Aquatic Habitat Whitepaper

Stevens Creek Hydroelectric Project
FERC No. 2535

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1.0 INTRODUCTION

Dominion Energy South Carolina, Inc. (DESC) is the licensee of the Stevens Creek Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 2535) (Project). The Project, which has an installed capacity of 17.28 megawatts (MW), is located in Edgefield and McCormick counties, South Carolina and Columbia County, Georgia, at the confluence of Stevens Creek and the Savannah River. The Project's dam (Stevens Creek Dam) is located approximately 1 mile upstream of the Augusta Diversion Dam (ADD) and approximately 13 miles downstream of the U.S. Army Corps of Engineers (USACE) J. Strom Thurmond Dam (Thurmond Dam). The surface area of the Stevens Creek Reservoir is 2,400 acres at the normal full pond elevation (EL) of 187.5 feet. The Project drainage area is approximately 7,122 square miles.

DESC operates the Project to generate clean, renewable energy and re-regulate highly variable river flows discharged by the USACE from the Thurmond Dam. The normal operating target range for the Project is to provide an hourly discharge of +/- 15 percent of the scheduled daily average discharge from Thurmond Dam, if the actual discharge from Thurmond Dam is within 500 cubic feet per second (cfs) of the scheduled discharge.

On November 22, 1995, FERC issued a 30-year license which is scheduled to expire on October 31, 2025. DESC intends to file an application for a new license with FERC on or before October 31, 2023. The Project is currently involved in a relicensing process which involves cooperation and collaboration between DESC, as licensee, and a variety of stakeholders including state and federal resource agencies, state and local government, non-governmental organizations, and interested individuals. DESC established a Water Quality, Fish and Wildlife Resource Conservation Group (RCG), with interested stakeholders to address Project issues related to aquatic and terrestrial resources.

As part of relicensing, DESC has collected existing information and developed several study plans in consultation with the RCG that will be used to characterize the Project area and vicinity. The information collected is summarized below and is intended to assist the licensee, resource management agencies, and other interested entities in understanding the aquatic resource surrounding the Stevens Creek Project as it relates to fish passage goals, diadromous fishes in the region, the baseline aquatic environment, and in decision making processes applicable for the Project's upcoming new license term.

2.0 DESCRIPTION OF THE BASIN

The Savannah River is one of the largest rivers in the southeastern United States, with a drainage area of more than 10,000 square miles (Entrix 2002a). The Savannah River begins at the confluence of the Seneca and Tugaloo rivers in northern Georgia, flowing 300 miles southeasterly through the Piedmont and Coastal Plain physiographic provinces before entering the Atlantic Ocean near Savannah, Georgia. The headwaters of the Savannah River Basin originate in the Blue Ridge Mountains. The Project is within the Middle Savannah River Valley, near the upper end of the Fall Line, a 20-mile-wide geologic boundary that divides the Piedmont and Coastal Plain physiographic provinces; the Fall Line in Georgia and South Carolina is the first location inland from the Atlantic Ocean where sets of rock rapids occur in the Savannah River. The Project is approximately 8 river miles (RMs) upstream of Augusta, Georgia, and 209 RMs from the Atlantic Ocean. The Savannah River forms most of the border between Georgia and South Carolina (Figure 1).

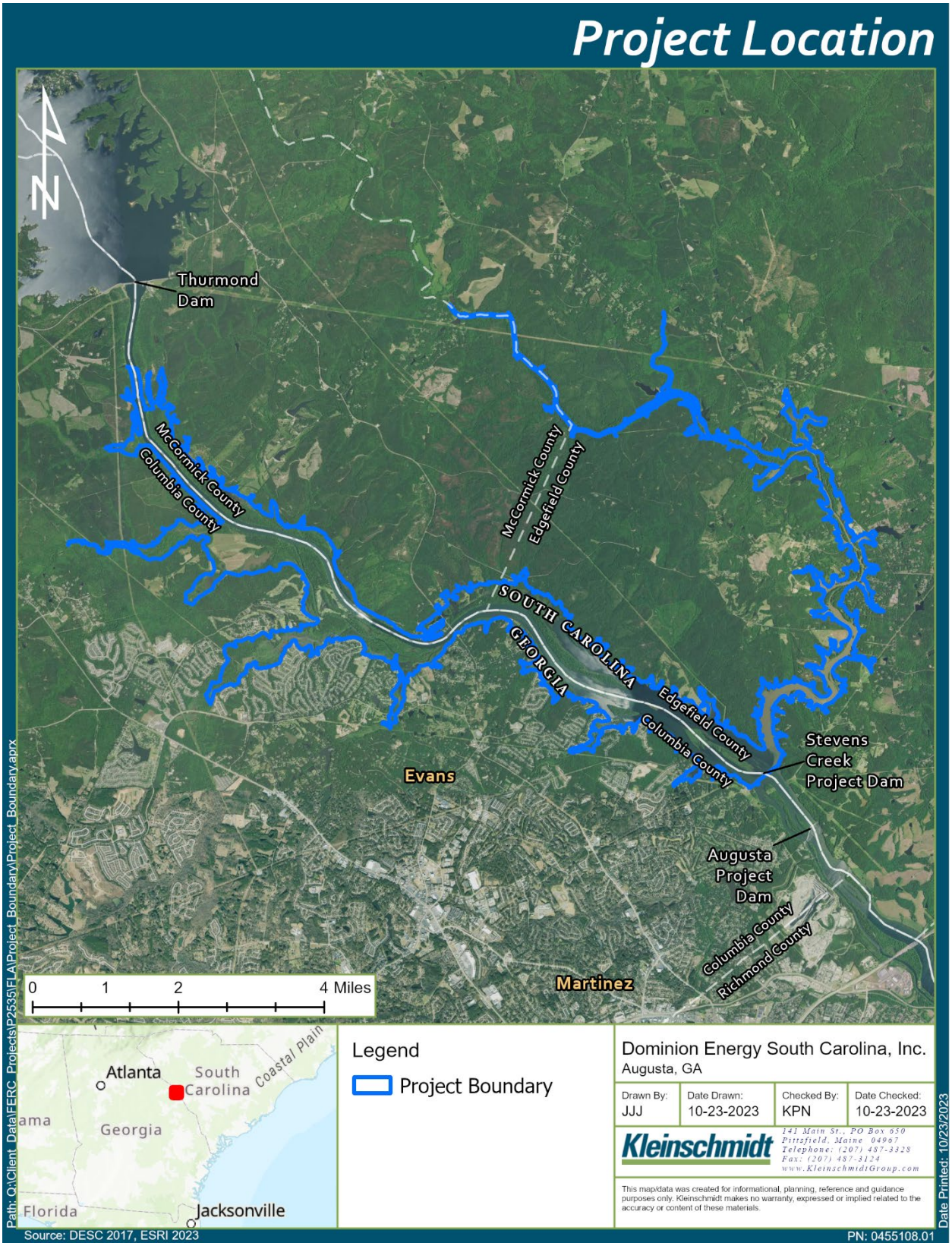

Figure 1 Project Location Map

2.1 Land Use in the Project Area

The Savannah River Basin is predominantly rural with widely spaced population centers. Augusta, Georgia, with a population of approximately 200,000, is the main urban center near the Project. The Project area includes public and private lands, such as national forest, private timber lands, rural residential developments,and some agriculture lands (FERC 1995). Land on the Georgia side of the Project area is privately owned with intermittent rural residential development. Most of the land in South Carolina is associated with the Sumter National Forest (SNF), which is managed for recreation and timber. Agricultural use of the land is limited, and forested uplands dominate the landscape. DESC owns a small amount of land within the Project boundary and retains flowage easements for the remainder of land within the Project boundary.

2.2 Water Use in the Project Area

DESC operates the Project to generate hydropower and re-regulate flows from USACE dams to downstream water users. The USACE is authorized by Congress to manage the Hartwell, Richard B. Russel, and J. Strom Thurmond Hydroelectric projects for water supply, water quality, hydropower production, flood risk management (originally called flood control), downstream navigation, recreation, and fish and wildlife management.

The Augusta Canal, a 13-mile-long historic and functional canal, is fed by the Savannah River and was designed to harness waterpower at the Fall Line to drive mills, provide transportation of goods, and provide a municipal water supply. It is the only canal in the United States in continuous use for its original purposes of providing power, transport, and municipal water. Today, the Augusta Canal provides drinking water to the city of Augusta, recreational and tourism opportunities (e.g., guided tours), and hydropower. Average annual river flow diverted to the Augusta Canal ranges from 2,000 to 3,000 cfs (USGS 2022).

Municipalities and industries have water withdrawals and discharge treated wastewater into the Savannah River in compliance with state permitting requirements. Entities near the Project withdrawing from or discharging to the Savannah River include the cities of Augusta and North Augusta, Columbia Water and Sewer, and Edgefield Water and Sewer. Large industries that use the river include Kimberly-Clark in Beech Island, South Carolina, the Vogtle nuclear power plant near Waynesboro, Georgia, and the U.S. Department of Energy's Savannah River Site in Aiken, South Carolina. The Columbia County Water

System, Georgia, is currently permitted to withdrawal 45.90 million gallons/day from the Stevens Creek Reservoir (GAEPD 2017).

2.3 Dams and Diversion Structures in the Basin

The USACE operates three hydropower projects upstream of the Project: Hartwell, Richard B. Russel, and J. Strom Thurmond (Figure 2). The three reservoirs form a chain along the Georgia-South Carolina border for a length of 120 miles. Thurmond Dam, located at RM 220.9, is the most downstream of these projects and is operated primarily for peaking hydroelectric production and flood risk management. The Thurmond Dam is approximately 13 RMs upstream of the Project. There are also two dams and smaller reservoirs downstream of the Project: the ADD and the New Savannah Bluff Lock and Dam (NSBLD). The ADD is one mile downstream of the Project and the NSBLD is approximately 20 RMs downstream of the Project (Figure 2). The upper portion of the Savannah River is highly regulated by the three USACE hydropower projects. The status of fish passage at these facilities is detailed further within Section 4.1.

2.4 Tributary Rivers and Streams

Stevens Creek

Stevens Creek is a major tributary of the Savannah River that is within the Project boundary. Stevens Creek is approximately 48 RMs in total length and discharges into the Savannah River just upstream of the Stevens Creek Dam. The Project boundary encompasses the lowermost 12 RMs of Stevens Creek, which is impounded, exhibiting sluggish flow regimes and substrates of sand and soft sediments. Upstream of the Project boundary, Stevens Creek and the tributaries within its subbasin are less influenced by impoundments and operation of the Thurmond Dam and Stevens Creek Dam. Farther upstream within the Stevens Creek subbasin, stream exhibit more variable flows and a mix of substrates that support a diverse and healthy aquatic community and support mussel species of conservation concern.

Other Direct Tributaries to the Project Area

Numerous other tributary streams directly enter the Savannah River within the Project boundary and include several larger named streams on the Georgia side of the Project area. The Project is located at the Fall Line, which is the transition between the Piedmont and Coastal Plain physiographic ecoregions. Many of the perennial streams and numerous tributaries entering the Project area (and the Fall Line in general), can quickly transition

from higher gradient, incised, Piedmont streams, into low gradient Coastal Plain streams as they enter the Savannah River floodplain. These streams, particularly on the Georgia side of the Project area, have high sediment loads resulting from historic agricultural practices, as well as recent local developments and land clearing. On the South Carolina side, tributary streams are generally within rural areas and national forests are less influenced by recent developments and impervious surfaces. However, these streams were still influenced by poor historic farming practices during the cotton era of the 1800s. In their upper reaches, these tributary streams are greatly incised with steep banks, and are generally flashy during rain events. Increased water velocities result in scour and bank erosion. As these streams approach the Savannah River floodplain, the streams widen, slow, and sediments are deposited and accumulated.

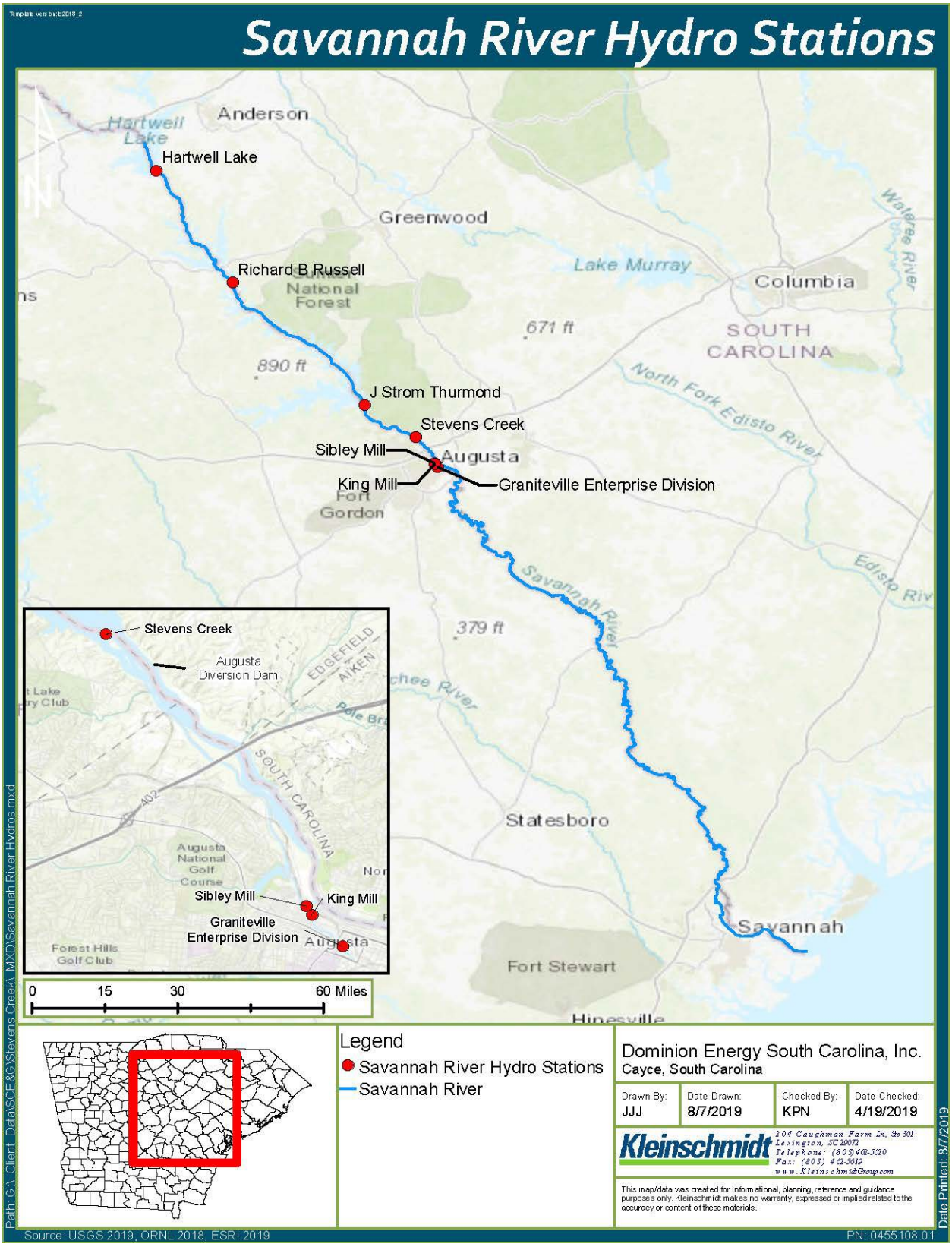

Figure 2 Hydroelectric Projects on the Savannah River

3.0 SPECIES OF INTEREST AND HABITAT NEEDS

3.1 Rare, Threatened, and Endangered Species and Other Species of Interest

Studies conducted by South Carolina Department of Natural Resources (SCDNR) in Stevens Creek Reservoir resulted in the collection of 2,686 fish representing 28 species (Bettinger and Bulak 2019). Within the Savannah River arm of the study area, coastal shiner (*Notropis petersoni*) was the dominant species, followed by bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), redear sunfish (*Lepomis microlophus*), redbreast sunfish (*Lepomis auritus*), and yellow perch (*Perca flavescens*) (Bettinger and Bulak 2019). During the same study, bluegill, redear sunfish, spotted sucker (*Minytrema melanops*), largemouth bass, and redbreast sunfish were the dominant species collected in Stevens Creek proper (Bettinger and Bulak 2019). However, for this document, species of interest are limited to aquatic species that are rare, threatened, or endangered (RTE), species of conservation concern, or migratory species that potentially occur within the Project vicinity. This includes species that are known to occur within a three-mile buffer around the Project boundary and proposed, endangered, threatened, or sensitive (PETS) species that occur in the Long Cane Ranger District of the SNF (See Appendix A for agency coordination). In addition, fishes that are of conservation concern, are important mussel hosts, or migratory species are included.

Table 1 Aquatic Species of Interest That May Occur in the Stevens Creek Project Area

Common Name	Scientific Name	US Status	State Status	Category
Invertebrates				
Brook Floater	*Alasmidonta varicosa*	-	-	USFS SNF Sensitive
Atlantic Spike	*Elliptio producta*	-	-	-
Roanoke slabshell	*Elliptio roanokensis*	-	-	USFS SNF Sensitive
Yellow Lampmussel	*Lampsilis cariosa*	-	-	USFS SNF Sensitive
Rayed Pink Fatmucket	*Lampsilis splenda*	-	-	USFS SNF Sensitive
Carolina Heelsplitter	*Lasmigona decorata*	E	-	USFS SNF Sensitive

Common Name	Scientific Name	US Status	State Status	Category
Eastern Creekshell	*Villosa delumbis*	-	-	-
Lean Crayfish	*Cambarus strigosus*	-	GA T	
Piedmont Prairie Burrowing Crayfish	*Distocambarus crockeri*	-	-	USFS SNF Sensitive
Fishes				
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	GA E SC E	Migratory (Anadromous)
Shortnose Sturgeon	*Acipenser brevirorostrum*	E	GA E SC E	Migratory (Anadromous)
American Shad	*Alosa sapidissima*	-	-	Migratory (Anadromous)
Blueback Herring	*Alosa aestivalis*	-	-	Migratory (Anadromous)
Hickory Shad	*Alosa mediocris*	-	-	Migratory (Anadromous)
American Eel	*Anguilla rostrata*	-	-	Migratory (Catadromous)
Rosyface Shiner	*Hybopsis rubrifrons*	-	-	
Highfin Shiner	*Notropis altipinnis*	-	-	
Notchlip Redhorse	*Moxostoma collapsum*	-	-	
Robust Redhorse	*Moxostoma robustrum*	ARS	GA E	Migratory (Potamodromous)
Snail Bullhead	*Ameiurus brunneus*			
Flat Bullhead	*Ameiurus platycephalus*	-	-	
Striped Bass	*Morone saxatilis*	-	-	Migratory (Anadromous)
Bartram's Bass	*Micropterus coosae*	-	-	Migratory (Locally)
Carolina Darter	*Etheostoma collis*	-	-	
Christmas Darter	*Etheostoma hopkinsi*	-	-	
Turquoise Darter	*Etheostoma inscriptum*	-	-	

E = Endangered, T = Threatened, ARS = At-Risk Species

3.2 Unionids

3.2.1 Native Freshwater Mussels within the Project Vicinity

Atlantic Spike

The Atlantic spike (*Elliptio producta*) is found throughout South Carolina and prefers streams or rivers with sandy, rocky, and/or muddy bottoms in sections where the current is moderate. This species is found throughout Maryland, Pennsylvania, North Carolina, Virginia, and South Carolina. Atlantic spike was once synonymized with yellow lance (*Elliptio lanceolata*) (Johnson 1970) but is now considered a separate species. The species appears relatively stable throughout its range and is widespread in South Carolina (Bogan and Alderman 2004). The host fish for this species is not known.

Carolina Heelsplitter

The Carolina heelsplitter (*Lasmigona decorata*) is found in cool, well-oxygenated reaches of rivers and streams. The current range of this species is limited as compared to its historic range. The decline and loss of populations are associated with factors including pollutants from municipal and industrial wastewater releases. The species is sensitive to silt and is generally found in silt-free areas with banks that are stabilized and shaded by trees and shrubs. One of the ten surviving South Carolina populations of Carolina heelsplitter is found in Turkey Creek and its tributaries upstream of the Project boundary. The Carolina heelsplitter population in Turkey Creek was stocked by the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), and the SCDNR in 2019. These creeks are part of the Savannah River drainage, located in Edgefield County, South Carolina. Numerous stream fishes, predominantly cyprinids and centrarchids, serve as host fish for the Carolina heelsplitter (Eads et al. 2010).

Brook Floater

The brook floater (*Alasmidonta varicose*) is a freshwater mussel species that is usually found in high gradient, consistently flowing reaches of rivers and streams. Preferred substrates are characterized by sand and gravel, often with adjacent boulders. This species is sensitive to habitat degradation, including excessive silt and nutrient inputs, and is also sensitive to hypoxia. Brook floater is considered a host generalist, being able to use a variety of fish species as its reproductive hosts, which varies by drainage (Eads et al. 2007; Wicklow et al. 2017, Skorupa et al. 2022). This species is known to occur in Edgefield and

McCormick counties in South Carolina. Specifically, it has been documented in several streams in the Stevens Creek Basin.

Roanoke Slabshell

The Roanoke slabshell (*Elliptio roanokensis*) is typically found in large rivers and occasionally in small creeks. Host fishes for this species are unknown but are expected to be anadromous fishes. The mussel tolerates large variations in flow levels and higher water temperatures, making it able to survive in some locations near dams and hydroelectric plants. However, the species is rarely found upstream of large barriers, presumably because of restricted upstream movements of migratory host fish species (SC SWAP 2015). In South Carolina, the mussel is found in the Pee Dee River and the Catawba, Congaree, and Savannah River basins. Although it has the potential to be found in watersheds in the Long Cane Ranger District in the Savannah River Basin, no known records in the SNF exist.

Yellow Lampmussel

The yellow lampmussel (*Lampsilis cariosa*) is a freshwater mussel species found primarily in medium to large rivers and streams with a variety of substrates, including silt or sand, gravel bars, and bedrock cracks. Not much is known about host species for yellow lampmussel, but species may include yellow perch (*Perca flavescens*) and white perch (*Morone americana*) (NRCM 2008). Distribution in South Carolina spans the Savannah, Broad, Wateree, Congaree, and Pee Dee River basins. The species is found in the Long Cane Ranger District in the Lower Stevens Creek and Turkey Creek—Stevens Creek watersheds with the potential to also occur in the Upper Stevens Creek watershed.

Rayed Pink Fatmucket

Rayed pink fatmucket (*lampsilis splendida*) (sometimes referred to as eastern lampmussel [*Lampsilis radiata*]) due to taxonomic uncertainty) occurs from the Altamaha River Basin in Georgia northward to the Cape Fear River Basin in North Carolina. This species is found in muddy and sandy areas in streams, rivers, and blackwater swamps, and appear sensitive to channel modification, pollution, sedimentation, and low oxygen conditions (Taxonomic Expertise Committee 2004). The species is known to use largemouth bass as a host species (Johnson et al. 2012).

3.2.2 Existing Information in the Project Vicinity

A mussel study plan for the Project was developed in consultation with the USFWS, Georgia Department of Natural Resources (GADNR), SCDNR, and the RCG. The purpose of study was to gather quantitative and qualitative data on the diversity, spatial distribution, and relative abundance of the mussel fauna occurring in portions of Stevens Creek, Little Kiokee Creek, and Uchee Creek within the Stevens Creek Project boundary. Mussel studies were not proposed for the Savannah River mainstem portion of the Stevens Creek Reservoir. In accordance with the study plan, a mussel survey took place in accessible portions of the aforementioned streams in October 2021. Detailed results of this survey were presented in the 2021 Mussel Study Executive Summary submitted to the RCG in June 2022.

In general, lotic habitats were of poor quality with slow flows or stagnant conditions across all sampling locations. The areas with the greatest potential habitat suitability were surveyed, but the majority of surveyed areas were unsuitable for mussels. No live mussels were observed in any of the sampling locations. However, two mussel species (eastern elliptio [*Elliptio complanata*] and eastern creekshell [*Villosa delumbis*]) were documented in Stevens Creek through the observance of shell fragments. In general, these impounded areas exhibit low base flow, but are subject to flashy discharge events during heavy precipitation, fluctuations in water level, and flows during power generation activities at Thurmond Dam. Additionally, benthic habitats were poor, with substrates that were primarily loose, mobile sands, clay bottoms with heavy silts and sediment loads, or dense aquatic vegetation. Further, stream margins and banks were bare of vegetation, formed of dense clay, and exhibited little in-channel structure or protection like rootwads or woody debris. Based on the lack of live mussel specimens and the observed habitat conditions in the accessible portions of Stevens Creek, Little Kiokee Creek, and Uchee Creek, mussel occurrence within the survey areas, particularly RTE species, is unlikely.

Although poor mussel habitats were observed within the Project boundary, it should be noted that a portion of the Stevens Creek watershed, farther upstream from the surveyed reach, outside of the Project boundary and the effects of impoundment, is of global conservation significance because of its high mussel diversity and presence of many rare species. Tributaries, such as Mountain Creek, Little Stevens Creek, and Sleepy Creek, provide habitat for the federally listed Carolina heelsplitter. Stevens Creek, upstream from the Project boundary, and many of its headwater tributaries also provide habitat for several mussel taxa of significant conservation concern.

Numerous other mussel surveys have taken place in the Stevens Creek subbasin outside of the Project area. Researchers found nine live freshwater mussel species in the Augusta Shoals area, located near RM 203, in 2002: Carolina slabshell (*Elliptio congarea*), sad elliptio (*Elliptio lugubris*), Roanoke slabshell, variable spike (*Elliptio icterina*), pod lance (*Elliptio folliculate*), Carolina spike, eastern elliptio, Florida pondhorn (*Uniomerus carolinanus*), and eastern creekshell (Entrix 2002a). No state or federally threatened or endangered freshwater mussel species were found (Entrix 2002a).

In 2006, the Catena Group inventoried freshwater mussels in the Savannah River from the Augusta Shoals area (near RM 203) downstream to estuarine waters (near RM 23). The Catena Group identified 26 species of freshwater mussels during the survey, noting that diverse and viable mussel populations occur throughout the Savannah River. Carolina slabshell, eastern elliptio, and Roanoke slabshell were the most common native species; however, the most abundant bivalve throughout the Savannah River drainage was the Asian clam (*Corbicula fluminea*) (Catena Group 2007). The Catena Group identified 15 freshwater mussel species that occur downstream of the Project (i.e., between RM 203 and RM 196.2). Two rare species (Atlantic pigtoe [*Fusconaia masoni*] and brother spike [*Elliptio fraternal*]) were described as "potentially occurring" based on pending DNA testing. The Atlantic pigtoe, which the USFWS listed as a threatened species in 2021, is presumed extirpated from the southern portion of its range, including the Savannah River Basin. The brother spike is a state-threatened species in South Carolina and Georgia.

In 2017, Alderman Environmental Services, Inc. performed freshwater mussel surveys along approximately 38 miles of stream within the SNF in McCormick, Greenwood, and Edgefield counties, South Carolina. Stream miles surveyed are outside of, but adjacent to, the Stevens Creek arm of the Project boundary. Biologists documented four freshwater mussel species during survey activities. These included eastern elliptio (23 live/36 shells), sad elliptio (1 live), eastern creekshell (3 live/1 shell), and Atlantic spike (8 live). Asian Clam was also observed within most streams surveyed. Substrate compositions observed during survey streams varied from mostly sand and gravel, to silt, sand, gravel, pebble, cobble, boulder, and bedrock. Beaver activity was observed on most survey streams. Alderman noted that the relatively low numbers of mussels observed was likely due to sediment accumulation and transport within stream valleys (Alderman 2017).

3.3 Migratory Fish Species

Historically, the Savannah River Basin supported seven diadromous species: American shad (*Alosa sapidissima*), blueback herring (*Alosa aestivalis*), hickory shad (*Alosa*

mediocris), American eel (*Anguilla rostrata*), striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and shortnose sturgeon (*Acipenser brevirostrum*). All seven species are known to occur downstream of the ADD presently. striped bass and blueback herring occur throughout the USACE reservoirs due to stocking efforts to establish a game fishery. Atlantic sturgeon and shortnose sturgeon are listed as endangered species under the Endangered Species Act (ESA). Atlantic sturgeon and shortnose sturgeon historically migrated throughout the Savannah River to reach spawning or rearing grounds at the Augusta Shoals.

3.4 Sturgeons (Atlantic and Shortnose)

3.4.1 Life History

Juvenile Atlantic sturgeon spend their first years in fresh or brackish waters of rivers prior to migrating to the ocean to mature. Adults participate in long spawning migrations back into freshwater rivers, where they spawn over hard clay, rubble, or gravel bottom with well-oxygenated waters (Vladykov and Greely 1963). Adults in South Carolina inhabit rivers and estuary habitats from March through November and occupy the Atlantic Ocean in the colder months (Collins et al. 2000).

Shortnose sturgeon prefer deeper areas with soft substrate and vegetated bottom and enters the ocean less frequently than Atlantic sturgeon (Rhode et al. 2009). In general, adults are found in deep waters during winter and shallow waters in the summer (Dadswell et al. 1984). Juveniles inhabit deep river channels above the salt wedge (Dadswell et al. 1984) or immediately downriver of the freshwater/saltwater boundary (Hall et al. 1991). Upriver spawning migrations in the Savannah River were observed from mid- February to mid-March over submerged timber, scoured sand, and clay and gravel substrates at depths of 6-9 meters and bottom velocities of 82 centimeters per second (Hall et al. 1991).

3.4.2 Existing Information within the Project Vicinity

The National Marine Fisheries Service (NMFS) is responsible for the protection of threatened and endangered anadromous and marine fish species. Atlantic sturgeon and shortnose sturgeon, two species that inhabit freshwater seasonally, are listed under the ESA as threatened and endangered, respectively. These species are not known to occur in the Project area at this time; however, there is potential for the species to occur in the future, following the implementation of fish passage downstream of Stevens Creek Dam (i.e., NSBLD and ADD).

Critical habitat for Atlantic sturgeon (designated in 2017 by NMFS) begins at the mouth of the Savannah River at the Atlantic Ocean and extends upstream to the NSBLD, which is located at RM 180, approximately 20 RMs downstream of the Project. There is no designated critical habitat for shortnose sturgeon.

In 2013, the USACE Savannah District committed to monitor the distribution of sturgeon in the Savannah River Estuary as part of the Savannah Harbor Expansion Project (SHEP). Monitoring was contracted to SCDNR and included a telemetry study pre-construction, during construction, and post-construction on both Atlantic and shortnose sturgeon (Post et al. 2018). SCDNR documented 13 adult and two juvenile shortnose sturgeon migrating upstream near RM 130 (Post et al. 2018). Shortnose sturgeon have been observed moving into the potential spawning areas near RM 130 during late winter and early spring over a five-year period (2014 through 2018) (Post et al. 2018). Similarly, SCDNR documented four adult Atlantic sturgeon making presumed spawning runs to potential spawning habitat between RM 104 and to within approximately 9 RMs of NSBLD during late winter and early spring during the same time period (GADNR 2017; Post et al. 2018). Juveniles of both species tend to stay lower in the river system closer to the estuaries (GADNR 2017, Post et al. 2018, Collins et al. 2002). Hall et al. (1991) reported that shortnose sturgeon made spawning runs upstream to between RM 111 and 118 and between RM 170 and 172; Collins and Smith (1993) reported that shortnose sturgeon made spawning runs upstream to between RM 111 and 141. GADNR reports that shortnose and Atlantic sturgeon may inhabit the Savannah River up to or near the NSBLD at RM 180.

3.5 Alosines

The Savannah River, particularly around the NSBLD, was historically home to a recreational shad fishery. The NSBLD serves as a partial migration barrier, where migrating fish congregate each year during spawning. Until 2014, recreational anglers used the NSBLD site to harvest congregating shad. The USACE closed access to the site due to safety concerns regarding the deteriorating wingwall, which reduced shad angling activities at the NSBLD (GADNR 2022). Although the NSBLD is a barrier, and was designed for navigation, the structure provides very limited fish passage, where migrating fish may utilize the lock structure during high flows. When flows are greater than 453 cubic meters per second, water levels are roughly equal, and allow fish to pass through the lock and dam (ASMFC 2017). The first obstruction without the ability for alosines to pass is the ADD. This migration barrier results in migrating adult alosines (i.e., blueback herring,

American shad, and hickory shad) having access to only 66 percent of the historical riverine habitat (SCDNR/GADNR 2020).

Because the Savannah River occurs in both Georgia and South Carolina, annual monitoring for alosids within the river is a combined effort between SCDNR and GADNR, as required by the Atlantic States Marine Fisheries Commission (ASMFC). The Savannah River Alosine Fishery is considered sustainable by GADNR and SCDNR at its current population level and existing fishing regulations (SCDNR 2017).

3.5.1 General Life History of Alosines and Existing Information within the Project Vicinity

Blueback Herring

Blueback herring spend their life within the Atlantic Ocean until ascending coastal rivers during spring spawning migrations. The egg, larva, and small juveniles remain in freshwater. Larger juveniles migrate downstream into estuaries, where they feed, grow, and migrate into the ocean. Spawning usually peaks in the first week of March, and success depends on the presence of clean vegetation and other material for egg adhesions (Bulak and Christie 1981, Rhode et al. 2009). Tidal, freshwater-breached impoundments and relict rice fields are heavily utilized for spawning by blueback herring in the Cooper River drainage of South Carolina (Christie et al. 1981). Introduced blueback herring occur in the main stem of the Savannah River and as landlocked populations within the upstream USACE reservoirs (i.e., Lake Hartwell, Russell, and Thurmond) because of fishery management efforts and angler activities (Rhode et al. 2009, ASMFC 2017). Non-coastal, landlocked or reservoir-dwelling blueback herring living in open waters typically move closer to shore for spawning, utilizing rocky shorelines or ascending flowing tributaries (Rhode et al. 2009). Blueback herring coming from the ocean typically enter the Savannah River in the spring and out-migrate as young of year fish in the fall. Blueback herring may pass the NSBLD during high water conditions (locking activities have not occurred at the NSBLD in recent history).

A survey conducted by SCDNR in 2018 evaluated the abundance of forage fishes in the Stevens Creek Reservoir between the Thurmond Dam and Stevens Creek Dam. Blueback herring were the most predominant forage species, followed by golden shiner (*Notemigonus crysoleucas*) and threadfin shad (*Dorosoma petenense*) (Bettinger and Bulak, 2019). Density of forage species were highest in August, particularly in the lower section of the reservoir, just upstream of Stevens Creek Dam. In November, densities remained

the highest in the lower two-thirds of the reservoir, but smaller fishes (<200mm) were more predominant than larger (>200mm) forage fishes (Bettinger and Bulak, 2019).

Hickory Shad

Similar to blueback herring, adult hickory shad (*Alosa mediocris*) spend their adult life in the Atlantic Ocean, migrating into freshwater from late winter to early spring to spawn. Spawning habitats include tidal freshwaters such as creeks, flooded swamps, sloughs, and other backwater tributaries to a main channel (Rhode et al. 2009). Small juveniles remain in freshwater for the summer but return to higher salinity waters by fall. Hickory shad are more piscivorous than other alosines, feeding on fish, small crabs, insects, squid, and fish eggs.

In South Carolina, hickory shad have sporadic occurrences in the lower reaches of Coastal Plain rivers. Within the Savannah River, the species is only known to occur below the Fall Line, with one capture in Lake Hartwell, which was presumably from angler introduction (Rhode et al. 2009).

American Shad

American shad are widely distributed along the Atlantic coast and occur in all the Coastal Plain drainages (Rhode et al. 2009). Similar to other alosines, schools of adults live in the Atlantic Ocean and ascend coastal rivers upon maturity to spawn. After hatching, larvae and young remain in the lower portions of the coastal river and estuaries to feed and grow. American shad rarely occur above the Fall Line but are highly established in Coastal Plain portions of major rivers and stream systems. However, this restriction is attributed to historic ranges in the upper reaches of the Atlantic Slope watersheds being unreachable through the construction of dam that impede migration. In the Savannah River, American shad begin spawning in tidal freshwater near river kilometer (km) 64 (McCord 2003) and have about 237 km of suitable spawning habitats below NSBLD (SCDNR/GADNR 2020). Fish passage techniques have been employed at the NSBLD to provide an additional 32 km of mainstem Savannah River to the base of the ADD, which is the first barrier with no dedicated fish passage (SCDNR/GADNR 2020). However, these fish passage techniques have not been implemented since 2014. A study within the vicinity of NSBLD tracked tagged American shad in 2001 and 2002 (Bailey et al. 2004). In 2001, over 50 percent of tagged American shad passed through the lock and dam structure, whereas 9 percent passed through NSBLD in 2002. The study concluded than American shad were not

uniformly distributed throughout the study area and predominantly grouped immediately below NSBLD and in a large pool approximately 3.75 miles downstream of the lock and dam. The population of American shad that reached the NSBLD study area was estimated to be 157,685 and 217,077 in 2001 and 2002, respectively (Bailey et al. 2004). This study confirmed that spawning habitat generally follows that found in other studies (Walburg and Nichols 1967, Beasley and Hightower 2000), with the species utilizing sand and gravel areas below an obstruction. Habitat utilization in these areas is twofold, where migration barriers prevent further upstream movements, and the areas below such barriers exhibit substrates free of fine sediments and silt.

3.6 American Eel

3.6.1 Life History

The American eel (*Anguilla rostrata*) is a catadromous species known to occur within river systems of Georgia and South Carolina. Mature American eels spawn in the Atlantic Ocean where the egg and pre-larval stages mature into the larvae leptocephalus stage. Larvae drift with ocean currents for approximately one 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 can overcome obstacles that often prevent passage of other aquatic species. Vertical obstacles, such as a dam, can be traversed by small eels provided 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°C and continue until water temperatures reach approximately 22°C (Haro 1991). Hammond and Welsh (2009) studied the movements of radio-tagged yellow eel near Millville Dam on the Shenandoah River, West Virginia, and found the onset of upstream migration in the spring to be associated with an increase in river discharge when water temperature exceeded 15°C. Welsh and Liller (2013) investigated the association between daily counts of upstream migrant yellow eel at the Mill Dam eel fishway and the environmental variables of lunar illumination, river discharge, and water temperature. They found elevated river discharge to be associated with almost all peaks of daily eel counts when water temperature ranged from 19 to 28°C. Mass upstream migration was observed during an extreme discharge event whereas little yellow eel movement was indicated during low discharge periods. Low lunar illumination was

also associated with higher counts of upstream migrants (Welch and Liller 2013). More recent studies in North Carolina, Maryland, Massachusetts, and New York further support for high flows, increased water temperature, and low lunar illumination triggering upstream movements of American eel (Mack and Cheatwood 2022).

3.6.2 Existing Information within the Project Vicinity

Although the American eel currently does not have special status under the state of Georgia or federal regulations, it has been identified by SCDNR as a priority species (SCDNR 2005). The 12-month findings published in 2015 by the USFWS states stressors on the American eel populations range wide are not of sufficient imminence, intensity, or magnitude to indicate a danger of extinction throughout all of its range.

Currently, there is limited information on American eel populations present within the Stevens Creek Project vicinity. However, fisheries surveys within the Stevens Creek Reservoir and downstream of the Project have confirmed the presence of American eel both upstream and downstream of the dam. Fisheries surveys completed in 1984 within the Savannah River and the adjacent Augusta Canal, downstream of the Project, showed American eel were the sixth most abundant fish (and fourth by biomass) in the fisheries community in the Savannah River and Augusta Canal study area (Entrix 2002b). Fish sampling completed in the spring of 2001 immediately downstream of NSBLD resulted in collecting a few adult specimens and observing a large congregation of juvenile eels approximately 6 inches in length (Entrix 2002b). More recent fisheries surveys completed by SCDNR (Bettinger and Bulak 2019) documented the presence of American eel within the Stevens Creek Reservoir, albeit in relatively low abundances compared to the total fisheries community observed. The presence of American eel above the Project suggest yellow eels are finding passage upstream. Means of passage could include climbing the dam surface or passage through leaking portions of the abandoned lock and/or turbine bays.

Along with the limited population data for American eel, little information exists for peak migration periods for American eel in the Project vicinity. However, the upstream eel movements are expected to follow what have been observed in other studies along the Atlantic drainages, where drivers of upstream migrations are increasing water temperature, high flows, and low lunar illumination (Hammond and Welch 2009, Welch and Liller 2013, Mack and Cheatwood 2022). DESC has been involved with the collection and synthesis of dissolved oxygen (DO), pH, conductivity, and water temperature data for the past 22 years at eight monitoring locations throughout the Stevens Creek Reservoir

and in the tailwater. Analysis of the water temperature data for the tailwater show that water temperatures typically reach 15°C in April and 22°C in August. Temperatures tend to hover between 20°C and 25°C throughout the summer before dropping to 15°C in November. Given migration patterns of yellow eel, the peak movement of migrating yellow eel in the tailwaters of Stevens Creek Dam may occur any time between March and December.

3.7 Robust Redhorse and other Migratory Suckers

3.7.1 Life History

The robust redhorse (*Moxostoma robustum*), a large, heavy-bodied sucker, was once presumed extinct but was rediscovered in the Oconee River below Georgia Power's Sinclair Hydroelectric Project (FERC No. 1951) in the early 1990s. This rediscovery sparked the formation of the Robust Redhorse Conservation Committee (RRCC) in 1995 to guide recovery efforts for the species. Preferred riverine habitat includes riffle areas or in/near outside bends, where depths are greater, and accumulations of logs and other woody debris are present (Evans 1997, Mosely and Jennings 2007). Habitat use shifts throughout the year with robust redhorse moving into swift shoals and gravel bars during spawning season and retreating downstream to non-spawning and overwintering habitats (Grabowski and Isley 2006). Spawning occurs between April and June over gravel substrate in deep and shallow waters (Hendricks 1998). Spawning usually lasts for two weeks when water temperature averages 20-24°C, where eggs are scattered in gravel and embryos are left to develop in the interstitial spaces (Ruetz and Jennings 2000).

3.7.2 Existing Information within the Project Vicinity

Robust redhorse is known to occur within the Savannah River, with a known spawning population present below the NSBLD (Grabowski and Isely 2007) as spawning aggregations have been continually observed in recent years. Additionally, robust redhorse has been documented spawning upstream of NSBLD in Augusta Shoals (RRCC 2017). Upstream of the Project, robust redhorse occur in Thurmond Reservoir, with a known spawning aggregation in Anthony Shoals where the Broad River (Georgia) enters the reservoir (Straight and Freeman 2013). Although robust redhorse is present upstream of Thurmond Dam and downstream of the ADD, no individuals have been detected in the Stevens Creek impoundment.

3.8 Other Species of Interest

Several species of interest listed in Table 1 are addressed in the Georgia or South Carolina State Wildlife Action Plan (SWAP), are tracked species, or are of conservation concern. However, several of these species do not have a federal or state protective status, are not migratory, are not known important mussel host species, or they exhibit populations that are relatively secure throughout their range. Because this document focused on protected species, migratory fishes, and mussels, the following species have been excluded from further analysis: rosyface shiner (*Notropis rubellus*), notchlip redhorse (*Moxostoma collapsum*), snail bullhead (*Ameiurus brunneus*), flat bullhead (*Ameiurus platycephalus*), Carolina darter (*Etheostoma collis*), Christmas darter (*Etheostoma hopkinsi*), and turquoise darter (*Etheostoma inscriptum*). Although migratory, striped bass was eliminated from this document due to its status as a heavily managed and stocked gamefish, there is an existing wealth of information regarding their persistence throughout the Savannah River system.

4.0 EXISTING HABITAT ENHANCEMENTS, REGIONAL FISH RESTORATION EFFORTS, AND IMPEDIMENTS

DESC and resource agencies identified two priority enhancement areas for the Fisheries Resource Enhancement Plan (2016 to 2025) per the existing FERC license: 1) fisheries and freshwater mussel restoration and/or enhancement, and 2) river bottom habitat enhancement. Recent and expected continued improvement of DO conditions at Thurmond Dam due to installation of auto-venting turbines and an oxygen diffuser system have made stocking or reintroduction of fish species a viable option for resource enhancement in the Stevens Creek area. Fish reintroduction was designated as a priority resource enhancement action in the 2016 to 2025 plan. American shad, robust redhorse, and striped bass were identified as potential species for reintroduction. Cool-water species such as walleye (*Sander vitreus*) or sauger (*Sander canadensis*) may be evaluated for introduction, but these species are not addressed in this document. Additional focus of the third ten-year plan will be on the evaluation and enhancement of freshwater mussel resources. DESC identified the use of stone to provide bottom structure in areas of flow as a potential means of improving fish spawning and rearing habitat near the Project. Removal of accumulated sediment was also identified as a potential method for improving spawning and rearing habitat within the Fisheries Resource Enhancement Plan.

4.1 Existing Migration Barriers

Major river channel modifications near Savannah for shipping and commerce have occurred since colonial times. These activities have altered salinity, decreased DO at depth, increased flushing rates in the lower estuary, and reduced freshwater tidal wetlands, all of which have adversely affected migratory fish species and their habitats (SCDNR and GADNR 2014). There are six dams on the Savannah River, of which only the first dam, the NSBLD at RM 187, approximately 21 RMs downstream of the Project, has an upstream fish passage system using its navigation lock. However, due to concerns about structural integrity, the lock has not been operated for fish passage since May 2014. The ADD, which is located approximately 19 RMs upstream of the NSBLD and one mile downstream of the Stevens Creek Dam, does not currently have operational fish passage, nor do the three USACE dams upstream of the Stevens Creek Project. The USACE recently completed the SHEP to deepen the 18.5-mile outer harbor to 49 feet at mean low water and the Savannah River channel (i.e., inner harbor) to 47 feet (USACE 2022). As mitigation for the SHEP, the USACE is currently required to provide sturgeon passage at NSBLD (USACE 2022); design of fish passage at NSBLD is ongoing and construction has not been initiated.

DESC's existing license for the Project requires upstream passage following the construction of a fishway at the ADD. The Section 18 prescription in the current Project license includes a requirement to refurbish the navigation lock, which would be operated using attraction flows or other fish attraction mechanisms to provide a minimum of 30 lockages during the shad migration season (SCDNR/GADNR 2020). Relicensing discussions with the USFWS and NMFS indicate that refurbishing the lock may no longer be the preferred method of passage. The USFWS and NMFS submitted a preliminary fishway prescription for the Augusta Canal Project (i.e., the ADD) in 2004 that included a vertical slot fishway on the Georgia side of the river. Based on comments received from the city of Augusta and additional evaluation and review by the USFWS and NMFS, the fishway prescription was modified to include a vertical slot fishway on the South Carolina side of the Savannah River. Negotiations between the USFWS and NMFS and the city of Augusta are ongoing and construction of the fishway has not been initiated.

5.0 WATER QUALITY WITHIN THE PROJECT VICINITY

5.1 Savannah River

A year-long water quality study was performed in the Project area from February 2021 to February 2022. The objective of this study was to assess the water quality in the Stevens Creek arm and Savannah River arm of the Stevens Creek Reservoir and of the Savannah River, immediately downstream of the Project. Water quality was monitored at six sites within Stevens Creek Reservoir, including five sites in the Savannah River (Deep Step, Above Powerhouse, Above Spillway, Below Powerhouse, and Below Spillway) and one site in Stevens Creek. The Above Powerhouse Monitoring Site was placed in Stevens Creek Reservoir upstream of the hydro station. The Below Powerhouse Monitoring Site was located directly downstream of the Stevens Creek Dam. The Below Spillway and Above Spillway monitoring locations were located downstream and upstream of the east end of Stevens Creek Dam, respectively. The Stevens Creek Monitoring Site was located near Woodlawn Road, approximately 4.5 miles upstream of its confluence with the Savannah River at Stevens Creek Dam. The Deep Step Monitoring Site was located in the Savannah River arm of Stevens Creek Reservoir, just upstream of the confluence with Stevens Creek.

YSI EXO3 sondes were deployed continuously for the entire year at the Stevens Creek, Above Powerhouse, Above Spillway, Below Powerhouse, and Below Spillway monitoring sites. A combination of a YSI EXO3 and a HOBO U26 Temperature and DO logger were deployed at Deep Step Monitoring Site periodically from June through October. A summary of DO excursions observed at various monitoring stations in the 2021 study is within the table below.

Summary of 2021 Dissolved Oxygen Excursions at Monitoring Sites.

Month	Number of Days Daily Average DO <5.0 mg/L	Events with DO <4.0 mg/L			
		Events	Minimum DO (mg/L)	Average DO (mg/L)	Average Duration (hours)
Thurmond Dam Tailrace					
May	20	35	0.38	3.18	8.19
Jun	26	49	0.43	3.57	8.46
Jul	30	58	1.53	3.32	6.22
Aug	23	36	0.45	3.46	17.26
Sep	30	71	1.98	3.55	5.37

Month	Number of Days Daily Average DO <5.0 mg/L	Events with DO <4.0 mg/L			
		Events	Minimum DO (mg/L)	Average DO (mg/L)	Average Duration (hours)
Oct	28	105	1.78	3.65	3.58
Stevens Creek					
May	7	3	3.42	3.87	0.67
Jun	0	0	N/A	N/A	N/A
Jul	6	8	2.80	3.71	8.50
Aug	28	21	2.40	3.47	26.24
Sep	21	9	2.79	3.74	15.89
Oct	26	24	2.32	3.70	12.58
Nov	2	2	3.96	3.96	0.00
Above Powerhouse					
May	0	0	N/A	N/A	N/A
Jun	0	0	N/A	N/A	N/A
Jul	0	0	N/A	N/A	N/A
Aug	18	0	N/A	N/A	N/A
Sep	28	1	3.93	3.94	2.00
Oct	15	3	3.70	3.92	4.33
Above Spillway					
May	0	0	N/A	N/A	N/A
Jun	0	1	3.60	3.75	3.00
Jul	2	1	3.95	3.97	3.00
Aug	2	3	3.60	3.87	2.67
Sep	2	3	3.62	3.86	3.67
Oct	8	8	0.37	3.07	2.88

N/A = Not Applicable

The monitoring sites below Thurmond Dam, Stevens Creek, Above Powerhouse, and Above Spillway presented the most excursions from state standards for DO. DO excursions were most prevalent below Thurmond Dam and at Stevens Creek, with the site Above Powerhouse having the third most excursions at the Project. During the critical period (May-October), daily average DO values were less than 5mg/L for 90% of the monitoring days below Thurmond Dam, 74% of monitored days at the Stevens Creek Site, 35% of the monitored days at the Above Powerhouse Site and 9% of monitored days at the Above Spillway Site. The low DO values occurring with the Savannah River and the Stevens Creek during the May through October timeframe may affect migratory fishes on both their upstream and downstream migrations. At this this potential affect has not been

assessed. However, ongoing water quality studies in 2023 will help continue to provide information on diurnal and seasonal fluctuations in DO within the Project boundary.

Notably, there were no DO excursions at monitoring sites below Stevens Creek Dam. Given upstream excursions within Stevens Creek and below Thurmond Dam, study results indicate that DO levels improve as water passes through the Project powerhouse and spillway, benefitting downstream resources. Low occurrence rates for DO excursions at the Deep Step site suggests that water quality is not being overly impacted despite heavy aquatic vegetation growth within that portion of the reservoir.

A wealth of water quality data has been collected at the Stevens Creek Project through the term of the existing license and through this relicensing study. The 2021 study results are consistent with monitoring results collected at the Project over the past 23 years and provides a more detailed resolution on the prior water quality observations. As expanded upon in the Pre-Application Document, results summarized from 2010 to 2019 revealed that DO levels in the Thurmond and Stevens Creek reservoirs generally remain above the instantaneous state standard of 4 milligrams per liter (mg/L) during the winter and spring. The Thurmond Reservoir begins to stratify annually in early summer, resulting in decreased DO levels near the Thurmond Dam low-level turbine intakes. DO levels typically become hypoxic/anoxic by mid-August within the hypolimnion of the Thurmond Dam forebay. DO levels in discharges from Thurmond Dam are typically below 4 mg/L starting in early July and continuing through October. DO excursions within Stevens Creek Reservoir have been documented during this timeframe; however, water quality improvement in downstream reaches has been demonstrated following the 2011 USACE installation of an oxygen diffuser system in the Thurmond Reservoir.

When considering project nexus in the context of a relicensing, it is important to consider the connection between the project operations and the potential effects on the resource in question. Water quality within the Stevens Creek arm and Savannah River arm of Stevens Creek Reservoir is significantly influenced by external sources outside of DESC's control; nevertheless, water quality monitoring data demonstrate that re-oxygenation occurs as water passes through Stevens Creek Reservoir, the Stevens Creek powerhouse, and over the Stevens Creek spillway, benefitting aquatic resources within the Savannah River downstream of the Project.

6.0 AQUATIC HABITATS WITHIN THE PROJECT AREA

6.1 Aquatic Habitats within the Impounded Reaches of the Savannah River and its Tributaries

The impounded portions of the Savannah River within the Stevens Creek Project boundary can generally be separated into two habitat reaches, approximately divided where Highway 28 crosses the river. The upstream reach just below Thurmond Dam is relatively deep, directly receives the peaking flows from USACE dam operations, and contains a mix of gravels and sands with occasional cobble. Entering the main channel are several perennial tributaries with large drainage areas (i.e., Little Kiokee Creek and Uchee Creek), whose confluence with the Savannah River create broad backwaters with surrounding emergent wetland systems. Another feature of this reach is a 3-mile side channel of the Savannah River (referred to as the Little River) along the Georgia side of the Project. This narrow side channel provides undercut banks, abundant woody structure, and retains the relict stream channel from pre-impounded conditions. As the Savannah River approaches Highway 28, the Savannah River slows and shallows. Substrates transition from gravels and coarse sand to fine sands and accumulated sediments. Aquatic vegetation can be found in the shallow areas and bank margins. Submerged woody structure can be found along the banks and is generally most abundant in areas with steep banks.

Downstream of Highway 28, the Savannah River widens, slows, and the river channel is less consolidated and becomes more braided. Sediment deposition is heavy within this reach with sand, silt, and accumulated organics dominating the substrate. Aquatic vegetation is widespread, dense, and further contributes to sediment capture and retention within Stevens Creek Reservoir. Woody structure can still be found within the channel and along banks but is less abundant and widespread than in the upstream reach of the Savannah River, particularly as the river approaches Stevens Creek Dam. See Figure 3 depicting aquatic habitats within the Project area.

6.2 Aquatic Habitats within Stevens Creek

Within the Project boundary, Stevens Creek can be characterized by three reaches with differing habitats (i.e., downstream reach, middle reach, and upstream reach). Although habitat transitions occur along a gradient, the three habitat reaches are from Stevens Creek Dam upstream to Woodlawn Road / State Highway S-19-53 (i.e., downstream reach), from Woodlawn Road upstream to the confluence with Horn Creek (i.e., the middle

reach), and from Horn Creek to the upstream Project boundary and beyond towards Garrett Road / State Road S-33-88 (i.e., upstream reach).

The downstream reach of Stevens Creek is similar to the impounded condition of the mainstem Savannah River near the Project dam. The impounded portions of Stevens Creek are broad, still-water pools in baseflow conditions. Substrates are a mix of silt, accumulated sediments, and organic material. Although the historic stream channel in Stevens Creek provides some deep-water habitats, the vast majority of the creek is broad, shallow, and contains abundant aquatic vegetation, particularly along the bank margins. Some woody structure is present and provides cover for fish, basking platforms for turtles, and perches for birds. Additionally, this reach of Stevens Creek contains numerous creek inlets with broad, emergent wetlands, providing additional habitat for aquatic and semi-aquatic species.

The middle reach of Stevens Creek is still affected by the dam, with low-flow impounded conditions, but the stream is generally more confined to a consolidated channel. The consolidated channel contained within the steep banks provides undercut banks, root wads, overhanging shrubs, and large woody debris. Substrates in the reach include sand, some accumulated silt sediments, and bank margins with mixed clays and sands. This middle reach is a transitional area between the shallow upstream reach and the broad impoundment of the downstream reach near the Project dam.

The upstream reach of Stevens Creek from the confluence of Horn Creek to the upstream Project boundary and beyond is shallow, with evidence of sediment deposition in the form of sand bars and benches. Although wide (greater than 50 meters) in some portions, water within the upstream reach of Stevens Creek is often only a couple of inches deep in warmer months. The point bars and woody debris within the channel provide some structure, variable flows, and coarser sands and gravels. Otherwise, this portion of Stevens Creek can be of relatively uniform flow and sandy substrate. In times of drought or low flow, some areas can be braided, or a series of isolated pools connected by subsurface flow within the sandy streambed. The banks are tall but with relatively gentle, stable slopes protected by herbaceous and shrubby vegetation.

6.3 Other Direct Tributary Streams and Lateral Connectivity

Many of the other direct perennial streams and tributaries in the Project vicinity are transitional between the higher gradient, incised, Piedmont streams, and the low gradient Coastal Plain streams. In addition, these streams tend to have high sediment loads and

incised channels resulting from historic agricultural practices (i.e., cotton farming). Although the streams on the South Carolina side are predominantly forested or protected from further development within the national forest, the Georgia side tends to experience more recent land clearing, local developments, and increased impervious surfaces. In the upper reaches of these watersheds, these streams are greatly incised with steep banks and are generally flashy during rain events. Increased water velocities result in scour and bank erosion. As these streams approach the Savannah River floodplain and Project area, they widen, slow, and sediments are deposited and accumulated.

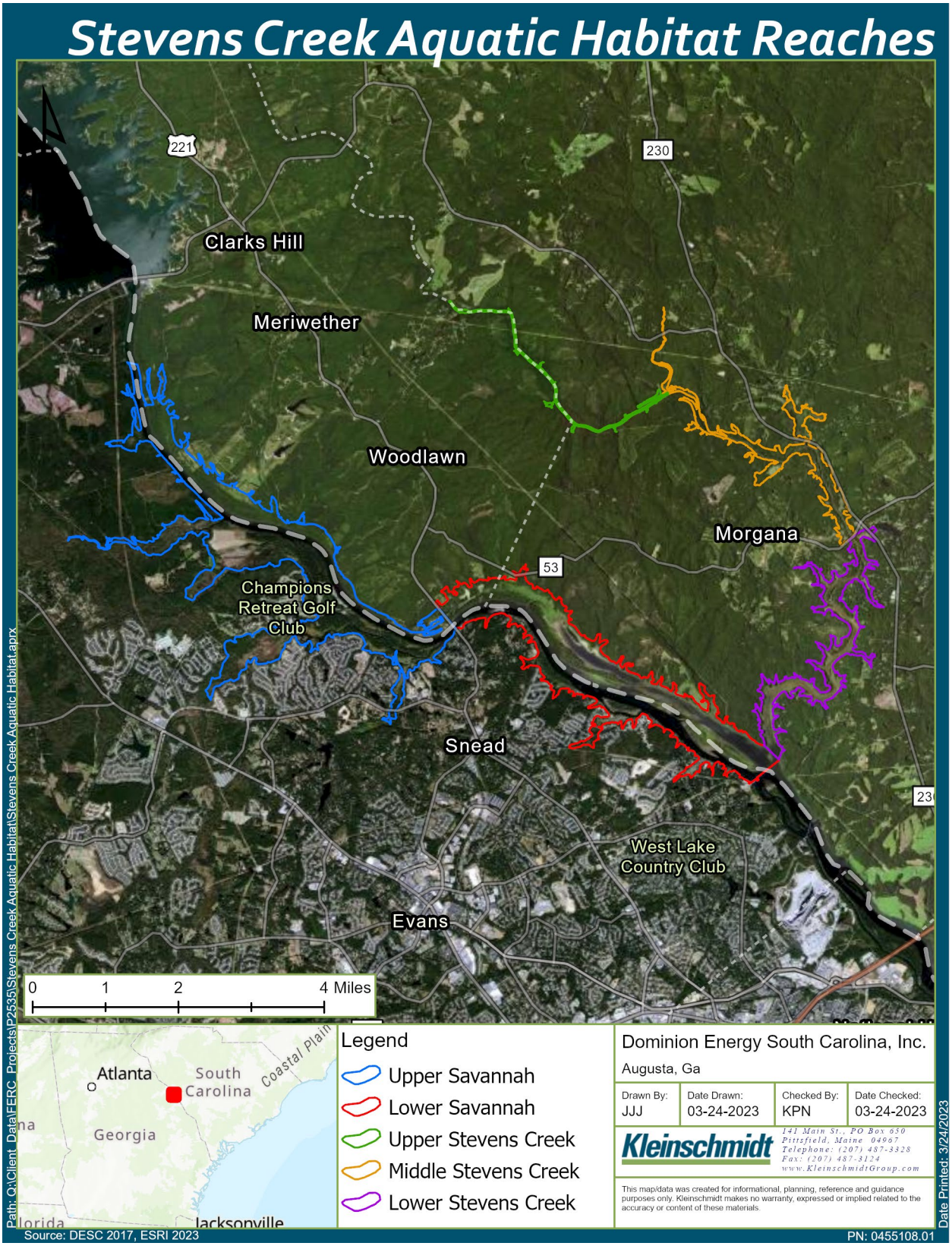

Figure 3 Aquatic Habitats within the Stevens Creek Project Area

7.0 DISCUSSION

The following discussion addresses the existing habitat availability, suitability, and the expected habitat use for species of interest following the hypothetical implementation of fish passage at NSBLD, ADD, and Stevens Creek Dam. Although the presence of mussel species within the Project boundary are lacking, surveys upstream of the Project area in Stevens Creek exhibit abundant and diverse mussel populations. Stevens Creek tributaries, such as Mountain Creek, Little Stevens Creek, and Sleepy Creek, provide habitat for the federally listed Carolina heelsplitter several mussel taxa of significant conservation concern in South Carolina. These populations of mussels within the Stevens Creek subbasin do not appear to be limited by the passage of glochidia host fish species. However, if implementation of fish passage structures at NSBLD, ADD, and Stevens Creek Dam were to occur, the movement of additional potential host fish upstream into the Stevens Creek subbasin may aid in mussel recruitment in areas that currently support a diverse mussel community and the presence of rare species. In areas of limited mussel recruitment, the reintroduction of mussel host fish has been shown to improve recruitment, particularly when paired with stocking of mussels (Galbraith et al. 2018). Population-level effects on mussel populations within the Project area are not anticipated because of the poor existing habitat conditions that were discussed previously.

Alosines have been a widely studied family of fishes within their ranges because of their importance as forage (i.e., blueback herring) or sportfish or commercial fishery (i.e., hickory shad and American shad). In addition, alosines (and striped bass) have been documented reaching new spawning grounds well-beyond former migration barriers following their removal (Burdick and Hightower 2006). As mentioned earlier in this whitepaper, alosines have been documented passing the NSBLD. Unlike the other two alosines, hickory shad are limited to Coastal Plain portions of Atlantic Slope rivers. One capture above the Fall Line occurred in Lake Hartwell but is expected to be from angler introduction. Although hickory shad has been observed spawning upstream of barriers after removal (i.e., the Quaker Neck Dam in North Carolina; Burdick and Hightower 2006), the species' spawning areas remained within the Coastal Plain reaches of streams and rivers. Further, hickory shad have not been reported in the Project vicinity or NSBLD and are generally only found in low numbers closer to the ocean. As such, the implementation of fish passage at the three dams is not anticipated to have a population-level effect on hickory shad.

Although American shad have been documented passing NSBLD, the species has not been found above the ADD or Stevens Creek Dam. Preferred spawning habitats are generally gravel and sandy substrates below obstructions in large rivers (Walburg and Nichols 1967, Beasley and Hightower 2000, Bailey et al. 2004); however, will spawn over other mediums if preferred habitats are lacking. Further, the selection of habitats is likely the result of the obstruction being a barrier to further upstream migration, and areas immediately below these obstructions generally exhibit moderate flows and clean substrates. Dedicated fish passage at NSBLD would aid in passing migrating American shad to the shoals at the base of the ADD. Likewise, fish passage at the ADD would allow access to another 1-mile portion of river with potentially suitable spawning habitat for American shad. However, shallow, gravel, and sand spawning habitats are generally lacking in the Savannah River and Stevens Creek between Stevens Creek Dam and Thurmond Dam. Although, these preferred spawning habitats are lacking within the Project boundary, the implementation of fish passage at Stevens Creek Dam would potentially provide access to suitable American shad spawning habitats far beyond the Project boundary in the Stevens Creek subbasin. As previously mentioned, Stevens Creek, Turkey Creek, and other larger streams within the Stevens Creek subbasin exhibit extensive bedrock, boulder, cobble, gravel, and coarse sand substrates (Hill 2005) that may provide suitable spawning areas for migratory fishes.

Successful blueback herring reproduction depends on the presence of clean vegetation and other material for egg adhesion (Rhode et al. 2009). Blueback herring in the ocean ascend coastal rivers to spawn, whereas landlocked populations move from open water to shorelines for spawning. The presence of blueback herring in rivers and impoundments upstream and downstream of the Project, both naturally and via supplemental stocking efforts, has resulted in a population within the Stevens Creek impoundment. The presence of aquatic vegetation within the Savannah River within Project boundary between Stevens Creek Dam and Thurmond Dam may provide a suitable medium for eggs to adhere during the spawn. The 2018 study performed by SCDNR (Bettinger and Bulak 2019) shows that blueback herring are the most abundant forage fish species within the Stevens Creek Reservoir. This study shows that a population of blueback herring already exists within the Project area but likely represents a landlocked population of stocked origin that actively spawning between Stevens Creek Dam and Thurmond Dam. Anadromous blueback herring have been observed above in the Savannah River upstream of the NSBLD during GADNR's sampling in 2006, 2013, and 2014 (GADNR unpublished data), suggesting the species is capable of passing the NSBLD in occasional periods of high flows. Because

populations are currently present upstream, within, and downstream of the Project area, population-level effects to blueback herring following the implementation of fish passage at the NSBLD, ADD, and Stevens Creek Dam are unknown.

Although data within the Project boundary and beyond is lacking, American eels have been documented within the Stevens Creek Reservoir in low numbers, and more moderate numbers below the Stevens Creek Dam. The American eel's ability to climb and traverse objects some percentage of upstream migrants to pass the leaky lock structures and low head structures at the NSBL, ADD, and Stevens Creek Dam during migrations. The number of eels migrating through the system and traversing these structures is unknown. As such, the number of eels that may utilize fish passage structures, if proposed, cannot be estimated. Further, population-level effects of the implementation of fish passage structures at NSBLD, ADD, and Stevens Creek Dam cannot be determined at this time.

Sturgeon are unable to pass NSBLD and other dams unless dedicated fish passage to accommodate large adult sturgeons is installed. Spawning shoals are limited to the Augusta Shoals at ADD and the shoals downstream of Stevens Creek Dam. Because of the series of impoundments along the river all the way to the mountains, no additional spawning habitat is present in the Savannah River upstream of Stevens Creek Dam. In addition, no suitable habitat for sturgeons is present in Stevens Creek. The implementation of fish passage to accommodate sturgeon at Stevens Creek Dam is not likely to have population-level effects on the species.

Robust redhorse is known to occur and spawn below NSBLD and Augusta Shoals. However, no observations of robust redhorse have been documented between Stevens Creek Dam and ADD. Robust redhorse spawn in swift shoals and gravel bars with moderate current. Although the species could survive upstream of Stevens Creek Dam, passage for robust redhorse through Stevens Creek Dam would not open up additional spawning habitats or preferred non-spawning habitats.

8.0 CONCLUSION

The Stevens Creek Dam demarcates the upstream limits of large shoal complexes on the Savannah River. The broad, dynamic shoal systems with extensive bedrock, gravels, and other coarse substrates, and with variable flows and occasional aquatic vegetation provide excellent spawning habitats for robust redhorse, sturgeons, and some alosines. However, these habitats do not exist upstream of Stevens Creek Dam and beyond. The implementation of fish passage at NSBLD would open a migratory route and allow access to the extensive Augusta Shoals upstream to ADD. Between ADD and Stevens Creek Dam, habitats contain a mix of slow sandy areas, aquatic vegetation, gravelly substrates, and bedrock shoals. If implementation of fish passage occurs at ADD, an additional segment of potentially suitable spawning habitats for migratory fishes would be accessible. However, implementation of fish passage at Stevens Creek Dam would not allow access to additional shoal complexes or spawning habitats for migratory suckers (i.e., robust redhorse) or sturgeons. Conversely, extensive suitable spawning habitats for migrating blueback herring (i.e., aquatic vegetation) would be accessible within the Stevens Creek Reservoir if passage were to be implemented at Stevens Creek Dam (following the implementation of passage at NSBLD and ADD). Further, blueback herring are already present within the Stevens Creek Reservoir and were documented to be the most abundant forage fish species; however, these are likely landlocked populations from a population of stocked origin. Implementation of fish passage at Stevens Creek Dam may allow access for migrating anadromous blueback herring to access potential spawning areas upstream of Stevens Creek Dam, but population-level effects cannot be determined. In summary, many of the species of interest within the Project vicinity and Savannah River Basin generally remain below the Fall Line (i.e., hickory shad, American shad), do not have suitable spawning/rearing habitats upstream of the Stevens Creek Dam (i.e., robust redhorse, Atlantic sturgeon, shortnose sturgeon), or are already present within the Project area (i.e., landlocked blueback herring), and are able to traverse the series of dams in their current state (i.e., American eel). The population-level response of species of interest to fish passage implementation at Stevens Creek Dam cannot be determined at this time. Studies at upstream and downstream locations should occur following passage implementation at NSBLD and ADD to determine if species of interest are successfully passing these proposed structures and if populations are experiencing positive responses. Consideration for dedicated fish passage at Stevens Creek Dam should follow the successful implementation of fish passage at NSBLD and ADD, respectively.

9.0 LITERATURE CITED

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APPENDIX A

STAKEHOLDER CONSULTATION MATRIX

Document	Commentor	Comment Code	Comment	Addressed in Body of Report	Applicant Response
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-01	Section 2.4. It is unclear if the second paragraph of this Section is discussing the Piedmont/Coastal Plain or Stevens Creek specifically. The Stevens Creek sub-basin is unlike the typical streams discussed in this Section and elsewhere because it flows through a national forest instead of through local developments, land clearing, and historic farm lands. This Section seems to conflict with Section 4.1.3 of Exhibit E (Environmental Report) and with the Diadromous Fish Restoration Plan for the Middle Savannah River: Strategy and Implementation Schedule (2005). These sentences should be revised for clarity (here, and elsewhere in the report where they are repeated).	Yes: Aquatic Habitat Whitepaper - Section 2.4	Revised for clarity. This section is in regards to the smaller tributary streams directly entering the Project area from the GA and SC sides. Although some areas are within National Forest and are now protected from development, these areas were subject to historic farming, where erosion/sediment has been shaped by poor historical agricultural practices (i.e., cotton farming).
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-02	Section 3.2.1. Revise the sentence “However, it has been extirpated from some reaches where it was previously found, possibly due to environmental factors including decreased water quality associated with sedimentation and pollution” to cite a source and note the role dams play in altering water quality and sedimentation rates.	Yes: Aquatic Habitat Whitepaper - Section 3.2.1.	Section revised as suggested.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-03	Section 3.2.2. This Section does not reflect the extensive mussel sampling conducted in the Stevens Creek sub-basin (see the Diadromous Fish Restoration Plan for the Middle Savannah River: Strategy and Implementation Schedule (2005)). This Section also does not incorporate findings from the U.S. Fish and Wildlife Service in Appendix 7. DESC should revise this Section to include a discussion of known mussel habitat and populations upstream of the Project boundary. In addition, the Section and report should discuss the role the dam plays in the creation of poor mussel habitat in the Project area by altering sediment dynamics and limiting longitudinal connectivity.	Yes: Aquatic Habitat Whitepaper - Section 3.2.2.	Additional information added.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-04	Section 3.2.2. The NMFS suggests removing the word “reconned” and replacing with “surveyed” as used previously in Section 3.2.2.	Yes: Aquatic Habitat Whitepaper - Section 3.2.2.	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-05	Section 3.4.1. Remove “may” and “can” from the first two sentences and revise as appropriate.	Yes: Aquatic Habitat Whitepaper - Section 3.4.1.	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-06	Section 3.5. In the sentence “The first obstruction without the ability for shads to pass is the ADD,” replace “shads” with “Alosines.”	Yes: Aquatic Habitat Whitepaper - Section 3.5	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-07	Section 3.5.1. The sentence “American shad rarely occur above the Fall Line but are highly established in Coastal Plain portions of major rivers and stream systems” is misleading. American shad currently do not occur above the Fall Line due to the presence of dams. Prior to obstruction, American shad migrations typically reached the headwaters of mainstem rivers and tributaries. Revise this sentence to note the reasons American shad are concentrated in the coastal plain.	Yes: Aquatic Habitat Whitepaper - Section 3.5.1.	Revised section.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-08	Section 3.5.1. After the sentence “Fish passage techniques…fish passage (SCDNR/GDNR 2020).” include a second sentence noting passage has not occurred in this way since 2014.	Yes: Aquatic Habitat Whitepaper - Section 3.5.1.	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-09	Section 3.5.1. Revise the last sentence to replace “preferring” with “utilizing.” As written, the sentence misrepresents the studies discussed by implying fish seek out migration barriers as spawning habitat. The studies referenced conclude fish utilize those habitats at the extent of their accessible range because they are limited in their capacity to move beyond them.	Yes: Aquatic Habitat Whitepaper - Section 3.5.1.	Statements revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-10	Section 3.6.1. Citation Haro (1991) does not appear in literature cited. Citation Hammond and Welsh (2009) does not appear in literature cited. Citation “Walsh and Liller (2013)” should be “Welch and Liller (2013)” and does not appear in literature cited.	Yes: Aquatic Habitat Whitepaper - Section 3.6.1.	Revised and citations added.

Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-11	Section 3.6.1. Mack and Cheatwood (2022) (https://doi.org/10.3996/JFWM-21-066) is an additional citation supporting high flows as a trigger for upstream movements.	Yes: Aquatic Habitat Whitepaper - Section 3.6.1.	Revised and citations added.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-12	Section 3.6.2. Replace the sentence "The federal status of this species is currently stable and has been reviewed by the USFWS and NMFS several times over the past decade" with "The 12-month findings published in 2015 by the USFWS states stressors on the American eel populations range wide are not of sufficient imminence, intensity, or magnitude to indicate a danger of extinction throughout all of its range."	Yes: Aquatic Habitat Whitepaper - Section 3.6.2.	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-13	Section 3.6.2. Revise the sentence "Fisheries surveys completed… fisheries community (Entrix 2002b)." to clarify what is meant by "relatively moderate numbers." If a number is known, state the number and include relevance.	Yes: Aquatic Habitat Whitepaper - Section 3.6.2.	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-14	Section 3.6.2. The last paragraph discusses only temperature relative to the timing of migration periods. Section 3.6.1 establishes river flows are also important and should be discussed in this section.	Yes: Aquatic Habitat Whitepaper - Section 3.6.2.	Section revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-15	Section 3.6.2. The proposed period of peak upstream movements being from April to November may be too short. At Roanoke Rapids Dam, passage peaks during the spring and fall as early as March and late as December, respectively. Because the Savannah River is further south than the Roanoke River, migrants may arrive earlier in the year.	Yes: Aquatic Habitat Whitepaper - Section 3.6.2.	Statements revised to reflect that exact peak migrations at Stevens Creek Dam are unknown but may occur during the March-December timeframe.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-16	Section 5.1. Revise the sentence "Monitoring Site 1 was used as a control and was placed in Stevens Creek Reservoir upstream of the hydro station." The 2021 water quality study did not use a control because it did not test anything. Water quality measurements were summarized and compared among sites. No statistical analyses were conducted.	Yes: Aquatic Habitat Whitepaper - Section 5.1., Water Quality Report, Exhibit E - Section 4.4.	Revised as suggested.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-17	Section 5.1. The third paragraph should include summary information for the DO violations at each site. For example, "Average daily DO in the Thurmond Dam tailrace was below state standard (5 mg/L) for 44 percent of the year. The recorded DO was below the instantaneous state standard (4 mg/L) for 27 percent of recorded samples."	Yes: Aquatic Habitat Whitepaper - Section 5.1., Water Quality Report, Exhibit E - Section 4.4.	Excursions from state standards has been provided in the updated/revised Water Quality Report. Revisions have been made to Section 5 in the Aquatic Habitat Whitepaper as well. The Whitepaper provides a summary of the WQ findings, whereas the Water Quality Report provides additional detail.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-18	Section 5.1. After the sentence "A wealth of water quality data has been collected at the Stevens Creek Project through the term of the existing license and through this relicensing study" add a sentence clarifying what the 2021 Water Quality Study added continuous monitoring data. A 23-year dataset is an excellent resource, but sampling monthly and reporting only maximum and minimum values provided limited resolution. The 2021 study has helped quantify the extent of hypoxic conditions in the Project area.	Yes: Aquatic Habitat Whitepaper - Section 5.1., Water Quality Report, Exhibit E - Section 4.4.	Additional clarifications added.

Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-19	Section 5 downplays the hypoxic conditions known to develop in the Stevens Creek arm of the reservoir and their potential as a migration barrier for aquatic organisms. An important result of the 2021 water quality study was at Site 5 (about five river miles upstream from the confluence with the Savannah River) average daily DO dropped below the state standard for at least 30 percent of the year (29 percent of measured days with no data during a summer month when DO was likely low). The measured DO was below the instantaneous state standard (4 mg/L) 15.7 percent of recorded samples. Because the 2021 water quality study sampled nearly continuously, it should be possible to use the dataset to examine DO changes throughout the day. DESC has presented data to resource agencies showing DO was lowest during mid-day and changes in DO more closely correlate with releases from Thurmond Dam than expected natural cycles. These key results are missing from the Stakeholder Consultation Matrix (Appendix E1). Results should be presented in the Stakeholder Consultation Documentation (Appendix E1), Water Quality Study Report (Appendix E4), and discussed in the Aquatic Habitat Report.	Yes: Aquatic Habitat Whitepaper - Section 5, Water Quality Report, Exhibit E - Section 4.4.	Comments and suggestions regarding diurnal fluctuations is noted. Additional analysis and examination of the changes in DO (and other water quality parameters) will be examined as part of the ongoing 2023 WQ study. Additional context provided regarding a potential migration barrier has been included.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-20	Section 6.3 should be revised as in Section 2.4.	Yes: Aquatic Habitat Whitepaper - Section 6.3.	Section revised for clarity.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-21	Section 7. Remove the sentence “If implementation of fish passage structures at NSBLD, ADD, and SCD were to occur, population-level effect to mussel populations is not anticipated.” There is extensive scientific literature linking longitudinal connectivity and natural sediment regimes with healthy mussel populations, and habitat fragmentation with population declines. The NMFS recommends citing Galbraith et al. (2018): Reestablishing a host–affiliate relationship: migratory fish reintroduction increases native mussel recruitment (https://doi.org/10.1002/eap.1775).	Yes: Aquatic Habitat Whitepaper - Section 7	Statement revised to differentiate between expectations of mussel recruitment inside the Project boundary vs. beyond the Project area in the Stevens Creek subbasin.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-22	Section 7. Remove the sentence “The implementation of fish passage at the three dams is not anticipated to have an effect on Hickory Shad populations.” There is extensive scientific literature linking increased longitudinal connectivity with positive impacts to migratory fish populations. The NMFS recommends citing Burdick and Hightower (2006); Distribution of Spawning Activity by Anadromous Fishes in an Atlantic Slope Drainage after Removal of a Low-Head Dam (https://doi.org/10.1577/T05-190.1).	Yes: Aquatic Habitat Whitepaper - Section 7	The statements have been revised for clarity. The recommended citation is useful and has been incorporated into the Whitepaper. However, this statement is specific to hickory shad. The subject dam was within the Coastal Plain, and although some species eventually moved far upstream near the Fall Line (American shad & striped bass; Milburnie Dam), hickory shad remained in the Coastal Plain in close proximity to the dam removal site to spawn. In SC, hickory shad typically spawn along channel edges or tidally influenced freshwater river reaches, usually within 50 miles of the ocean (SCDNR SWAP 2015), and no hickory shad have been captured in the Savannah River near the Fall Line or near NSBLD (SCDNR informal communication). As such, population-level effects on hickory shad is not anticipated at or upstream of the Stevens Creek Dam.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-23	Section 7. Revise the sentence “Suitable spawning habitats are generally gravel and sandy substrates below obstructions in large rivers (Walburg and Nichols 1967, Beasley and Hightower 2000, Bailey et al. 2004)” as in Section 3.5.1.	Yes: Aquatic Habitat Whitepaper - Section 7	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-24	Section 7. Remove the sentences “However, shallow, gravel, and sand spawning habitats are not present in the Savannah River between SCD and JSTD. Fish passage at SCD would not provide access to suitable spawning habitats for American Shad.” Diadromous Fish Restoration Plan for the Middle Savannah River: Strategy and Implementation Schedule (2005) shows significant shad spawning habitat above Stevens Creek Dam within the Stevens Creek Sub-basin. Additionally, American shad spawning is not necessarily substrate specific, when presented no alternative, they will spawn over mud.	Yes: Aquatic Habitat Whitepaper - Section 7	Statements revised to differentiate between preferred spawning areas, spawning areas with the Project boundary, and potential spawning area beyond the Project area in the Stevens Creek subbasin.

Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-25	Section 7. Remove the sentences “This study shows that a population of Blueback Herring already exist within the Project area. Because populations are currently present upstream, within, and downstream of the Project area, population-level effects to Blueback Herring following the implementation of fish passage at the NSBLD, ADD, and SCD are unknown.” NMFS is concerned only about anadromous blueback herring, not stocked, landlocked populations.	Yes: Aquatic Habitat Whitepaper - Section 7	Statement revised to differentiate between anadromous and landlocked populations of stocked origin. Additional context provided.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-26	Section 7. Revise the sentence “American Eel’s ability to climb and traverse objects allow it to pass the leaky lock structures and low head structures at the NSBL, ADD, and SCD during migrations” to replace “it” with “some percentage of upstream migrants.”	Yes: Aquatic Habitat Whitepaper - Section 7	Revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-27	Section 7. Remove sentence “The fisheries data collected in the Project vicinity shows that eel populations appear stable.”	Yes: Aquatic Habitat Whitepaper - Section 7	Removed.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-28	Section 8. The DLA fails to consider the significant habitat in the Stevens Creek sub-basin by focusing only on Savannah River habitats between Stevens Creek Dam and Thurmond Dam. From the Diadromous Fish Restoration Plan for the Middle Savannah River: Strategy and Implementation Schedule (2005): “Physical habitat evaluations throughout the watershed revealed significant miles of high quality diadromous fish spawning and maturation habitat. Large perennial streams including Stevens Creek and Turkey Creek, along with many moderate size streams and tributaries, contain extensive bedrock, boulder, cobble, gravel and coarse sand substrate. Our goal of fish passage above the Augusta Diversion Dam and Stevens Creek Dam includes providing access to not only the main-stem Savannah River but also to the high quality habitats located within the Stevens Creek sub-basin.”	Yes: Aquatic Habitat Whitepaper	The distinction between habitats within the Project boundary and the habitats located in the Stevens Creek subbasin well upstream of the Project area has been revised in multiple locations within the Aquatic Habitat Whitepaper. Citation added as necessary.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-29	Section 8. Remove sturgeon from the sentence “If implementation of fish passage occurs at ADD, an additional segment of potentially suitable spawning habitats for Alosines, suckers, and sturgeons would be accessible.” At present there are no plans for sturgeon to be passed above the Augusta Diversion Dam.	Yes: Aquatic Habitat Whitepaper - Section 8	Statement revised.
Aquatic Habitat Whitepaper	NMFS	DLA NMFS E3-30	Section 8. Remove the sentence “However, Blueback Herring are already present within the Stevens Creek Reservoir and were documented to be the most abundant forage fish species.” There are key differences between landlocked and anadromous blueback herring. NMFS is concerned only about anadromous blueback herring, not stocked, landlocked populations.	Yes: Aquatic Habitat Whitepaper - Section 8	Statements revised to differentiate between anadromous and landlocked populations.