to charge a reasonable fee to cover the costs of administering the Shoreline Permitting Program. Discussion of any fee policies and public notice of changes in fee policies will be included within this section]

10.0 ENFORCEMENT OF SHORELINE MANAGEMENT PLAN

10.1 VIOLATIONS OF SHORELINE MANAGEMENT PLAN

11.0 SHORELINE MANAGEMENT PRACTICES

[Discussion of programs promoted by SCE&G to protect and improve the Project shorelines through the use of Shoreline Management Practices]

11.1 SCE&G SHORELINE MANAGEMENT PRACTICES

11.1.1 FOREST MANAGEMENT SHORELINE MANAGEMENT PRACTICES

11.2 LANDOWNER RECOMMENDED BMPS

11.2.1 MINIMIZING NON-POINT SOURCE POLLUTION

12.0 PUBLIC EDUCATION AND OUTREACH

12.1 SHORELINE MANAGEMENT PLAN EDUCATION

12.2 PUBLIC ACCESS AREA MAPS

12.3 WATERFOWL HUNTING ON PARR RESERVOIR

12.4 WATER SAFETY

13.0 MONITORING AND REVIEW PROCESS

[*Discussion of GIS, or other methods by which SCE&G will monitor changes in land use over time. Also, discuss the recommended SMP review cycle and any changes to the review cycle]*

13.1 OVERALL LAND USE MONITORING

13.2 REVIEW PROCESS

14.0 REFERENCES

MONTICELLO SHORELINE MANAGEMENT PLAN OUTLINE

SHORELINE MANAGEMENT PLAN
MONTICELLO RESERVOIR

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(FERC NO. 1894)

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MONTICELLO RESERVOIR

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5.1 PROJECT OPERATIONS

5.2 NUCLEAR EXCLUSION ZONE

5.3 SHORELINE PERMITTING

[Discuss dock approval and exclusion areas]

5.4 PUBLIC RECREATION

5.4.1 ISLANDS

5.4.2 RECREATION LAKE

5.5 NON-DEVELOPMENT AREAS

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8.1.1 DOCKS

8.1.2 SHORELINE VEGETATION MANAGEMENT

8.1.3 ACCESS PATH

8.1.4 SHORELINE STABILIZATION

8.1.5 WATER WITHDRAWAL

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11.1.3 WOODY DEBRIS & STUMP MANAGEMENT

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HYDRAULIC & PROJECT OPERATIONS MODEL STUDY PLAN

FINAL STUDY PLAN HYDRAULIC & PROJECT OPERATIONS MODEL

PARR HYDROELECTRIC PROJECT

FERC NO. 1894

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April 2014

FINAL STUDY PLAN
HYDRAULIC & PROJECT OPERATIONS MODEL

PARR HYDROELECTRIC PROJECT

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Prepared for:

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April 2014

FINAL STUDY PLAN
HYDRAULIC & PROJECT OPERATIONS MODEL

PARR HYDROELECTRIC PROJECT

FERC NO. 1894

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FINAL STUDY PLAN
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PARR HYDROELECTRIC PROJECT

FERC NO. 1894

SOUTH CAROLINA ELECTRIC & GAS COMPANY

1.0 INTRODUCTION

South Carolina Electric & Gas Company (SCE&G) is the Licensee of the Parr Hydroelectric Project (FERC No. 1894) (Project). The Project consists of the Parr Hydro Development and the Fairfield Pumped Storage Development. Both developments are located along the Broad River in Fairfield and Newberry Counties, South Carolina.

This document provides a detailed outline of the process proposed to complete a Hydrologic and Project Operations Model as part of the Parr and Fairfield relicensing project. These models will be used to assess ability to provide potential changes to project operations, and the resulting effects of potential modifications to operations of the projects. These models will primarily focus on the effects that may result from proposed changes in project operation on energy, capacity, water budget, and flood control. The intent of this effort is to develop a series of high-level fully functional modeling tools, which can be used to incorporate stakeholder requests as parameters to provide outputs and results that can be easily interpreted.

2.0 STUDY OBJECTIVES

2.1 HISTORIC INFLOW HYDROGRAPH DEVELOPMENT

Critical to the operations of hydroelectric projects is the hydrology, which generally requires using the best available gage data to determine local contributing flows. Unless there is a gage immediately upstream of the project headpond, the inflows can be derived by pro-rating available gages, to account for any ungaged drainage area between the respective gages and the site, and then summing the values. Alternatively, a downstream gage can be used to back-calculate inflow using the respective daily reservoir level and evaporation estimates. The goal of this task is to create the best available historic inflow series, which will form the input to the operations models, energy models, and habit and recreational studies.

2.2 HYDRAULIC MODELING

The operations of Parr and Fairfield may affect recreational or habitat interests on the downstream reach of the river. Rapid changes in flow result in a wave (either positive or negative) that propagates downstream, potentially affecting habitat, stream channel stability, and recreational opportunities. The hydraulics of this wave are affected by both translation and attenuation as it progresses downstream. The impacts of existing and proposed modifications to operations (if any) can best be evaluated with a 1-D hydraulic model, which will allow the evaluation of the unsteady flow wave along the downstream reach under several different operating conditions. The goal of this study is to either construct a model (or utilize an existing model) that will evaluate stage (water level), discharge, and velocity with time, along the Broad River downstream of the Parr Dam.

2.3 OPERATIONS MODEL

The Parr-Fairfield project includes several components that need to be included in an operational model. These include the Parr Dam and powerhouse hydraulic capacities, the Fairfield Pumped Storage project operational parameters (for both pumping and generating), the Monticello Reservoir, and the Parr Reservoir. The operations of this system have historically been closely coordinated for the primary purpose of supporting the electrical grid (both demand and stability). SCE&G will need to maintain this coordination during future operating conditions. Additionally, any potential changes to operations in the future will need to be evaluated for effects on dam safety, and operating rules or limitations. This is best accomplished by developing a comprehensive operation model. The goal of this task is to assess and quantify historic operations and limits, and to incorporate these rules into a comprehensive and flexible operations model that can be easily modified to simulate proposed future operations. We propose using the HEC-Res Sim model to investigate headpond fluctuations and associated hydro generation hours that SCE&G could have.

2.4 SCENARIO COMPARISON

SCE&G will develop a process for Technical Working Committees/Resource Conservation Groups (TWCs/RCGs) and stakeholders to submit scenarios to be analyzed and compared to evaluate potential future operations and their effects. The operations model will be used to run submitted scenarios. Results will be reviewed by the TWCs/RCGs during a series of meetings. Model results will be summarized and integrated into the final recommendations presented in the license application.

2.5 SUMMARY STATISTICS

With several integrated modeling efforts, each including possibly several different scenarios, it is critical to develop summary tables and/or summary metrics for each scenario. The goal of this task is to consider each of the studies, and the potential set of results, and develop a standardized means of summarizing and quantifying the results. As an example, it may include the number or percent of flood days changed from baseline conditions, the change in habitat area, the change in streamflow variance, or the increase/decrease in potential MWh. Using the summary statistics, stakeholders and TWC members can prioritize their requests and work to minimize the negative aspects of operational changes.

3.0 STUDY DOMAIN

The focus of this study includes the Parr Reservoir (defined as the elevation of the top of the crest gates, or El. 266.0'), the Fairfield Pumped Storage facility and the Monticello Reservoir, and the Broad River downstream of Parr Shoals Dam extending to and including Frost Shoals, near Boatwright Island.

Members of the Operations RCG expressed an interest in the Project's potential effects on the Congaree National Park (CNP). However, due to the complexities associated with the confluence of the Saluda and Broad Rivers upstream of the CNP, both of which are independently regulated by other hydro projects, the proposed operations model will not extend to the CNP. Rather, the Parr Project's potential to alter flows at the CNP will be statistically determined for specific flows or seasons of interest that are submitted from the TWCs or RCGs.

4.0 METHODOLOGY

4.1 INFLOW HYDROGRAPH DEVELOPMENT

Development of the inflow hydrograph can be accomplished by two methods: the use of upstream gages prorated to the dam's drainage area, or the use of the gage immediately downstream with detailed information of the project's past operations. In the case of the Parr model, the upstream gage proration method will be used, due to the limited availability of detailed Project operation data. Historic data will be reviewed to determine the period of record and time increment to be used to represent project inflow. The proposed inflow data will be reviewed by the Operations RCG for agreement.

4.1.1 UPSTREAM GAGE PRORATION

Proration of streamflow gages, in order to account for ungaged drainage area, is not necessarily a linear relationship. In order to evaluate the regional relationship between runoff and drainage area, two unregulated stream gages on the same river with overlapping records is required. The only gages that meet this in the immediate Parr Dam watershed are two gages on the Enoree River. These two gages will be used to assess an appropriate proration coefficient (α) and exponent (γ), which may be used to regionally prorate all of the gages required in construction of an historic inflow series.

An equation that may be used with the fitted regional coefficients to determine inflow to Parr is below, where the values are the ratios of the total area to gaged area for each gage location. Additionally, these gages are at different distances from the Parr Reservoir, and drain through different channels, thus the arrival times should be adjusted accordingly. The angled brackets denote a routed hydrograph series.

$$Parr\ Inflow = \langle \alpha * BRC \left(\frac{3250.8}{2790}\right)^{\gamma} \rangle + \langle \alpha * TRD \left(\frac{807.9}{759}\right)^{\gamma} \rangle + \langle \alpha * ERW \left(\frac{731.3}{444}\right)^{\gamma} \rangle$$

where,

BRC – Broad River at Carlisle
TRD – Tyger River near Delta
ERW – Enoree River at Whitmire
α – Fitted Regional Coefficient
γ – Fitted Regional Exponent
⟨…⟩ - Routed Translation

Routing will be completed using a simplified Muskingum approach, and will allow for wave attenuation and travel time, which are more critical for shorter period flows. Daily flow rates would not require this routing, as the average daily flows can simply be summed.

During the development of the hydrologic dataset, the statistical modeling approach and individual gage coefficients may be adjusted to increase data correlation. This has the potential to increase the accuracy of model simulations for inflow conditions that are of greater interest to stakeholders. Details of potential adjustments will be presented to the RCG for comment via memo, with a solicitation for flows (or ranges of flow) of interest. The dataset will be finalized by maximizing correlation across the target range of flows submitted by the RCG.

TABLE 1 SUMMARY OF AVAILABLE HYDROLOGIC DATA

DATA SOURCE	PERIOD OF RECORD	DATA TYPE
Parr Reservoir (#02160990)	10-1-1984 to Current	Stage
Broad R. at Alston (#02161000)	10-1-1896 to Current	Stage & Discharge
Congaree R. at Congaree NP (#02169625)	10-1-1984 to 8-9-2013	Stage
Broad River at Blair (#02160750)	9-11-2010 to 3-7-2013	Discharge
Broad River near Carlisle (#02156500)	10-1-1938 to Current	Stage & Discharge
Broad River below Neal Shoals (#021564493)	3-27-2012 to 9-26-2013	Stage & Discharge
Broad River at Diversion Dam (#02162100)	10-1-1987 to 9-24-2012	Stage
Enoree River at Whitmire (#02160700)	10-1-1973 to Current	Stage & Discharge
Enoree River near Woodruff (#02160390)	2-9-1993 to Current	Stage & Discharge
Tyger River near Delta (#02160105)	10-1-1973 to Current	Stage & Discharge
Fairfield Pumped Storage Generation/Flow	TBD	Discharge
Monticello Reservoir	TBD	Stage

4.2 HYDRAULIC MODELING

The downstream reach of the Broad River below Parr Shoals Dam will be modeled using the Army Corps of Engineers' HEC-RAS v4.1, which is a 1-dimensional model that will allow correlation between flow releases from Parr Reservoir and resulting water level stage in the river downstream. Wave travel times, rates of rise, and stage recession times will also be available from this model. Readily available data will be used for developing the model. The model will be developed to include the hydraulic affects of flow releases down to the Frost Shoals area near Boatwright Island (approximately 20 miles downstream of the Parr Shoals Dam). The results of the model will be used to determine flow estimates for other interests in the project, such as navigation, recreation, or habitat benefits.

4.3 OPERATIONS MODEL

Development of the operations model includes two major tasks: develop the rules and patterns from historical operations, and secondly use these rules to construct a model for testing alternative scenarios. Success of this task can be measured by the ability of the model to replicate historical operations, but can also be measured by the ease and flexibility of testing future scenarios that produce easily interpreted results by stakeholders and TWC members (i.e., important information is not lost in modeling details). The operations model can become quite complicated very quickly, thus to successfully accomplish both of these goals, an appropriate model framework using the best available data is required early in the process.

4.3.1 OPERATION RULES & REGULATIONS

Not only is hydrology a stochastic process, but operating history and generation (pumping/generating) can also be stochastic as a response to weather patterns, random outages, increased grid demand, changes to grid support via addition of other generators, low flow periods, or even differences in decisions between operators using forecast data. Therefore, it is impossible to state explicit rules that define the operating regime for any of the projects, but both extreme limits (i.e., minimum/maximum pond levels, or minimum/maximum flow rates, rates of change, etc.) may be extracted from specified rules, curves, or observations of the system. Additionally, subjective operational patterns may be inferred from historic operations (i.e., typical pumping volumes in June are a certain amount, generating is typically highest during a given period of the week, etc.). Both the hard and soft rules are important for developing an understanding of conjunctive project operations. Although the rules may not exactly depict the operations at any given point in time, from either the past or the future, they should be able to depict the expected system response.

Several key components of data will be concurrently analyzed:

- pond operating levels (Parr Dam & Monticello Reservoir)
- spillway gate operating guidelines
- pumping rates (Fairfield)
- generation rates (Parr & Fairfield)
- rates of change from generation flows
- typical generation periods (time of day, weekday, months)
- seasonal influences
- influence of low river flow conditions boundary
- influence of high river flow conditions boundary
- influence of water withdrawals from Monticello Reservoir
- potential impacts of future upstream and downstream water withdrawals on project inflow and downstream effects.

In order to appropriately define typical system responses, detailed historic information is required. This includes as available:

- hourly (or finer) generation records for Parr & Fairfield
- Parr and Monticello Reservoir stage records
- meteorological data (precipitation, temperature)
- river flow gage records

These records will be reviewed, plotted, regressed, and inferred upon to develop an understanding of 'typical' system responses. Again, exact operations for a complicated system are impossible due to the stochastic nature of all influences, but typical rules may be inferred.

4.3.2 OPERATIONS MODEL FRAMEWORK

Once a comprehensive understanding and documentation of typical operating rules has been developed, they may be used within a modeling framework to replicate historic operations (validation process), and then test future or altered operating conditions.

The model will be constructed at hourly time steps to allow testing of different release rates and spilling events from the Parr Dam, and/or operating conditions at Fairfield. Longer durations may miss critical operating responses, and unnecessarily short time steps would be excessive and not add additional value. The duration of the validation period will vary based on the available data, but should cover as many sequential years as manageable.

The operations model will be developed using the Army Corps of Engineers HEC-Res Sim software package. This package is freely available, easily integrates with other models (such as HEC-RAS), and has the capacity to model multiple projects (including the Fairfield pumped-storage) with a range of complex and even contradictory operating rules. Results of the model are easily viewed either within HEC-Res Sim, or externally using the HEC-DSSVue software package.

4.4 SCENARIO COMPARISON

From the early development of the study plan, model runs should be sufficiently detailed to outline how the projects' operations will be tested. For example, what river flows are critical (low flows to high flows) and should be emphasized? What rates of generation are important, and how quickly can they be changed? A matrix defining each scenario, and how each component of the project is being operated, should be developed. This will naturally confine modeling efforts, and maintain focused efforts for comparison by the TWC members and stakeholders.

4.4.1 STATISTICS

Statistics are valuable for concisely summarizing the nature or property of a random or stochastic variable. For example, the sample mean is commonly used to describe a set of data, but additional information may be obtained from higher order moments (variance, skew, kurtosis). The critical statistic (metric) should be determined early in the study process for each study or model output. For example, the total habitat area may be critical, the average generating rate, the 1% exceedance flow rate, the variance in water levels during a critical period, the maximum headpond level, the 7Q10 flow rate, etc. are all examples of summary statistics. These should be discussed early, and concurrence with working groups or stakeholders should be achieved early in the process to determine what is considered critical.

Additional examples of potential flow statistics include:

- rise-fall rates
- mean, median, quartile flow rates
- variance, skew, kurtosis
- autocorrelation function & partial autocorrelation function lags
- flow-duration curves
- excess distribution functions and conditional excess distribution functions
- 7Q10 flow
- 5, 10, 50, 100-year peak flows
- stage-duration curves (Parr Reservoir)

5.0 REPORTING

A preliminary report documenting the development of the operations model will be provided to the RCG for review prior to the completion of the model. This preliminary report will include the methods and information as follows:

- discussion of model data acquisition
- inflow hydrograph development
- development of future inflow hydrograph(s)
- hydraulic 1D model development & calibration
- operations model development & verification
    - Parr Operations
    - Fairfield Pumping/Generating

Following a comment period, a demonstration session will be conducted to familiarize interested stakeholders with the implementation of the HEC-Res Sim and HEC RAS models for this Project. During this session, the input data and Project parameters will be reviewed, and a “hands-on” session can be conducted to allow stakeholders to learn how to run the model. After the demonstration session is conducted, the final model will be developed and used to analyze operations scenarios.

A final report will document methods and results as encountered in the modeling effort, including:

- scenario results
- hydraulic routing model
- operations model
- energy modeling
- scenario comparison matrices & statistics

6.0 SCHEDULE

Data collection and model development will begin no later than the spring of 2015, with a preliminary report documenting the development of the model completed by the end of 2015. The methodology for this modeling effort may be revised or supplemented based on consultation with TWCs and other interested stakeholders. Model results will be used as an information resource during discussion of relicensing issues and developing potential Protection, Mitigation and Enhancement measures with the SCDNR, USFWS, TWCs/RCGs and other relicensing stakeholders. The final report, which will include the scenario results, will be completed for filing with the final license application.

APPENDIX I

CULTURAL RESOURCES

FILED SEPARATELY UNDER PRIVILEGED INFORMATION

INITIAL HISTORIC AND ARCHAEOLOGICAL RESOURCES STUDY (PRIVILEGED)

PHASE I CULTURAL RESOURCE INVESTIGATION
(PRIVILEGED)

APPENDIX J

CURRENT NET INVESTMENT
(PRIVILEGED)

APPENDIX K

PROJECT SINGLE LINE DRAWINGS
FILED SEPARATELY UNDER (CEII)