Table 2.3.2-6 Groundwater Withdrawals for 2004, in Million Gallons Per Day (mgd), within South Carolina Part of the Savannah River Basin and within 50 Miles of the VEGP Site by Different Counties and for Different Consumptive Water Use Categories

Serial No.	County	Agriculture	Golf Course	Industrial	Water Supply	Mining	Total
1	Edgefield	0.00	0.21	0.00	0.00	0.00	0.21
2	Aiken	0.01	0.08	3.62	10.80	0.08	14.59
3	Barnwell	0.00	0.00	0.00	0.15	0.00	0.15
4	Allendale	1.94	0.00	2.43	0.00	0.00	4.37
5	Hampton	0.36	0.08	0.00	0.34	0.00	0.78
6	Jasper	0.14	0.00	0.00	0.26	0.00	0.40

Note: mgd values are obtained from the reported annual total water use.

Source: SC DHEC 2005

Table 2.3.2-7 Groundwater Withdrawals, in Million Gallons per Day (mgd), for Irrigation Use within Georgia Part of the Savannah River Basin and within 50 Miles of the VEGP Site by Different Counties

County	State	No. of Permitted Wells	Well Depth Range (ft)		Well Diameter (in.)		Total Permitted Withdrawal (mgd)
			Min.	Max.	Min.	Max.	
Burke	GA	87	58	640	4	18	122.2
Columbia	GA	8	100	285	3	6	0.8
Jefferson	GA	60	200	598	4	18	92.7
Jenkins	GA	55	120	650	4	16	53.8
McDuffie	GA	17	150	410	6	8	3.4
Richmond	GA	6	170	340	4	6	1.1
Screven	GA	133	110	750	4	16	140.8

Table 2.3.2-8 Georgia EPD Permitted Municipal and Industrial Groundwater Use Within 25 Miles of the VEGP Site

Well ID	Permit Holder	County	Aquifer	Year	Permitted Monthly Average, gpm (mgpd)	Permitted Annual Average, gpm (mgpd)	Average Annual Water Use, gpm (mgpd)
C-2	City of Sardis	Burke	Floridan	2004	278 (0.40)	278 (0.40)	63 (0.09)
				2005	278 (0.40)	278 (0.40)	NA
C-12	East Central Regional Hospital - Gracewood Campus	Richmond	Cretaceous Sand	2004	347 (0.50)	278 (0.40)	146 (0.21)
				2005	NA	NA	76 (0.11)
C-13	City of Hephzibah	Richmond	Cretaceous Sand	2004	833 (1.20)	833 (1.20)	160 (0.23)
				2005	NA	NA	236 (0.34)
C-19	Olin Corporation	Richmond	Cretaceous Sand	2004	847 (1.22)	847 (1.22)	514 (0.74)
				2005	NA	NA	486 (0.70)
C-19	Olin Corporation - Corrective Action Wells	Richmond	Cretaceous Sand	2004	632 (0.91)	632 (0.91)	229 (0.33)
				2005	NA	NA	250 (0.36)
I-1	International Paper	Burke	Cretaceous Sand	2004	660 (0.95)	660 (0.95)	181 (0.26)
				2005	660 (0.95)	660 (0.95)	35 (0.05)
I-2	Prayon, Inc	Richmond	Cretaceous Sand	2004	292 (0.42)	264 (0.38)	35 (0.05)
				2005	NA	NA	63 (0.09)
I-3	Thermal Ceramics, Inc.	Richmond	Cretaceous Sand	2004	625 (0.90)	625 (0.90)	313 (0.45)
				2005	NA	NA	208 (0.30)
I-4	Procter & Gamble Manufacturing Company	Richmond	Cretaceous Sand	2004	486 (0.70)	486 (0.70)	278 (0.40)
				2005	NA	NA	243 (0.35)
I-5	Southern Wood Piedmont Company	Richmond	Cretaceous Sand	2004	451 (0.65)	451 (0.65)	188 (0.27)
				2005	NA	NA	174 (0.25)
M-1	City of Waynesboro	Burke	Cretaceous Sand	2004	2778 (4.00)	2431 (3.50)	NA
				2005	2778 (4.00)	2431 (3.50)	NA
M-2	Augusta-Richmond Utilities Department	Richmond	Cretaceous Sand	2004	12778 (18.40)	12083 (17.40)	8285 (11.93)
				2005	NA	NA	8.40
	Southern Nuclear Operating Co.	Burke	Cretaceous Sand	2004	4167 (6.00)	3819 (5.50)	556 (0.80)
				2005	4167 (6.00)	3819 (5.50)	583 (0.84)

Notes:
NA – not available
Groundwater permit and usage data **(Voudy 2006)**
Groundwater aquifer description **(Georgia DNR 2006)**
Well locations are labeled on Figure 2.3.2-7 using the listed Well IDs.
Southern Nuclear Operating Co. well locations are shown on Figure 2.3.2-8.

Table 2.3.2-9 Georgia EPD Permitted Agricultural Groundwater Use Within 25 Miles of the VEGP Site

Well ID	Permit Holder	County	Depth (ft)	Permit (gpm)
A-1	ANDERSON JOHN	Burke	363	1500
A-2	BLANCHARD HENRY	Burke	500	1200
A-3	BLANCHARD HENRY	Burke	450	1400
A-4	BOLLWEEVIL PLANTATION	Burke	300	190
A-5	Chance Bill	Burke	500	450
A-6	CHANDLER FARM	Burke	580	1600
A-7	Chandler Michael	Burke	556	2400
A-8	Chandler Randall	Burke	579	2500
A-9	COCHRAN IRBY	Burke	420	1350
A-10	COLLINS ROBERT	Burke	430	1350
A-11	COLLINS ROBERT	Burke	530	1200
A-12	COLLINS ROBERT	Burke	480	1100
A-13	COLLINS ROBERT	Burke	440	1100
A-14	Collins Robert	Burke	490	1700
A-15	DIXON CARL	Burke	600	2000
A-16	DIXON JAMES	Burke	210	400
A-17	DIXON JAMES	Burke	200	200
A-18	DIXON JOANNE	Burke	640	1150
A-19	DIXON PERCY	Screven	560	2000
A-20	DIXON PERCY	Burke	560	2000
A-21	DIXON PERCY	Burke	350	115
A-22	DIXON PERCY	Burke	350	115
A-23	DIXON PERCY	Burke	550	3400
A-24	DIXON PERCY	Burke	350	200
A-25	DIXON PERCY	Burke	575	2500
A-26	DIXON PERCY	Burke	550	2500
A-27	GWR Partnership LLP	Burke	360	200
A-28	Hatcher William	Burke	300	500
A-29	HEATH CLAXTON	Burke	300	150
A-30	HEATH CLAXTON	Burke	400	250
A-31	HEATWOLE BYARD	Burke	325	200
A-32	HOPKINS HENRY	Burke	363	350
A-33	Horst Isaac	Burke	260	250
A-34	MALLARD CLYDE	Burke	320	400
A-35	MALLARD CLYDE MALLARD FARMS	Burke	210	250
A-36	MALLARD J.	Burke	200	150
A-37	McGregor Charles	Burke	430	350
A-38	MOBLEY DANNY	Burke	396	350
A-39	Mobley Danny	Burke	424	650
A-40	MOBLEY HERBERT	Burke	465	1100
A-41	MOBLEY HERBERT	Burke	500	1250
A-42	MOBLEY JAMES F.	Burke	572	2000
A-43	PENNINGTON FARMS- INC.	Burke	240	250
A-44	RAYMOND NEIL	Burke	430	1350
A-45	Shepherd Joseph	Burke	421	1500
A-46	SMART DARRELL	Burke	300	350
A-47	SMART DARRELL	Burke	300	350

Table 2.3.2-9 (cont.) Georgia EPD Permitted Agricultural Groundwater Use Within 25 Miles of the VEGP Site

Well ID	Permit Holder	County	Depth (ft)	Permit (gpm)
A-48	SMART DARRELL	Burke	300	350
A-49	SMART DARRELL	Burke	300	400
A-50	MIMS JOHN	Jenkins	445	1500
A-51	MIMS JOHN	Jenkins	460	1500
A-52	MULKEY A.	Jenkins	300	1000
A-53	MULKEY A.	Jenkins	400	500
A-54	PARKER GEORGE	Jenkins	450	700
A-55	PARKER GEORGE	Jenkins	300	450
A-56	PARKER GEORGE	Jenkins	300	450
A-57	Parker George	Jenkins	450	450
A-58	POINTE SOUTH GOLF CLUB- INC.	Richmond	311	400
A-59	BRAGG SOL	Screven	380	240
A-60	BRIAR CREEK COUNTRY CLUB	Screven	180	300
A-61	CAIN BRIAN	Screven	390	600
A-62	Cain Brian	Screven	493	1100
A-63	CLEMENT INVESTMENTS	Screven	282	1250
A-64	FOREHAND FARMS	Screven	160	250
A-65	Lee Mike	Screven	480	1800
A-66	Mill Haven Company Inc.	Screven	600	1200
A-67	MILLHAVEN CO.- INC.	Screven	553	1900
A-68	MILLHAVEN CO.- INC.	Screven	565	1400
A-69	NEWTON JAMES	Screven	350	400
A-70	SOWELL CAROLYN	Screven	275	300
A-71	STEPONGZI FRANK & PEARL	Screven	225	300
A-72	THOMPSON JAMES	Screven	475	750
A-73	THOMPSON ROGER	Screven	500	1000
A-74	WADE PLANTATION	Screven	215	200
A-75	WADE PLANTATION	Screven	250	190
A-76	WADE PLANTATION	Screven	460	1200
A-77	WADE PLANTATION	Screven	119	1000
A-78	WADE PLANTATION	Screven	750	1800
A-79	WADE PLANTATION	Screven	494	900
A-80	WADE PLANTATION	Screven	475	1200
A-81	WADE PLANTATION	Screven	672	1100
A-82	WADE PLANTATION	Screven	475	1100
A-83	WADE PLANTATION	Screven	525	1400
A-84	Wade Plantation	Screven	467	1100

Notes:

Groundwater permit data **(Lewis 2006)**

Well locations are labeled on Figure 2.3.2-7 using the listed Well IDs.

Table 2.3.2-10 SDWIS Listed Public Water Systems Supplied From Groundwater Within 25 Miles of the VEGP Site in Georgia

Well ID	Water System ID	Water System Name	County Served	Type	System Status
C-1	GA0330000	Girard	Burke	Community	Active
C-2	GA0330002	Sardis	Burke	Community	Active
C-3	GA0330013	Mamie Joe Rhodes Harrison Subdivision	Burke	Community	Closed
C-4	GA0330006	Burke Academy	Burke	Non-Transient Non-Community	Active
C-5	GA0330022	Burke County Training Center	Burke	Non-Transient Non-Community	Active
C-6	GA0330020	Delaigle Mobile Home Park	Burke	Transient Non-Community	Closed
C-7	GA1650000	Millen	Jenkins	Community	Active
C-8	GA1650001	Perkins Water Authority	Jenkins	Community	Active
C-9	GA1650006	Jockey International, Inc.	Jenkins	Non-Transient Non-Community	Active
C-10	GA1650005	DNR - Magnolia Springs State Pk.	Jenkins	Transient Non-Community	Active
C-11	GA1650008	National Fish Hatchery	Jenkins	Transient Non-Community	Closed
C-12	GA2450023	East Central Regional Hospital	Richmond	Community	Active
C-13	GA2450002	Hephzibah	Richmond	Community	Active
C-14	GA2450017	Hephzibah - Oakridge	Richmond	Community	Active
C-15	GA2450014	Mars Trailer Park	Richmond	Community	Active
C-16	GA2450016	Mobile Home Country Club MHP	Richmond	Community	Active
C-17	GA2450004	Richmond County	Richmond	Community	Closed
C-18	GA2450159	Albion Kaolin Company	Richmond	Non-Transient Non-Community	Closed
C-19	GA2450152	Olin Chemicals	Richmond	Non-Transient Non-Community	Closed
C-20	GA2510000	Hiltonia	Screven	Community	Active
C-21	GA2510015	Buck Creek M.H.P.	Screven	Community	Closed
C-22	GA2510052	Millhaven Plantation	Screven	Community	Closed
C-23	GA2510011	DOT - Georgia Welcome Center	Screven	Transient Non-Community	Active
C-24	GA2510057	Savannah River Challenge Program	Screven	Transient Non-Community	Active
	GA0330035	Southern Nuclear - Simulator Bld	Burke	Non-Transient Non-Community	Active
	GA0330017	Southern Nuclear - Vogtle Makeup	Burke	Non-Transient Non-Community	Active
	GA0330036	Southern Nuclear - Vogtle Rec	Burke	Transient Non-Community	Active

Notes:
US EPA SDWIS Database **(EPA 2006b)**
Well locations are labeled on Figure 2.3.2-7 using the listed Well IDs.
Southern Nuclear Operating Co. well locations are shown on Figure 2.3.2-8.

Table 2.3.2-11 VEGP Water-Supply Well Specifications and Yields[1]

Water Supply Well No.	Well Depth (ft)	Aquifer	Design Yield (gpm)[2]	Water Use
MU-1 [a]	851	Cretaceous	2000	Make-up water for plant use (e.g. nuclear service cooling water system; make-up to the water treatment plant demineralizer, and potable water source).
MU-2A [a]	884	Cretaceous	1000	Make-up water for plant use (e.g. nuclear service cooling water system; make-up to the water treatment plant demineralizer, and potable water source).
TW-1 [a]	860	Cretaceous	1000	Back-up water for the production make-up well system.
SW-5[a]	200	Tertiary	20	Water supply for old security tactical training area.
IW-4 [a]	370	Tertiary	120	Irrigation water for ornamental vegetation.
CW-3 [a]	220	Tertiary		Water supply for nuclear operations garage.
REC [a]	265	Tertiary	150	Potable water supply for recreation area.
SB [a]	340	Tertiary	50	Potable water supply for simulator training building.
SEC [b]	320	Tertiary	10	Non-potable water for lavatory use at a new plant entrance security building

Notes:
[1] Well locations, excluding Well REC, are shown on Figure 2.3.2-8. Well REC is located approximately 9300 ft southwest from Well IW-4.
[2] (gpm) gallons per minute

Sources:
[a] SNC 2005b
[b] SNC 2005a

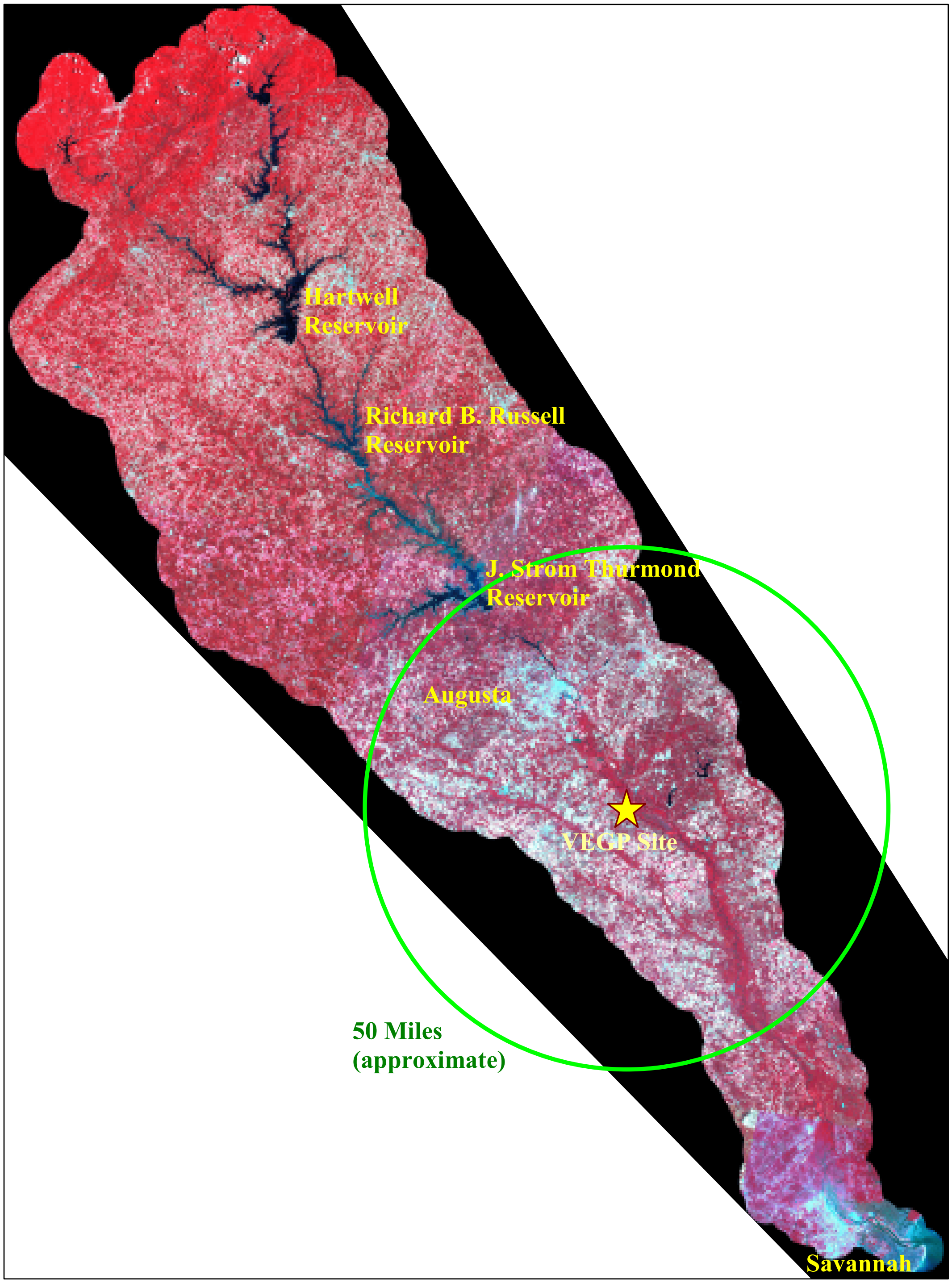
Table 2.3.2-12 Onsite Groundwater Use by VEGP for 2005, in Thousand Gallons per Month

Month	Well MU-1	Well MU-2A	Well TW-1	Well SW-5	Well IW-4	Well CW-3	Well REC	Well SB
January	19,209	0	0	0	0	3	28	2
February	17,416	0	0	0	0	2	50	58
March	21,601	0	0	0	0	2	41	54
April	26,211	0	0	0	0	1	47	65
May	29,648	0	0	0	0	2	67	75
June	35,625	0	0	0	14	2	42	83
July	23,846	0	0	0	55	2	125	118
August	24,560	0	0	0	126	6	104	66
September	28,020	0	0	0	134	4	84	69
October	30,290	0	0	0	0	3	79	49
November	20,282	2,880	0	0	0	2	72	104
December	26,363	0	0	0	0	2	41	160
Total	303,071	2,880	0	0	329	31	779	904
Monthly Average	25,256	240	0	0	27	3	65	75

Table 2.3.2-13 Projected Groundwater Use by AP1000, in Gallons per Minute (gpm)

Well Water Supply[a]	Normal Case (gpm)	Maximum Case (gpm)
Total well water demand	752	3,140
Power plant makeup water	215	787
Well water for service water system makeup	537	2,353

a. Values are from Figure 3.3-1 and Figure 3.3-2 in Section 3.3.1.



Note: River basin within approximately 50 mi of the VEGP site shown by the green circle

Source: EPA 1999

Figure 2.3.2-1 Major Surface Water Bodies Within the Affected Hydrologic System

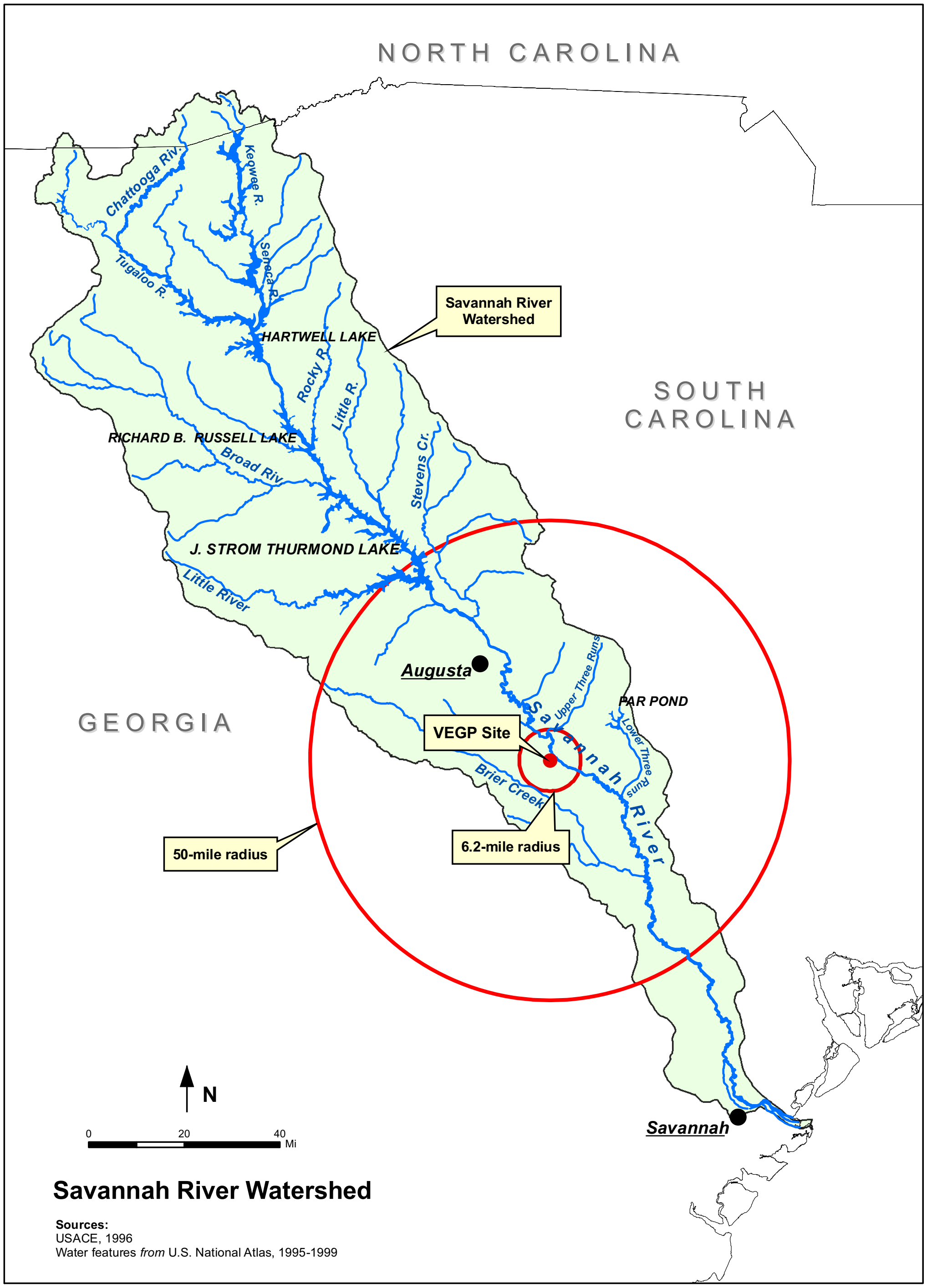


Figure 2.3.2-2 Major Rivers and Streams, and the Location of Major Reservoirs in the Savannah River Basin

Figure 2.3.2-3 Counties Located within a 50-Mile Radius from the VEGP Site and within the Savannah River Basin

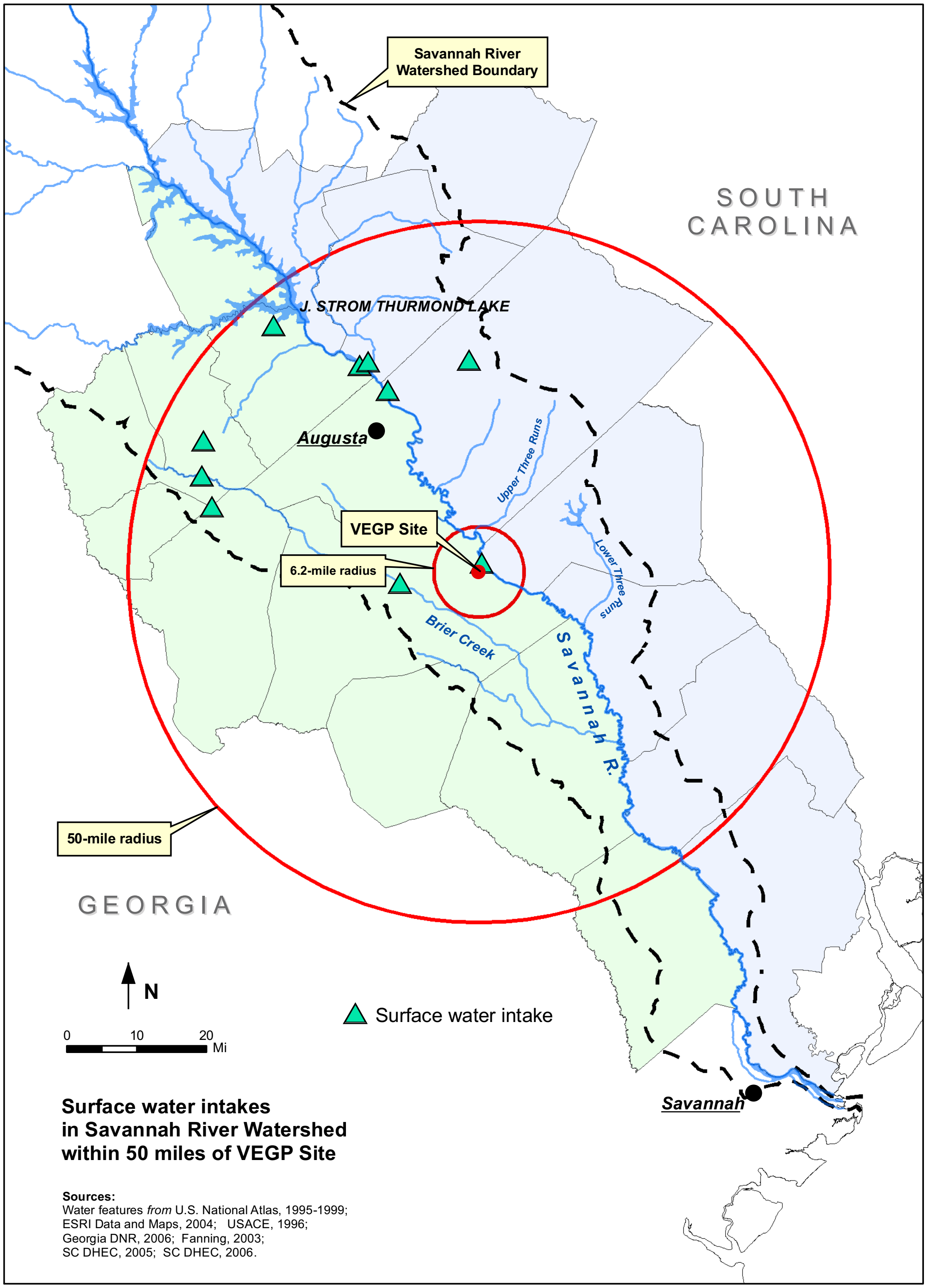


Figure 2.3.2-4 Location of Surface Water Withdrawal Intakes Within the Savannah River Basin and Within 50 Miles of the VEGP Site

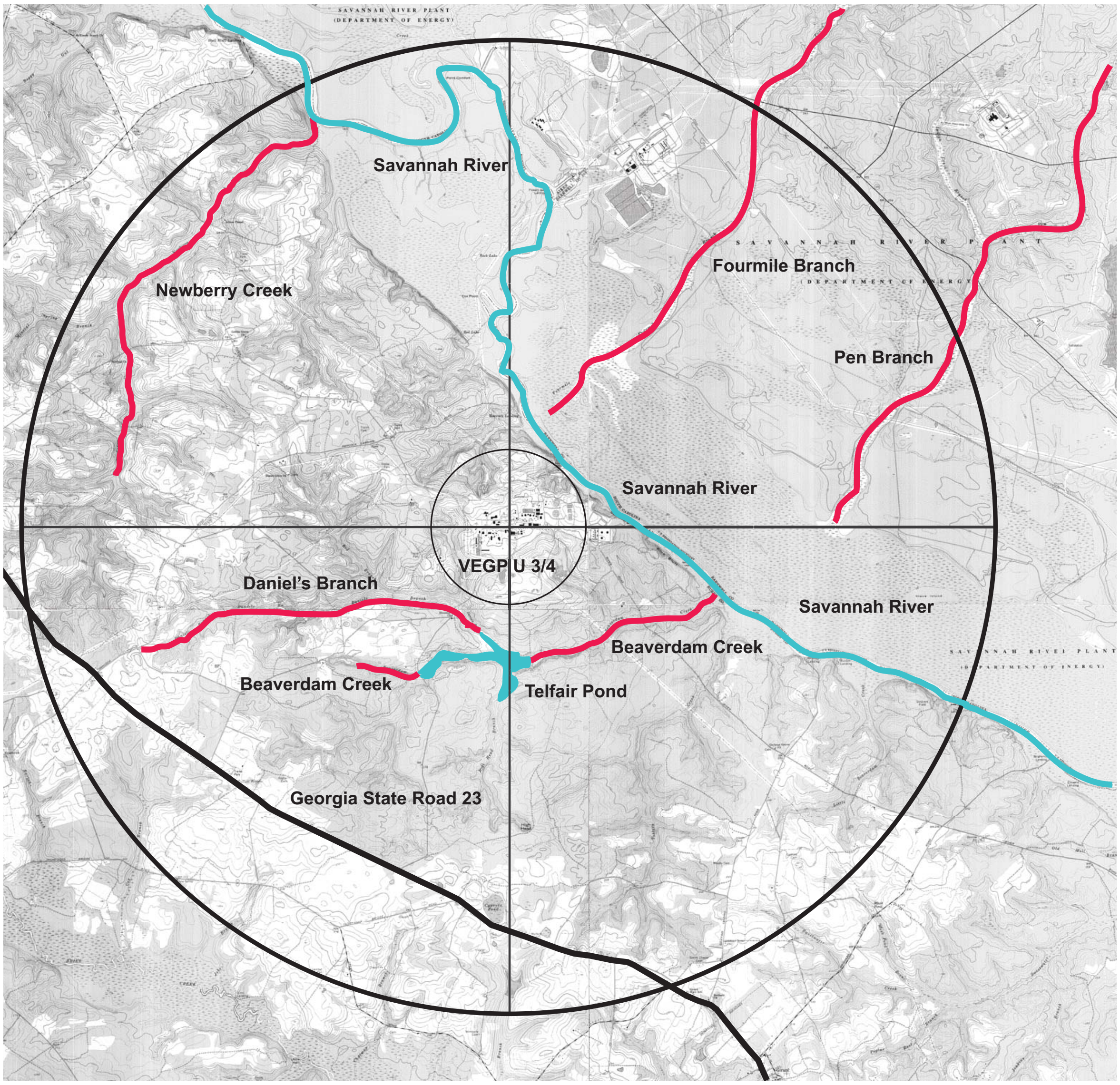


Figure 2.3.2-5 Major Surface Water Bodies Within a 6.2-Mile (10-km) Radius of the VEGP Site

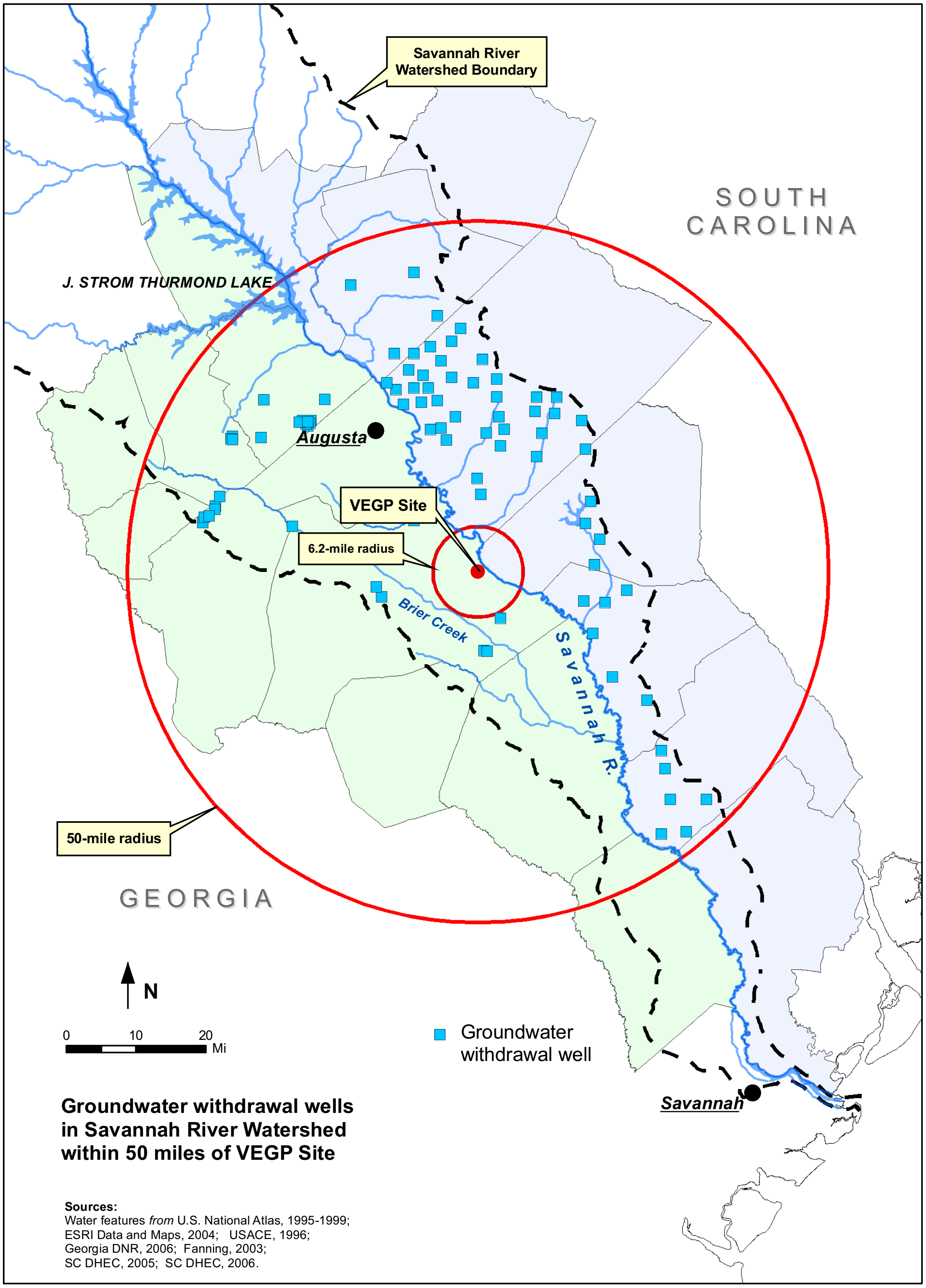


Figure 2.3.2-6 Location of Groundwater Withdrawal Wells Within the Savannah River Basin and Within 50 Miles of the VEGP Site

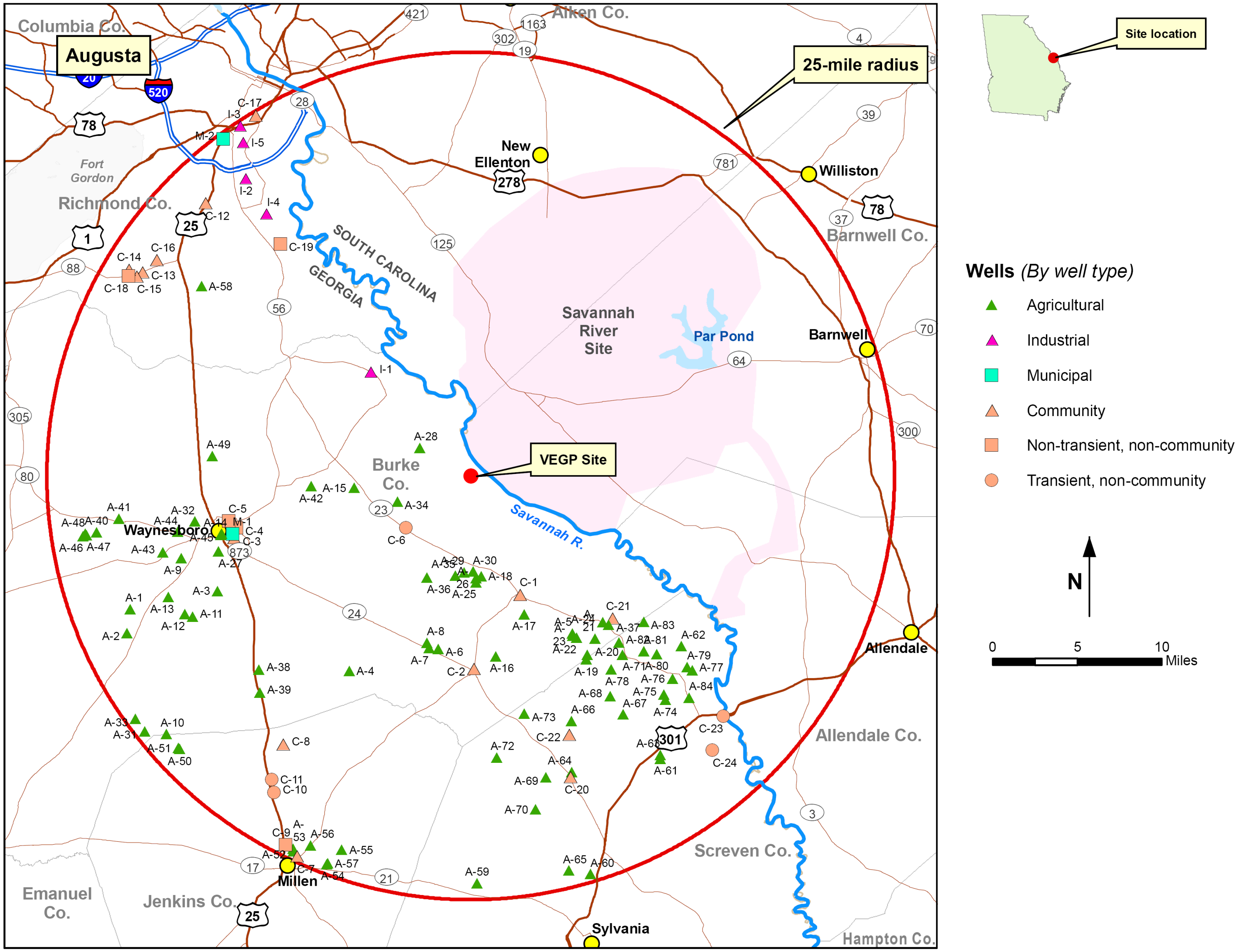


Figure 2.3.2-7 Locations of Water-Supply Wells Within 25 Miles of the VEGP Site

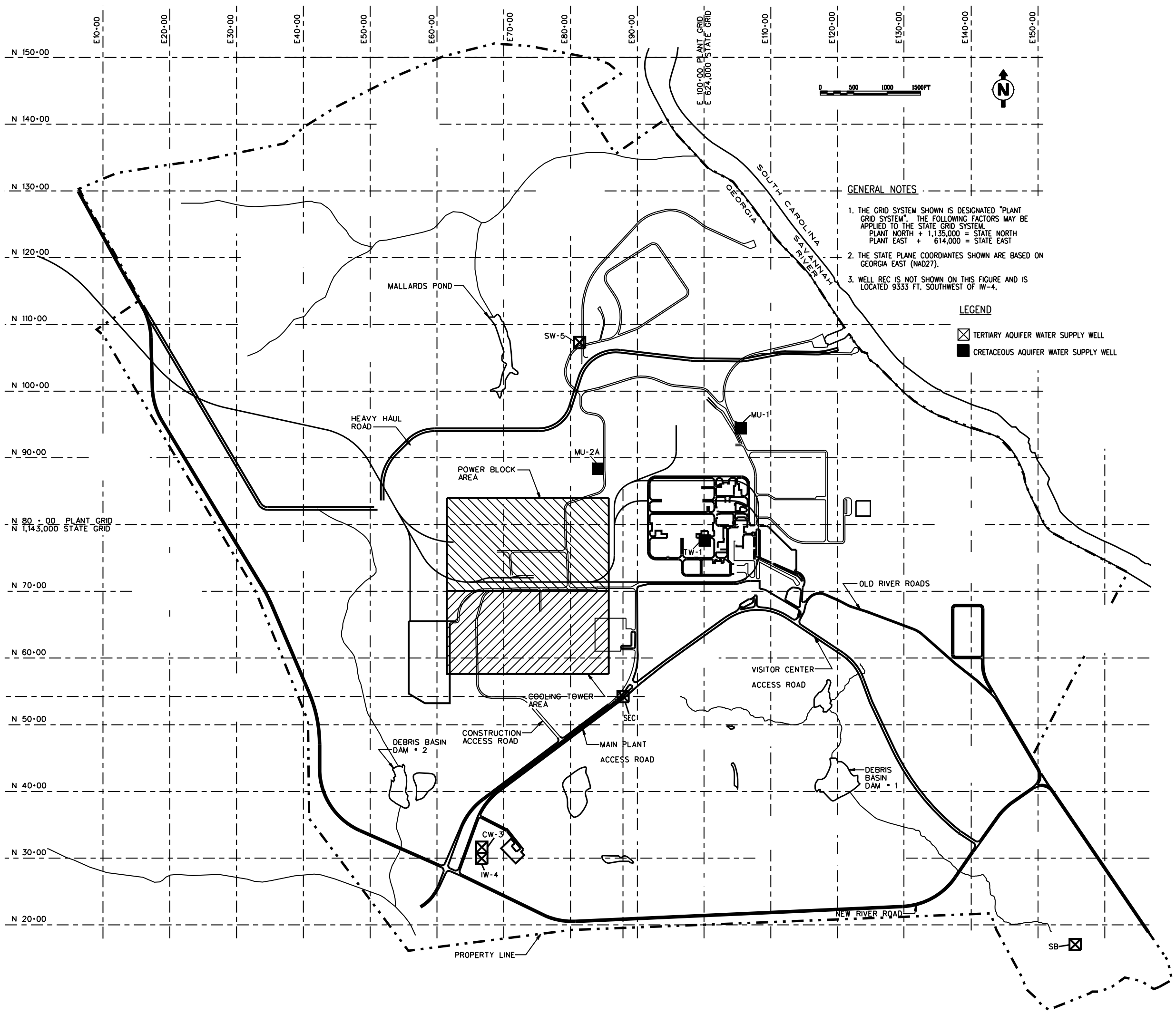


Figure 2.3.2-8 Location of Groundwater Withdrawal Wells for VEGP Units 1 and 2

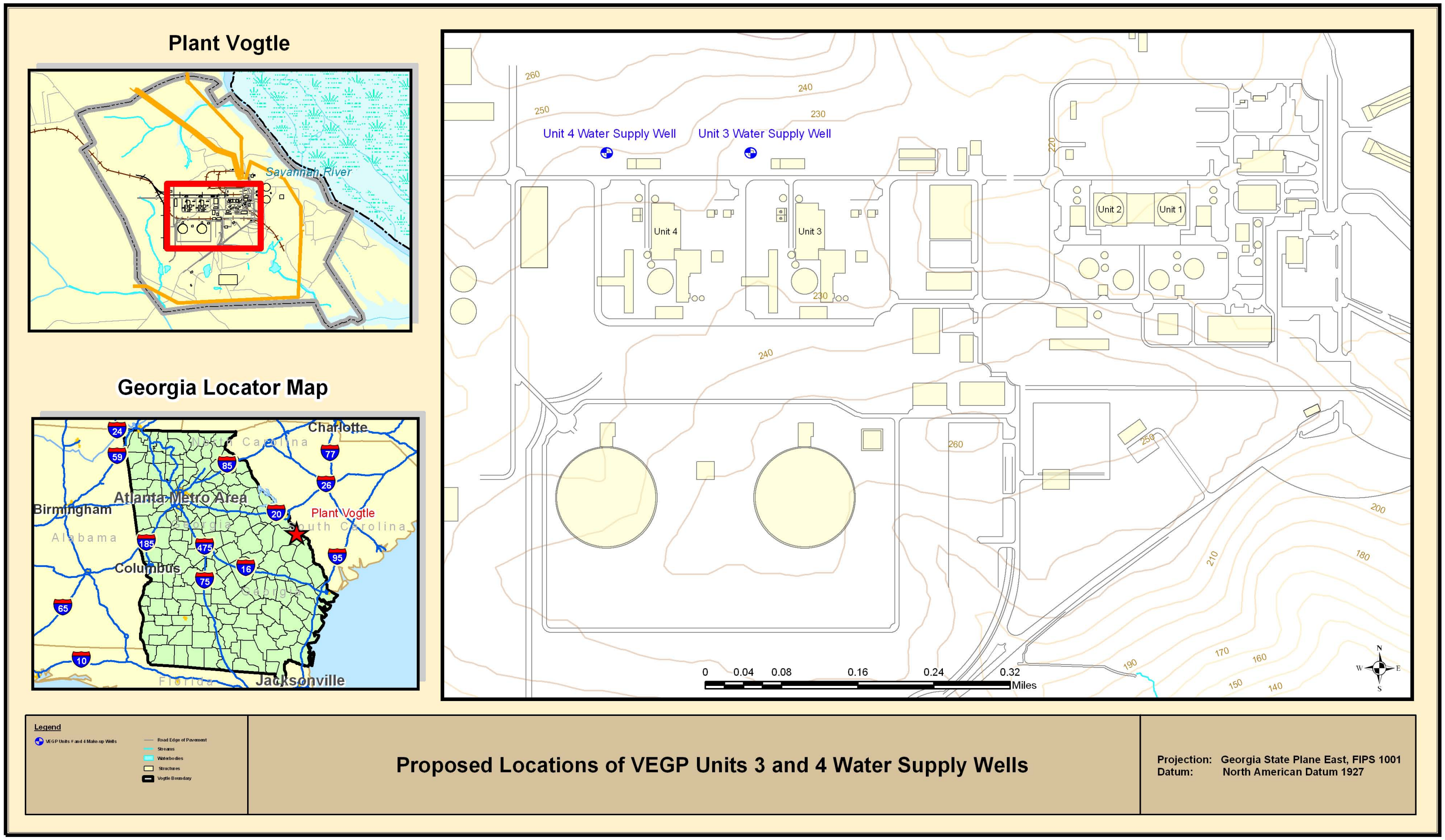


Figure 2.3.2-9 Locations of Proposed Groundwater Withdrawal Wells for VEGP Units 3 and 4

Section 2.3.2 References

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2.3.3 Water Quality

2.3.3.1 Surface Water

The new units will withdraw makeup water from the Savannah River through a new intake structure located upstream of the existing intake structure as discussed in Section 1.2.4. All cooling system discharges from the new units, including cooling tower blowdown, will be discharged to the Savannah River via a new discharge structure that will be built downstream of the existing discharge structure. Aside from some small on-site ponds and streams, the Savannah River is the only surface water body that could be affected by construction and operation of new units at the VEGP site.

The Environmental Protection Division (EPD) of Georgia Department of Natural Resources (GDNR) monitors water quality of the Savannah River as part of its River Basin Management Planning (RBMP) initiative **(GDNR 2001)**. This initiative was intended to promote cooperation between the public and private sectors and to encourage citizens and agencies to work together to identify and reduce sources of pollution, improve water quality, protect fish and wildlife habitats, restore degraded habitats, and enhance public recreational opportunities.

The USGS has divided the Savannah River into seven sub-basins and assigned Hydrologic Unit Codes (HUCs) to each. The approximately 122-mile-long portion of the river from J. Strom Thurmond Dam (impounding Clarks Hill Lake) to Brier Creek, downstream of VEGP, has been designated HUC 03060106, Middle Savannah River (see Figure 2.3.3-1). To facilitate monitoring water quality trends in the greater Augusta, Georgia area, GDNR has subdivided this reach of river into four segments (see Table 2.3.3-1), two upstream, one including VEGP, and one downstream of VEGP.

Water quality in the Middle Savannah River Basin is generally good, with 104 of 122 river miles fully supporting designated uses **(GDNR 2002)**. The two stream segments with degraded water quality are both upstream of VEGP, in Columbia and Richmond Counties. The tailwaters of both Clarks Hill Lake and Stevens Creek Reservoir periodically experience low levels of dissolved oxygen, particularly in late summer when Clarks Hill Lake is stratified and hypolimnetic water, low in oxygen, is released to generate electricity at the J. Strom Thurmond Dam powerhouse. The U.S. Army Corps of Engineers installed five auto-venting turbines at the J. Strom Thurmond Dam powerhouse in 2004 (two more will be installed in 2006) which are expected to increase dissolved oxygen downstream in the Savannah River by more than 2 parts per million **(COE 2004; Pavey 2004)**. The water use classification of Fishing/Drinking Water was not fully supported in the Stevens Creek to Highway 78/278 segment due to low dissolved oxygen and exceedances of the water quality standards for fecal coliform bacteria. These deficiencies have, in the past, been attributed to a combination of urban runoff, malfunctioning septic systems, sanitary sewer overflow, and/or animal wastes **(GDNR 2001)**.

Although water quality in the Middle Savannah River generally supports designated uses, Georgia DNR has announced fish consumption advisories based on elevated mercury concentrations in certain fish species for several reaches of river including between J. Strom Thurmond Dam and Burke County. **(GDNR 2005a)**

Like Georgia, South Carolina monitors Savannah River water quality. The South Carolina Department of Health and Environmental Control (SCDHEC) maintains three water quality monitoring stations in Aiken County upstream of VEGP and another downstream of VEGP in Allendale County **(SCDHEC 2003)**. The three upstream stations are at US 1 (Station SV-251), SC Highway 28 (Station SV-252), and Savannah River Lock and Dam (Station SV-323). In a Watershed Water Quality Assessment, SCDHEC examined Savannah River Basin water quality at these three stations for the 1996-2000 period and concluded that recreational uses were fully supported at all three sites. **(SCDHEC 2003)**. Recreational uses also were fully supported at the downstream monitoring station (Station SV-118). **(SCDHEC 2003)**

In 2004, SCDHEC issued a Fish Consumption Advisory for 53 South Carolina waterbodies, including the Savannah River, because of concerns about mercury contamination. The advisory also cautioned that "some fish also contain [the radionuclides] cesium-137 and strontium-90." **(SCDHEC 2005b)**

In addition to Georgia and South Carolina, the U.S. Department of Energy (DOE) has monitored Savannah River water quality for more than 50 years, initially to assess potential impacts of the SRS's nuclear and industrial facilities on the river's aquatic communities and later to ensure compliance with the provisions of the Clean Water Act, enacted in 1972. These water quality data provide a valuable long-term baseline dataset against which to measure man-induced change in the middle reach of the Savannah River.

DOE monitors Savannah River water quality at a series of stations up- and downstream of SRS tributary streams that receive NPDES-regulated effluents from SRS facilities **(Mamatey 2004).** These river sampling sites are located at RM-160, RM-150.4, RM-141.5, RM-129.1, and RM-118. The existing VEGP discharge is at RM-150.4 (see Figure 2.3-1 for approximate location). In 2003, the last year for which data are available, water quality data from the five Savannah River stations showed no indication of water quality degradation or impairment (Table 2.3.3-2). Temperatures and dissolved oxygen levels were within a range known to support aquatic organisms. Contaminants were either present in low concentrations (metals) or below the lower limit of detection (pesticides).

In addition to non-radiological constituents, DOE monitors radionuclides in Savannah River water at points above and below SRS, and below the point at which VEGP liquid discharges enter the river **(Mamatey 2004)**. Composite samples are collected weekly at five river locations and analyzed for tritium, cobalt-60 (Co-60), cesium-137 (Cs-137), gross alpha, and gross beta. An annual grab sample is obtained at each location and analyzed for strontium-89/90 (Sr-89/90), technetium-99 (Tc-99), isotopes of uranium (234, 235, and 238), isotopes of plutonium (238 and

239), americium-241 (Am-241), and curium-244 (Cm-244). The results of these analyses for 2003, which is the latest year for which data are available, are shown in Table 2.3.3-3. All measured concentrations were below the applicable regulatory criteria.

2.3.3.2 Groundwater

Information on the quantity and quality of groundwater in the vicinity of VEGP may be found in the VEGP UFSAR. There are two aquifers of interest at the VEGP site. The lower aquifer system is referred to as the Cretaceous aquifer system (now generally referred to as the Dublin and Midville aquifer systems) and consists primarily of the sands, gravels, and clays of the Tuscaloosa Formation. The upper aquifer system is variously referred to as the Tertiary aquifer system, the principal artesian aquifer, the limestone aquifer, and as the Floridan aquifer system. In the vicinity of the site, the Floridan also includes the water table aquifer. It consists primarily of the limestones and permeable sands of the Lisbon formation or stratigraphic equivalents. They are separated by a 60 to 70 foot thick aquiclude of hard, clayey marl referred to as "Blue Bluff marl." The Blue Bluff marl, which is the principal load-bearing stratum for the plant, is located about 85 feet below grade at 134 feet below mean sea level **(NRC 1985)**. The water table aquifer system beneath the plant is hydraulically isolated by stream channels (Savannah River to the east, Hancock Landing drainage to north, Beaverdam Creek to the south that represent hydraulic bearing to groundwater flow). Groundwater in this shallow aquifer is replenished by precipitation that percolates to the water table and moves laterally to the aforementioned interceptor streams **(GPC 1972)**.

Overall, the groundwater of the VEGP area is the calcium-sodium bicarbonate type, with total dissolved solids less than 200 parts per million. Groundwater from the water table aquifer contains from 20 to 170 parts per million total dissolved solids; groundwater from the deeper confined aquifer contains from 110 to 194 parts per million. The variation in total dissolved solids is apparently due to the length of time the water has remained in the ground; more time allows more leaching of solids. Sodium is the dominant cation in groundwater from both shallow and confined aquifers.

EPD is the entity within GDNR with the responsibility for protecting the state's groundwater quality. To this end, EPD has implemented a comprehensive state-wide groundwater management policy of anti-degradation and instituted a groundwater quality assessment program that includes the Georgia Ground-Water Monitoring Network **(Donahue 2004)**. The Geological Survey Branch of EPD maintains the network, which is designed to monitor the ambient groundwater quality of nine major aquifer systems in Georgia. One of these nine, locally named aquifer systems, the Jacksonian Aquifer System (part of Floridan aquifer system) of central and east-central Georgia, underlies VEGP.

Over the last 50 years as the coastal region of Georgia developed, subtle changes began to occur in the Upper Floridan aquifer that supplies the majority of the groundwater in the region. This porous limestone aquifer has extremely high productivity and provides drinking water to the major population centers on the Georgia, South Carolina and northern Florida Atlantic Coasts. Over time as a result of increasing use, the direction of flow in the aquifer changed and groundwater containing salt began to flow upward into major pumping centers in Savannah, GA-Hilton Head, SC; Brunswick, GA; and Jacksonville-Fernandina beach FL. This problem was first recognized in the 1960s. In the late 1970s and 1980s, a number of studies were done to define the problem and in 1995, Georgia EPD began a public education program and voluntary efforts to control the saltwater intrusion problems in the Upper Floridan aquifer. In 1997, the Georgia Department of Natural Resources, Environmental Protection Division (GADNR EPD) developed a two-stage approach to addressing the issue. The first stage was the implementation of an interim strategy that addressed groundwater withdrawal permitting from 1997 to 2005. The interim strategy instituted a moratorium on groundwater withdrawal permits for municipal, industrial, and agricultural uses within a 24-county area of coastal Georgia (including Burke but not Richmond or Columbia counties). The second stage, called the Coastal Sound Science Initiative (CSSI), consisted of scientific and engineering investigations to generate information and data to build a plan for managing salt water intrusion. The results indicate that there are three major locations where salt water intrusion is taking place. Model simulation indicates that if current pumping rates are maintained through the 21st century, the rate of movement of the largest of the three plumes will be about 130 feet per year. GADNR EPD believes that if the plumes continue to expand at the 1965-2004 rates, then salt water will not be a problem in Georgia for more than 100 years. Groundwater management will vary by county and be guided by each county's proximity to the three plumes **(GDNR 2005b)**. Burke County is one of the more distant counties from the plumes. The interim Strategy defined three sub-regions with requirements that become more stringent near the coast. Burke County, where the VEGP site is located is in sub-region 3, the least restrictive sub-region. It consists of 19 full counties plus the portion of Effingham County north of Highway 119. The strategy for this region provides for conservation and reuse, justification of need, and monitoring to ensure the groundwater resource is protected for the future. Although more stringent than for some other counties in Georgia, the requirements placed on groundwater withdrawal in Burke County should not significantly impact withdrawal of groundwater to support the proposed VEGP Units 3 and 4.

Between January 2003 and January 2004, EPD monitored the water quality of eight wells in the Jacksonian Aquifer System **(Donahue 2004)**. Three of the wells, arrayed around a significant recharge area, were in Burke County west of VEGP. The other five wells were south and west of VEGP in Jefferson, Emanuel, Johnson, and Bleckley counties. Five of the wells are in the northern clastic facies (sands) of the Barnwell Group; two wells are in the less permeable silts and clays of a transition facies **(Donahue 2004)**. One well, north of the VEGP site, draws from an isolated limestone body.

The pH of water in the eight wells ranged from 4.62 to 7.44, while conductivity ranged from 37 to 228 micro-siemens per centimeter. Lowest pH and conductivity values were from the shallow "updip" well (J-7, approximately 25 miles west of the VEGP site) in the clastic facies. All samples were tested for volatile organic compounds (VOC), including the gasoline additive methyl tert-butyl ether (MTBE). No VOCs were detected. Excessive levels of beryllium have been detected in the past in well J-8 (approximately 40 miles west of the VEGP site), but in 2003-2004 concentrations were below the primary maximum contaminant limit (MCL; 4 parts per billion). Nitrate/nitrite, as nitrogen, ranged from undetectable to 7.6 ppm, and was detectable in six of the eight wells. The elevated nitrogen value was also from well J-8.

EPD is also responsible for monitoring radiation and radioactive materials in the environment. Since 1976, EPD has monitored radiation at nine nuclear facilities in Georgia and the bordering states of Alabama, Tennessee, and South Carolina **(GDNR 2004**, Executive Summary). Georgia DNR's most extensive environmental radiation monitoring network is focused on an area in Georgia adjacent to and downstream of the SRS and VEGP **(GDNR 2004)**. Because the two sites are across the Savannah River from one another, EPD has, since 1978, combined monitoring at the two facilities into a single program or "monitoring network" designed to detect radionuclides not only in groundwater but also in air, soils, crops, wildlife, surface water, and fish in the region.

Tritium was reported from several relatively deep wells in Burke County in 1991, and the Geologic Survey Branch of GDNR, with the assistance of DOE, began an investigation of the source of the tritium and the extent of contamination. The groundwater testing program in Burke County included an examination of existing wells, drilling and monitoring of several test wells, and testing of rainfall to determine its tritium content. As of 2002, no significant tritium contamination had been found in any deep aquifers in the VEGP area. More tritium was found in groundwater associated with the shallow (up to 200 feet deep) Upper Three Runs aquifer, however. Tritium concentrations averaged less than 1,000 pico-curies per liter (pci/L) over the 2000-2002 period, less than or equal to 5 percent of the MCL. Based on the areas with highest concentrations (southwest of SRS facilities), tritium appears to be transported by air (rain) from SRS **(GDNR 2004)**.

Tritium concentrations have been highest in the Tobacco Road Sand and Irwington Sand Member formations (20 to 80 feet deep) of the Upper Three Runs aquifer (**GDNR 2004**, Figure D-14B). Tritium concentrations in other Upper Three Runs formations have been much lower, and have been undetectable in the deeper Gordon, Millers Pond, and Dublin aquifers **(Georgia DNR 2004)**. EPD geologists theorize that the vertical profile reflects the historical rainout of airborne tritium from SRS, looking backward in time, from top to bottom of the Upper Three Runs aquifer. Maximum concentrations are presumed to relate to deposition of tritium in 1950s, 1960s, and 1970s, when SRS production facilities were operating at or near capacity and airborne releases from tritium facilities were at their highest levels.

Table 2.3.3-1 Stream Segments and Classifications, Middle Savannah River

Segment Described	County or Counties	Length (mi)	Classification	Fully or Partially Supporting Designated Uses
Thurmond Dam to Stevens Creek	Columbia	9	Drinking Water	Partially[a]
Stevens Creek Dam to Hwy 78/278	Columbia Richmond	9	Drinking Water	Partially[b]
Hwy 78/278 to Johnsons Landing (reach adjacent to VEGP)	Richmond Burke Screven	78	Fishing	Fully
Johnsons Landing to Brier Creek	Screven	26	Fishing/Drinking Water	Fully

Source: GDNR 2002, Appendix A

a Did not meet water quality standard for dissolved oxygen

b Did not meet water quality standards for dissolved oxygen and fecal coliforms

Table 2.3.3-2 Savannah River Water Quality in 2003

		Location				
		RM-118.8	RM-129.1	RM-141.5	RM-150.4[a]	RM-160
Parameter	Unit	Range (Mean)	Range (Mean)	Range (Mean)	Range (Mean)	Range (Mean)
Temperature	°C	9.4-25.7 (18.05)	9-23.3 (17.558)	9-22.8 (17.408)	9.2-23.1 (17.267)	9-22.4 (17.025)
Dissolved Oxygen (DO)	mg/L	5.25-11.33 (8.042)	6.11-10.53 (7.767)	6.04-10.96 (7.788)	6.13-11.4 (8.37)	7.19-10.21 (8.473)
pH	SU	5.8-7.02 (6.6)	5.7-7.27 (6.628)	5.8-7.09 (6.518)	6.24-6.93 (6.682)	5.94-7.3 (6.697)
Hardness	mg/L	11-18 (15.333)	12-27 (18.417)	13-19 (15.417)	12-20 (15.583)	12-19 (15.455)
Total Suspended Solids	mg/L	4-20 (8.5)	1-17 (8.636)	2-26 (9.25)	4-34 (11.75)	2-26 (9.167)
Nitrate Nitrogen	mg/L	0.19-0.42 (0.29)	0.026-0.32 (0.226)	0.2-0.37 (0.284)	0.23-0.38 (0.303)	0.24-0.34 (0.285)
Total Phosphate Phosphorus	mg/L	0.084-0.16 (0.116)	0.034-0.16 (0.091)	0.038-0.15 (0.103)	0.064-0.42 (0.138)	0.03-0.23 (0.103)
Total Organic Carbon (TOC)	mg/L	3.8-6 (4.742)	4-15 (6.025)	3.7-6.8 (4.792)	3-7.6 (4.517)	3.1-6.1 (4.245)
Aluminum	mg/L	0.055-0.696 (0.316)	0.049-0.695 (0.3)	0.045-1.207 (0.369)	0.059-1.071 (0.391)	0.057-0.71 (0.36)
Beryllium	mg/L	0.306-0.306 (0.306)	0.002-0.002 (0.002)	0.002-0.002 (0.002)	0.002-0.002 (0.002)	0.0004-0.002 (0.001)
Cadmium	mg/L	0.0003-0.002 (0.001)	0.0001-0.003 (0.001)	0.001-0.003 (0.001)	0.0001-0.003 (0.001)	0.0002-0.003 (0.001)
Chromium	mg/L	0.001-0.001 (0.001)	0.001-0.001 (0.001)	0.001-0.002 (0.001)	0.001-0.002 (0.001)	0.001-0.001 (0.001)
Copper	mg/L	0.001-0.002 (0.002)	0.001-0.002 (0.001)	0.001-0.002 (0.002)	0.001-0.002 (0.001)	0.001-0.744 (0.15)
Iron	mg/L	0.487-1.402 (0.867)	0.396-1.893 (0.915)	0.41-1.905 (0.921)	0.396-1.566 (0.782)	0.422-1.165 (0.656)
Mercury	ug/L	0.011-1.158 (0.237)	0.015-0.141 (0.074)	0.024-0.153 (0.07)	0.018-0.246 (0.111)	0.01136-0.165 (0.072)
Manganese	mg/L	0.023-0.162 (0.097)	0.017-0.18 (0.092)	0.063-0.205 (0.114)	0.072-0.293 (0.121)	0.066-0.486 (0.144)

Table 2.3.3-2 (cont.) Savannah River Water Quality in 2003

		Location				
		RM-118.8	RM-129.1	RM-141.5	RM-150.4[a]	RM-160
Parameter	Unit	Range (Mean)	Range (Mean)	Range (Mean)	Range (Mean)	Range (Mean)
Nickel	mg/L	0.004-0.134 (0.031)	0.004-0.01 (0.006)	0.005-0.009 (0.007)	0.003-0.009 (0.006)	0.005-0.01 (0.008)
Lead	mg/L	0-0 (ND)	0-0 (ND)	0-0 (ND)	0-0 (ND)	0-0 (ND)
Thallium	mg/L	0-0 (ND)	0-0 (ND)	0.009-0.009 (0.009)	0-0 (ND)	0.011-0.011 (0.011)
Zinc	mg/L	0-0 (ND)	0-0 (ND)	0-0 (ND)	0.011-0.014 (0.013)	0-0 (ND)

Source: **Mamatey 2004**
ND = no data
a Location of VEGP discharge

Table 2.3.3-3 Radioactivity in Savannah River Water in 2003

Radionuclide	Location	Number of samples	Sample mean (pCi/l)	Standard Deviation (pCi/l)
H-3	River Mile 118.8	52	7.49E+02	4.32E+01
	River Mile 141.5	52	8.89E+02	6.03E+01
	River Mile 150.0	52	7.24E+02	6.06E+01
	River Mile 150.4	52	1.17E+03	1.45E+02
	River Mile 160.0	52	1.20E+02	1.26E+01
Co-60	River Mile 118.8	52	1.29E-01	5.78E-02
	River Mile 141.5	52	1.06E-01	5.09E-02
	River Mile 150.0	52	1.01E-01	4.11E-02
	River Mile 150.4	52	2.32E-01	1.11E-01
	River Mile 160.0	52	1.15E-01	5.80E-02
Cs-137	River Mile 118.8	52	8.08E-02	6.35E-02
	River Mile 141.5	52	4.21E-02	6.25E-02
	River Mile 150.0	52	3.27E-02	5.50E-02
	River Mile 150.4	52	-4.15E-04	6.76E-02
	River Mile 160.0	52	7.19E-02	5.96E-02
Sr-89/90	River Mile 118.8	1	1.55E-01	4.28E-02
	River Mile 141.5	1	1.13E-01	3.97E-02
	River Mile 150.0	1	4.81E-02	2.69E-02
	River Mile 150.4	1	7.36E-02	3.86E-02
	River Mile 160.0	1	5.20E-02	3.43E-02
Tc-99	River Mile 118.8	1	-1.10E+00	1.64E+00
	River Mile 141.5	1	1.21E+00	1.83E+00
	River Mile 150.0	1	-1.56E-03	1.74E+00
	River Mile 150.4	1	1.10E+00	1.83E+00
	River Mile 160.0	1	-1.56E-03	1.74E+00
U-234	River Mile 118.8	1	2.01E-01	1.67E-01
	River Mile 141.5	1	4.15E-01	3.81E-01
	River Mile 150.0	1	3.58E-01	3.69E-01
	River Mile 150.4	1	9.37E-01	4.47E-01
	River Mile 160.0	1	-3.91E-01	2.91E-01
U-235	River Mile 118.8	1	2.02E-01	1.73E-01
	River Mile 141.5	1	4.84E-01	4.43E-01
	River Mile 150.0	1	6.33E-01	4.53E-01
	River Mile 150.4	1	7.93E-01	4.92E-01
	River Mile 160.0	1	-4.03E-01	3.24E-01

Table 2.3.3-3 (cont.) Radioactivity in Savannah River Water in 2003

Radionuclide	Location	Number of samples	Sample mean (pCi/l)	Standard Deviation (pCi/l)
U-238	River Mile 118.8	1	1.18E-01	1.55E-01
	River Mile 141.5	1	6.74E-01	3.71E-01
	River Mile 150.0	1	-4.49E-01	2.40E-01
	River Mile 150.4	1	7.79E-02	3.21E-01
	River Mile 160.0	1	2.40E-01	3.19E-01
Pu-238	River Mile 118.8	1	-2.08E-02	4.63E-02
	River Mile 141.5	1	-7.17E-02	5.34E-02
	River Mile 150.0	1	-5.08E-02	7.65E-02
	River Mile 150.4	1	-7.38E-04	7.36E-02
	River Mile 160.0	1	3.41E-01	1.39E-01
Pu-239	River Mile 118.8	1	7.28E-03	1.56E-02
	River Mile 141.5	1	1.52E-01	9.32E-02
	River Mile 150.0	1	3.79E-01	1.40E-01
	River Mile 150.4	1	2.18E-01	1.05E-01
	River Mile 160.0	1	-3.59E-02	3.76E-02
Am-241	River Mile 118.8	1	-7.87E-02	3.15E-02
	River Mile 141.5	1	1.67E-01	1.65E-01
	River Mile 150.0	1	1.58E-01	1.41E-01
	River Mile 150.4	1	-2.10E-02	9.53E-02
	River Mile 160.0	1	3.13E-02	1.16E-01
Cm-244	River Mile 118.8	1	4.51E-02	4.52E-02
	River Mile 141.5	1	5.94E-02	5.96E-02
	River Mile 150.0	1	5.24E-02	5.26E-02
	River Mile 150.4	1	-3.14E-02	3.14E-02
	River Mile 160.0	1	0.00E+00	2.17E+01
Gross beta	River Mile 118.8	52	2.28E+00	8.91E-02
	River Mile 141.5	52	2.30E+00	8.02E-02
	River Mile 150.0	52	2.14E+00	9.97E-02
	River Mile 150.4	52	2.51E+00	1.13E-01
	River Mile 160.0	52	2.08E+00	1.04E-01
Gross alpha	River Mile 118.8	52	3.52E-01	7.22E-02
	River Mile 141.5	52	3.36E-01	4.99E-02
	River Mile 150.0	52	3.59E-01	6.50E-02
	River Mile 150.4	52	5.59E-01	7.64E-02
	River Mile 160.0	52	1.47E-01	5.19E-02

Source. **Mamatey 2004**

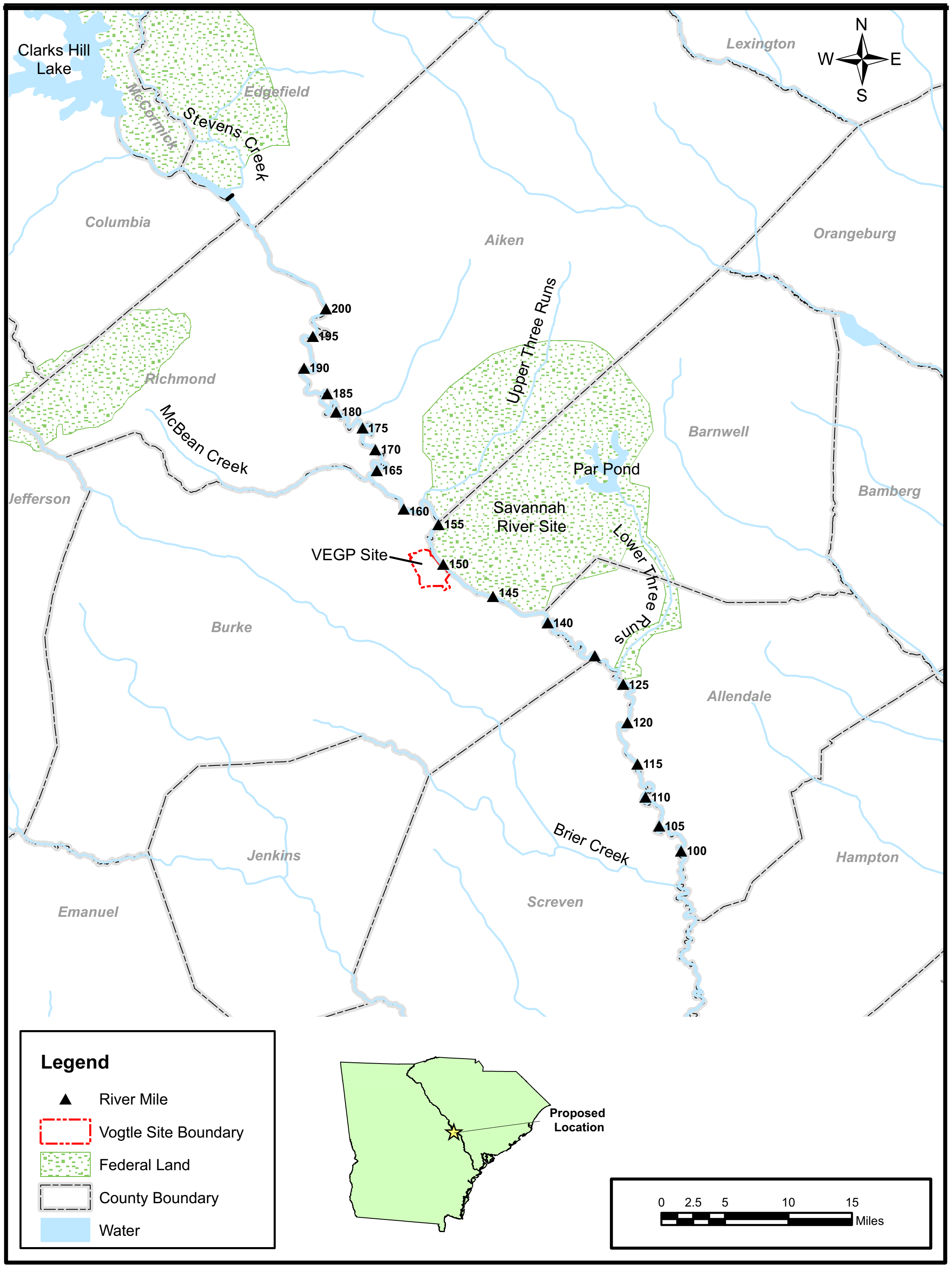

Figure 2.3.3-1 Middle Savannah River

Section 2.3.3 References

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and Autumn surveys of the transmission lines **(TRC 2006)**, SNC recognizes that the possibility of other special-status plants or animals along the transmission lines can never be totally ruled out. This is true especially for animals, some of which are mobile, secretive, and rarely observed even when present.

As discussed in Sections 3.7.2, the specific route of the proposed new transmission line has not been determined, but likely will cross Burke, Jefferson, Warren, and McDuffie counties. Special-status species in these four counties are listed in Table 2.4-2. Land use in the same four counties is presented in Table 2.2-2.

Transmission line corridors are maintained in accordance with established procedures to prevent woody growth from reaching the transmission lines. The removal of woody species can provide outstanding grassland and marsh habitat for many rare plant species dependent on open conditions.

GPC currently participates in a wildlife management program with the Georgia DNR on transmission line corridors. The "Wildlife Incentives for Non-Game and Game Species" (WINGS) program is designed to help land users convert GPC transmission corridors into productive habitat for wildlife. WINGS offers grant money and land management expertise to landowners, hunting clubs, and conservation organizations who commit to participating in the program for 3 years.

2.4.2 Aquatic Ecology

2.4.2.1 Onsite Waterbodies

Two small streams traverse the VEGP site. A small, unnamed stream drains Mallard Pond (see Figure 2.1-1) and flows into the Savannah River swamp upstream of the proposed river intake structure. Little is known about the aquatic biota of this stream, which is quite small and probably supports limited communities of aquatic macroinvertebrates and fish. Beaverdam Creek, a larger stream, flows out of Telfair Pond (see Figure 2.1-3) and moves east to the Savannah River approximately two miles downstream of the existing river intake structure. GPC conducted studies of fish **(Wiltz 1982)** and benthic macroinvertebrates **(Staats 1983)** in Beaverdam Creek in the 1970s to determine if construction of Units 1 and 2 had any effect on the stream's aquatic communities.

GPC biologists sampled fish in Beaverdam Creek over a two-year period (1977-1978) to evaluate potential effects of siltation and sedimentation on resident fish populations. A total of 2,435 fish representing 39 species were collected during the study. Collections were dominated by minnows, sunfish, and darters. Dusky shiners (*Notropis cummingsae*), bluegill (*Lepomis macrochirus*), mosquitofish (*Gambusia affinis*), and blackbanded darter (*Percina nigrofasciata*) were the species most often collected **(Wiltz 1982)**. Collectively, these four species made up 68 percent of all fish collected during the study. To reduce turbidity in Beaverdam Creek from transmission line construction and logging (on adjacent private property), GPC planted grass in eroding areas and installed erosion control devices (silt fences, hay bales). As a result, turbidity was reduced and fish habitat enhanced. Beaverdam Creek supported a diverse fish community before and after these erosion control measures were implemented.

GPC conducted a study over the 1973-1978 period to determine if construction of VEGP and access roads affected abundance and/or diversity of benthic macroinvertebrates in Beaverdam Creek. The study demonstrated that number and diversity of benthic macroinvertebrates in stream segments down-gradient from construction areas were not significantly different from upstream segments. Construction of an access road did reduce number and diversity of benthic organisms, but the benthic community recovered quickly when construction ceased and disturbed areas adjacent to the roadbed were revegetated. The study also demonstrated that Beaverdam Creek supported a surprisingly diverse benthic community, including numerous representatives of taxa (Ephemeroptera, Trichoptera, Plecoptera) that are typically associated with good water quality.

Several detention ponds built on the southern part of the property during construction of the first units have become permanent ponds (Figure 2.1-1). The biota in these ponds and in various small drainages on the property has not been sampled.

2.4.2.2 Savannah River

2.4.2.2.1 Plankton and Benthic Macroinvertebrates

The Academy of Natural Sciences of Philadelphia has monitored the aquatic communities of the middle Savannah River up- and downstream of the SRS (and coincidentally, the VEGP site) since 1951 **(Academy of Natural Sciences 2005)**. These studies, intended to assess impacts of contaminants and thermal discharges from SRS nuclear and industrial facilities, are a valuable source of information on the ecological health of the middle reaches of the Savannah River. These monitoring studies identify long-term trends in aquatic communities that might be confounded or obscured by normal year-to-year variability or by even longer-term occurrences, such as droughts, that can produce substantial change in aquatic communities.

The Academy of Natural Sciences' monitoring includes basic water chemistry and surveys of attached algae, aquatic macrophytes (aquatic vascular plants), aquatic macroinvertebrates, and fish. The study design includes four sampling stations: three exposed to SRS influence, and an unexposed reference station upstream. Multiple exposed stations are employed because of the complex pattern of SRS inputs along the river. Potential impacts are assessed by determining whether differences exist between the exposed and reference stations which are either greater or of a different character than would be expected if they were due merely to natural differences among sampling sites. **(Academy of Natural Sciences 2005)**

Diatoms have generally been the most abundant algal group, with two pollution-tolerant species (*Melosira varians* and *Gomphonema parvulum*) dominating collections **(Halverson et al. 1997)**.

The dominant algae are species characteristic of moderate- to high-nutrient levels and typical of southeastern coastal plain rivers. Algae at sites downstream of SRS influence and upstream of SRS influence both showed evidence of organic pollution, apparently from an upstream (Augusta area) source. **(Halverson et al. 1997)**

Aquatic insect density and diversity are important indicators of water quality. The Academy of Natural Sciences' monitoring of aquatic insects in the Savannah River up- and downstream of SRS (and VEGP) shows a generally increasing abundance of aquatic insects after the mid-1980s **(Halverson et al. 1997)** and increased taxa richness **(Academy of Natural Sciences 2005)**. In 1995, a year in which between-station differences were analyzed, measures of biotic diversity were higher for downstream stations than an upstream (of SRS and VEGP) control station; conversely, measures of pollution tolerance were higher for an upstream station than downstream stations **(Halverson et al. 1997)**. These studies showed that water quality downstream of SRS and VEGP was better than water quality upstream, in the vicinity of the cities of Augusta and North Augusta.

The 2000 ANS survey **(Arnett 2001)** summarizes changes in the mussel community of the middle Savannah River over the period from 1951-2000 as follows: a generally decreasing abundance and diversity of native species, an increasing dominance of "hardier forms," and an increasing scarcity of juveniles of some species. These changes were attributed to increased competition over the last several decades with the non-native Asiatic clam and changes in the flow characteristics of the Savannah River associated with "the construction of dikes, upriver dams, and removal of meanders…" Mollusks have been collected at five locations: one upstream of VEGP, one immediately downstream of VEGP, and three further downstream of VEGP. ANS scientists collected 16 mussel species between 1951 and 2000, none of which were state or federally listed. Mollusks found in the vicinity of VEGP include fingernail clams, peaclams, the Asiatic clam (*Corbicula fluminea*), and native mussels **(Arnett 2001)**.

2.4.2.2.2 Ichthyofauna of the Middle Savannah River

Information on the fishes of the middle Savannah River can be found in hundreds of publications. Three documents are particularly comprehensive and informative: *The Fishes of the Savannah River Plant* **(Bennett and McFarlane 1983)**, the eight-volume Comprehensive Cooling Water Study prepared by Du Pont (1987), *Fishes of the Middle Savannah River Basin* **(Marcy et al. 2005),** and the *Savannah River Biological Surveys for Westinghouse Savannah River Company* **(Arnett 2001)**.

The fishes of the Middle Savannah River include three groups: resident freshwater species, which are found in the area year-round, diadromous species, which are present during seasonal migrations, and marine/estuarine species, which are sometimes found in the middle Savannah River well upstream of the saltwater-freshwater interface. Resident fishes include a variety of minnows (family Cyprinidae), suckers (family Catastomidae), catfish (family Ictaluridae), sunfish (family Centrarchidae), and perch (family Percidae). Diadromous species include eels (family Anguillidae), shad and river herring (family Clupeidae), and striped bass (family Moronidae). Marine/estuarine species that are sometimes collected in the vicinity of VEGP include striped mullet, needlefish, and hogchoker. Relatively small numbers of these marine "strays" are collected, and they are of little commercial or recreational importance. As a consequence, they will not be discussed further in this environmental report.

Resident Fish of the Middle Savannah River

The Savannah River and mouths of creeks draining into the Savannah River were sampled intensively during the period 1983-1985 by the SRS as part of the Comprehensive Cooling Water Study. In a 1983-1984 study of seasonal patterns of distribution and abundance, fish were collected in November, January, June, and August using electrofishing gear and hoop nets. Electrofishing collections were dominated by centrarchids, which made up almost 50 percent of all fish collected. Redbreast sunfish (*Lepomis auritus*), bluegill, and largemouth bass (*Micropterus salmoides*) appeared most frequently in electrofishing collections, representing 16.7, 14.1, and 8.9 percent, respectively of fish collected. They were followed by spotted sucker (*Mingtrema melanops*; 8.5 percent), spotted sunfish (*L. punctatus*; 7.9 percent), chain pickerel (*Esox niger*; 5 percent), and bowfin (*Amia calva*; 5 percent). Hoop net collections were numerically dominated by flat bullhead (*Ameiurus platycephalus*; 29.2 percent), channel catfish (*Ictalurus punctatus*; 21 percent), redbreast sunfish (9.7 percent), and white catfish (*A. catus*; 9 percent). **(DuPont 1987)**

These species are all commonly found in large southeastern Coastal Plain river systems in habitats ranging from sloughs and backwaters to oxbow lakes to small tributary streams to small impoundments on these tributary streams **(Lee et al. 1980; Manooch 1984)**. As such, they are considered habitat generalists that can avail themselves of a range of habitats. Research has shown that fish species with very specific habitat requirements (for spawning, for example) are more likely to go extinct than those with more general habitat requirements **(Angermeier 1995)**. It follows that these generalists are more likely to thrive in large river systems that are subject to periodic droughts and floods.

The 1983-1984 SRS study included separate surveys of "small fish." These surveys were intended to develop relative abundance estimates of small, schooling species that serve as forage for a variety of top-of-the-food-chain predators, including such recreationally important species as largemouth bass, black crappie (*Pomoxis nigromaculatus*), striped bass (*Morone saxatilis*), white bass (*Morone chrysops*) and hybrid bass (*M. saxatilis* X *M. chrysops*). Shiners (genus *Notropis*) made up 89 percent of all fish collected in the small fish surveys **(Du Pont 1987)**. Brook silversides (*Labidesthes sicculus*), lined topminnow (*Fundulus lineolatus*), golden shiner (*Notemigonus crysoleucas*), and mosquitofish (*Gambusia* spp.) also appeared regularly in the small fish surveys. All of these species are common residents of swamps, bayous, and streams in the southeastern U.S. The 1983-1984 study did not distinguish between the various species of *Notropis* collected. A follow-up survey of small, minnow-like fish in the Savannah

River and its tributaries found that three Notropids made up more than two-thirds of minnows collected: coastal shiner (*Notropis petersoni*; 39.6 percent), dusky shiner (*N. cummingsae*; 17.4 percent), and spottail shiner (*N. hudsonius*; 10.4 percent). **(Du Pont 1987)**

With regard to distribution and abundance of fishes in the vicinity of VEGP, the series of reports prepared by the Academy of Natural Sciences of Philadelphia (ANS) provides the most extensive and comprehensive data source known to exist. The ANS study was initiated in 1951 and continues through to present, representing the "longest comprehensive study of a large river in the United States" **(Arnett 2001)**. The study encompasses the Savannah River from river mile 160 to river mile 123 (Vogtle is at river mile 150.5) and is designed to look for special patterns of biological disturbance and temporal patterns of change in the Savannah River adjacent to SRS including basic water chemistry, diatoms/periphyton, protazoa, aquatic insects, macro-invertebrates and fish. Two of the ANS study sample locations are close to VEGP. Station 2A lies just upstream of VEGP at River Mile 151.2 and station 2B lies just downstream at River Mile 149.8. Results from instream electroshocking conducted by boat during the 2000 study showed the same species and species groups dominating the Savannah River fish community as were seen in the 1983-1985 study: spottail shiner (*Notropis hudsonius;* 34.59 percent), bannerfin shiner (*Cyprinella leedsi*; 22.08 percent), bluegill (*Lepomis macrochirus*; 14.24 percent), whitefin shiner (*Cyprinella nivea*; 7.14 percent), brook silverside (*Labidesthes sicculus*; 4.92 percent), and redbreast sunfish (*Lepomis auritus*; 4.57 percent). Other commonly collected species included coastal shiner, largemouth bass, spotted sucker, redear sunfish and rosyface chub **(Arnett 2001).**

Diadromous Fish of the Middle Savannah River

<u>Sturgeons (Acipenseridae)</u>

The shortnose sturgeon (*Acipinser brevirostrum*) is an anadromous fish that spawns in large Atlantic coastal rivers from New Brunswick, Canada, to north Florida **(Scott and Crossman 1973)**. A species of commercial importance around the turn of the century, the shortnose sturgeon is now listed by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service as an endangered species. The decline of the species has been attributed to the impoundment of rivers, water pollution, and overfishing; recruitment rates appear to be too low to replenish depleted populations.

Shortnose sturgeon grow slowly, reach sexual maturity late in life, and live as long as 30 years. Fish from southern populations can grow faster and mature earlier than those from northern populations. Spawning occurs in or adjacent to <u>deep areas of rivers</u> with significant currents during each spring when water temperatures warm to 9°-12°C degrees (48°-54°F) **(Jenkins and Burkhead 1994)**. This can happen as early as February in Georgia and South Carolina. Adults apparently return to natal streams to spawn at 2 to 5 year intervals. Eggs are demersal and adhesive after fertilization, sinking quickly and adhering to sticks, stones, and gravel on the river bottom. The interaction of water temperature, current velocity, and substrate type determines suitability of spawning habitat and hatching success. Few sturgeon larvae or juveniles have ever been collected, so little is known of their distribution and movement. Substrate in the vicinity of VEGP was characterized as "shifting sands" based on sampling conducted originally in 1972 and subsequently confirmed in 2006 **(GPC 1972, Southern Company 2006)**.

Before 1982, shortnose sturgeon were not known to occur in the middle reaches of the Savannah River. From 1982 through 1985, intensive sampling of the ichthyoplankton in the mid-reaches of the Savannah River was conducted. During the 1982 – 1985 studies, 12 shortnose sturgeon larvae were collected from the Savannah River near SRS **(Paller et al. 1984, Paller et al. 1985, and Paller et al. 1986)**. Westinghouse Savannah River Company conducted a biological assessment to evaluate the potential impacts of SRS operations on shortnose sturgeon and concluded that "existing and proposed operations [specifically L-Reactor] of the Savannah River Plant will not affect the continued existence of the shortnose sturgeon in the Savannah River" **(Muska and Matthews, 1983)**. This conclusion was based on the fact that (1) shortnose sturgeon spawned in the Savannah River up- and downriver of SRS, (2) passage up- and downstream was not blocked by thermal effluents, (3) entrainment was unlikely because shortnose sturgeon eggs are demersal, adhesive, and negatively buoyant, and (4) impingement of healthy juvenile and adult sturgeon on cooling water system screening devices is highly unlikely given their strong swimming ability. NMFS concurred with the DOE determination that SRS operations did not threaten the Savannah River population of shortnose sturgeon **(Du Pont 1987)**.

A South Carolina Wildlife and Marine Resources Division (now South Carolina Department of Natural Resources) study of seasonal movement and spawning habitat preferences of Savannah River shortnose sturgeon found two probable spawning sites, one upstream of VEGP at River Miles 171-173 and the other downstream of VEGP at River Miles 111-118 **(Hall, Smith and Lamprecht 1991)**. A companion radiotelemetry study indicated that spawning occurred between River Miles 111 and River Mile 142 at water temperatures of 9.8°- 16.5°C (50°- 62°F) **(Collins and Smith 1993)**. Plant Vogtle borders the Savannah River from approximately River Mile 150 to River Mile 151.7.

From 1984-1992, more than 97,000 shortnose sturgeon were stocked in the Savannah River as part of a state and federal recovery program **(Smith et al. 2001)**. Recaptures of marked fish after an average time of 7.2 years indicated that fish stocked as juveniles made up at least 38.7 percent of the adult population. Some of the stocked sturgeons did not imprint on the Savannah River and were later found in the Edisto River (SC), the Ogeechee River (GA), the Cooper River (SC), and Winyah Bay (SC).

Population estimates and catch-per-unit-effort data from 1997-2000 suggested that the adult population was larger in 2000 than 1990, but juveniles were still rare. This suggests that a recruitment bottleneck exists during early life stages. Water quality degradation in the nursery habitat is believed to be at least partially responsible for the poor recruitment in the Savannah River. **(Smith et al. 2001)**

A related species, the Atlantic sturgeon (*A. oxyrhynchus*), is also found from Canada (Labrador) to north Florida. Like the shortnose sturgeon, the Atlantic sturgeon is anadromous, ascending coastal rivers to spawn as early as February – March in Florida and as late as July in Canada **(Jenkins and Burkhead 1994)**. There is evidence, however, for fall spawning migrations in some South Carolina rivers **(Collins et al. 2000)**. There are also indications that Atlantic sturgeon in southeastern rivers, including the Savannah, spawn further downstream than shortnose sturgeon in the same rivers, but still "well above" the salt wedge.

Shad and River Herring (Clupeidae)

Three clupeids ascend the Savannah River to spawn in its middle reaches: the American shad (*Alosa sapidissima*), the hickory shad (*A. mediocris*), and the blueback herring (*A. aestivalis*). Two other clupeids, gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*), are also found in the Savannah River, but do not move between the Savannah River and the open ocean, and thus are not anadromous in the strictest sense. Gizzard shad are found in brackish water, and have been referred to as a "semi-anadromous" species.

The American shad is the most important clupeid in terms of the commercial and recreational fishing opportunities it provides. American shad once provided an important commercial fishery in the lower Savannah River, but a decline in the population in the 1980s and 1990s reduced the number of commercial fishermen pursuing shad. This is illustrated by NMFS and Georgia DNR data on commercial landings in Georgia. From 1970 to 1975, commercial fishermen in Georgia landed from 161,700 pounds to 531,500 pounds of American shad annually **(NMFS 2006)**. Over a recent five year period (1999-2004), however, landings ranged from 27,699 in 2002 to 58,081 pounds in 2000 **(GDNR 2005)**. The total value of American shad landed over the 1999-2004 period ranged from $22,682 in 2002 to $45,496 in 1999. Most, if not all, commercial shad fishermen have other full-time jobs and fish for extra money on days off or weekends during the spring run.

Clemson University researchers estimated the population size of American shad that reached the New Savannah River Bluff Lock and Dam to be 157,685 fish in 2001 and 217,077 in 2002. This suggests that substantial numbers of spawning American shad pass VEGP during their annual spawning run: New Savannah River Bluff Lock and Dam are at River Mile 187, approximately 35 river miles upstream of VEGP. **(Bailey, Isely, and Bridges 2004)**

Hickory shad are smaller and less numerous than American shad. They support a modest commercial and recreational fishery. Blueback herring are smaller still, but are netted by commercial operators who sell them for live bait. Blueback herring are the bait of choice for anglers who pursue striped and hybrid bass in Clarks Hill, Russell, and Hartwell reservoirs.

Striped bass

The striped bass is an anadromous species, but in the Savannah River the degree of anadromy is greatly reduced. Unlike striped bass in the northeast and middle Atlantic, which spend their adult lives in the Atlantic Ocean and ascend coastal rivers to spawn, Savannah River striped bass tend to spawn in the lower, tidally-influenced part of the river and move upstream to non-tidal portions of the river after spawning. Fish fitted with radio transmitters have traveled as far upstream as the New Savannah Bluff Lock and Dam (River Mile 187) after spawning. Dudley et al. (1977) theorized that "excessively warm coastal waters" in summer at the mouth of the Savannah River may have led to the development of this behavioral pattern in Savannah River striped bass; water temperatures along the Georgia coast may reach 86°F, exceeding those tolerated by striped bass. **(Dudley, Mullis and Terrell 1977)**

During the 1980s, Savannah River striped bass suffered a precipitous population decline. From 1980 to 1988, catch-per-unit-effort of large striped bass in the lower Savannah River declined by more than 90 percent **(Reinert et al. 2005)**. Not surprisingly, the decline in large adult striped bass was accompanied by a steep decline in egg production. The population decline was attributed to operation of a tide gate, installed in the lower estuary by the U.S. Army Corps of Engineers in 1977. The tide gate, which was intended to prevent sediment from accumulating in the harbor, had the unintended effect of increasing salinity upstream in important striped bass spawning areas and speeding the transport of eggs and larvae from upstream spawning sites to the harbor, where they encountered high salinities and industrial pollutants.

Because of the population decline, the states of Georgia and South Carolina declared moratoriums on the harvest of striped bass (from the mouth of the Savannah River to New Savannah Bluff Lock and Dam) in 1988 and 1990, respectively **(Reinert et al. 2005)**. In response to concerns about the impact of the tide gate on anadromous fisheries, the Corps of Engineers discontinued operation of the tide gate in 1991. A long-standing program of stocking striped bass in the estuary was modified in the early 1990s. Based on research findings, Georgia DNR began stocking larger fish further up-river and improved its transportation and handling methods to reduce stress responses in stocked fish. From 1990 to 2002, 1.6 million striped bass of various sizes and ages were stocked in the Savannah River. Electrofishing surveys were instituted in order to measure the effectiveness of the stocking programs.

Catch-per-unit-effort of adult striped bass in the Savannah River increased sharply in the 1990s in response to the stocking programs **(Reinert et al. 2005)**. The importance of the stocking program was demonstrated by the fact that more than 70 percent of striped bass collected were hatchery-bred fish. The success of the stocking program (and a preponderance of 2-and 3-year old fish) led Georgia DNR to suspend Savannah River stocking in 2003 and 2004.

Egg production has been slower to recover. Egg densities in 2000 were approximately 10 percent of densities recorded in the late 1970s **(Reinert et al. 2005)**. However, with the return of suitable spawning conditions and the increased abundance of large spawning females in the estuary, egg production is expected to increase as well.

Based on fishing reports, striped bass numbers up and downstream of VEGP have increased in response to downstream habitat restoration efforts and stocking programs, and a popular catch and release fishery has developed **(Babb 1999, 2005)**. In its 2005 "Fishing Prospects" newsletter, Georgia DNR notes that "the number of striped bass in the river has increased substantially in recent years. However, it is important for anglers to realize that most of the stripers they catch were stocked and the number of naturally-reproducing striped bass remains low" **(GDNR 2005)**. South Carolina DNR announced in July 2005 that Savannah River striped bass restoration efforts had been so successful that the harvest moratorium on Savannah River striped bass, in place since 1991, would end on October 1, 2005 **(Creel 2005)**. Although the population is currently dominated by hatchery-bred fish, the striped bass population of the Savannah River is obviously expanding and, if current trends continue, should return to levels seen in the 1960s and 1970s. Striped bass populations in river systems up and down the Atlantic coast have largely rebounded as a result of commercial and recreational harvest restrictions that followed enactment of the Atlantic Striped Bass Conservation Act (16 U.S.C. § 1851) in 1984.

American eel (Anguilla rostrata)

The American eel occurs in rivers and streams along the east coast of the U.S. from Maine to Florida. The American eel is catadromous, growing to sexual maturity in freshwater and migrating hundreds of miles into the Atlantic Ocean (the Sargasso Sea) to spawn. Adults do not return to freshwater after spawning. Eggs spawned in the Sargasso Sea drift westward and northward with ocean currents and develop into larvae, then nektonic glass eels, which swim west across the Continental Shelf and enter east coast estuaries, where they darken and become elvers (at about 65 mm in length). At about 100 mm, elvers become fully-pigmented juvenile (yellow) eels. Males, which tend to remain in estuarine areas, grow rapidly and mature into adults at age 3 to 10 years **(Jenkins and Burkhead 1994)**. Females tend to move inland, into tidal freshwater rivers and upriver tributaries, where they mature into adults at age 4 to 18 years.

American eel numbers along the Atlantic coast were relatively stable through the 1970s. Fisheries managers and commercial fishermen noticed a decline in numbers of eels ascending coastal streams in the 1980s and 1990s **(Haro et al. 2000)**. Responding to concerns of state and federal agency biologists, the Atlantic States Marine Fisheries Commission in April 2000, issued an Interstate Fishery Plan for American Eel that summarized and synthesized information on the population decline and proposed a range of measures that will ensure the species' recovery and continued viability.

The USFWS, on July 6, 2005 announced in a 90-day Finding that it was initiating a status review to determine if listing the American eel as a protected species was warranted. The Federal Register (FR) notice listed an array of threats to the species (e.g., commercial harvest, habitat loss and degradation, changes in oceanic conditions) and concluded that "…we find that the petition presents substantial scientific and commercial information indicating that listing the American eel may be warranted." In the discussion of population status, the FR pointed out that population declines have been most dramatic in Canada and New England and populations may be stable in the southeastern U.S. In 2007 the USFWS completed the status review and determined that listing the American eel as either a threatened or endangered species is not warranted (FR Vol 72, No. 22, February 2, 2007).

American eels in the Middle Savannah River Basin are fully pigmented juveniles (yellow eels) and are mostly females **(Marcy et al. 2005)**. McCord (2004) observed high densities of yellow eels in the Middle Savannah River in relatively shallow, non-navigable reaches offering pool-riffle habitats with rocks and submerged aquatic vegetation. In the vicinity of VEGP, eels are found in the Savannah River mainstem, in the Savannah River swamp, in tributary streams, and in small impoundments on these tributaries **(Marcy et al. 2005)**. There is scant information on current population trends in South Carolina and Georgia, but commercial landings of eels in Georgia declined more than 80 percent from 1983 to 1995 **(ASMFC 2000)**. Resource agency biologists in South Carolina and Georgia do not monitor eel population trends in the Savannah River, but anecdotal information suggests that eel numbers are lower now than in the 1970s and 1980s.

2.4.2.3 Sensitive Species

Sensitive Aquatic Populations

As discussed previously in this section, the Academy of Natural Sciences of Philadelphia has monitored the freshwater mussels of the middle Savannah River since 1951 as part of a larger monitoring program designed to assess potential impacts of the SRS on the general health of the river. Mussels are collected annually at five locations, one upstream of VEGP, one immediately downstream of the VEGP, and three further downstream of VEGP. Academy scientists collected 16 mussel species between 1951 and 2000, none of which was state- or federally listed **(Arnett 2001)**.

The only federally-listed fish species known to occur in the Savannah River in the vicinity of VEGP is the endangered shortnose sturgeon (*Acipenser brevirostrum*). This anadromous species, first documented in the middle Savannah River in the early 1980s by SRS researchers, is known to spawn up and downstream of VEGP **(DOE 1997)**. A related species, the Atlantic sturgeon (*Acipenser oxyrinchus*), which has been designated a Species of Concern by the NMFS **(NMFS 2004)**, also ascends the Savannah River to spawn in fresh water but little is known about its spawning habits in the Savannah River. The Atlantic sturgeon was considered for listing under the Endangered Species Act in 1998, but the NMFS ultimately determined that listing was not warranted.

The robust redhorse (*Moxostoma robustum*), a species thought to be extinct, was rediscovered by Georgia DNR biologists in 1991 in the Oconee River, near Toomsboro, Georgia **(USFWS 1998)**. Since 1991, remnant populations have also been found in portions of the Pee Dee River (NC-SC), the Savannah River (SC-GA), and Ocmulgee River (GA) **(RRCC 2003)**. This large sucker (up to 30 inches long and 17 pounds) has large molar-like pharyngeal teeth that its uses to crush and eat bivalves, both native mussels and non-native Asiatic clams (*Corbicula* sp.).

Once common in Atlantic slope river systems from the Pee Dee to the Altamaha, the species' range has been severely reduced by dams, which blocked its movement, and by streamside erosion, which led to siltation of feeding and spawning areas. The robust redhorse has no federal status, but has been designated an endangered species by the State of Georgia. The decline of the species has been attributed to habitat loss (dams and impoundments on native streams) and habitat degradation (pollution, siltation from agricultural and silvicultural activity in watersheds). The non-native flathead catfish, introduced to many southeastern streams by fishermen, may also have contributed to the robust redhorse's decline as this large, aggressive catfish feeds on native catastomids and competes with them for food (crayfish and clams).

The robust redhorse was first documented in the middle Savannah River in 1997, when a single adult was collected near VEGP **(RRCC 1998; Barrett 2000)**. Since that time, robust redhorse have been found at several locations between the Augusta Shoals area and U.S. Highway 301, which is approximately 30 miles down-river from VEGP **(Barrett 2000; Hendricks 2002)**. Spawning has been documented in both the Augusta Shoals and New Savannah Bluff Lock and Dam areas **(Freeman and Freeman 2001; Hendricks 2002)**. The Robust Redhorse Conservation Committee, a multi-agency group, has worked on the recovery of the species since 1995, rearing young redhorse at hatcheries and stocking them in streams in Georgia and the Carolinas. This group was instrumental in stocking fingerling robust redhorse in the Broad River, a major tributary of the Savannah River that empties into Clarks Hill Reservoir. Fish from these stockings have been found as juveniles in both the Broad River and Clarks Hill Reservoir.

The bluebarred pygmy sunfish (*Elassoma okatie*), is a rare species of fish that, until recently, was found only in the Edisto River, New River and eastern Savannah River drainages in South Carolina. During faunal surveys conducted in 1995 and 1996 by the Army Corps of Engineers, the species was found at a single location on the Fort Gordon army installation in Georgia. Subsequent studies performed at Fort Gordon in 1997 and 1998 using more selective equipment found bluebarred pygmy sunfish at four of the five principal streams at the installation **(USACE, 2007)**.

The bluebarred pygmy sunfish is a small fish rarely exceeding an inch in length. The female's base coloration is pinkish-brown with light beige vertical bars while males are blue-grey to black with iridescent blue vertical bars **(Sandel et al. 2006)**. The bluebarred pygmy sunfish is found in specific micro-habitats consisting of roadside ditches and backwaters of creek or rivers with brown stained (tannin) water and abundant vegetation including bladderwort, duckweed, alligatorweed, pondweed, spatterdock, rushes and grasses **(Marcy et al. 2005)**.

Georgia Power **(Wiltz 1982)** conducted surveys in the late 1970s of the resident fishes of Beaverdam Creek, a six-mile long stream that drains much of the area south and west of the Vogtle site. Daniels Branch, a tributary, was also sampled. Wiltz collected no pygmy sunfish (genus *Elassoma*) and no *Lepomis* or *Enneacanthus* species with which it could be easily confused. All sunfish captured were common species (e.g., redbreast, bluegill) or species not likely to be confused with the bluebarred pygmy sunfish. This suggests that few, if any, representatives of the genus *Elassoma* were in the Beaverdam Creek drainage in the late 1970s when the surveys were conducted. The blackwater streams of the SRS, across the river from Plant Vogtle, have been sampled since the early 1950s by Westinghouse and Savannah River Ecology Laboratory scientists, none of whom (based on Marcy et al. 2005) has ever captured a bluebarred pygmy sunfish. According to the distribution map in Marcy et al. **(2005)** a population of bluebarred pygmy sunfish has been found in a small stream in Allendale County, SC, south of the SRS.

Georgia Power has not conducted systematic surveys for the bluebarred pygmy sunfish on the Vogtle site for obvious reasons: it is an obscure species that was first described in 1987 and was only granted legal protection by the state of Georgia in late 2006. The Corps biologists who discovered the bluebarred pygmy sunfish at Fort Gordon used specialized sampling apparatus (floating Plexiglas light traps) normally associated with larval fish studies rather than surveys of adult fish.

In April, 2007 Georgia Power fisheries biologists performed a habitat assessment of Mallard Pond drainage in order to determine the presence or absence of those habitats commonly associated with populations of bluebarred pygmy sunfish. Survey results indicate that neither Mallard Pond nor the pond drainage contains the vegetation types and flow characteristics regarded as the preferred habitat type for the bluebarred pygmy sunfish. Based on the April survey results and the fact Wiltz **(1982)** collected no bluebarred pygmy sunfish in the Beaverdam Creek drainage, it appears unlikely that the species is present at the Vogtle site.

The only pygmy sunfish that has appeared, irregularly, in Savannah River fish samples collected by the ANS is *Elassoma zonatum*, the banded pygmy sunfish (see **Arnett 2001)**. Given that pygmy sunfishes (*Elassoma* spp.) are creatures of backwaters, bayous, oxbows, and swamps rather than river channels, it is unlikely that construction of new intake/discharge structures would not affect this group (or the bluebarred sunfish in particular). It is also unlikely that plant operations would affect this group or species.

Records of the USFWS, Georgia DNR, and South Carolina DNR were reviewed for information on sensitive aquatic species in counties crossed by VEGP transmission lines. The Altamaha spinymussel (*Elliptio spinosa*), a candidate for federal listing, occurs in the Altamaha River and its tributaries in the coastal plain of Georgia. It is found in two counties (Long and McIntosh) crossed by the Vogtle-Thalmann transmission line. This large mussel has experienced a substantial decline in number (of sites occupied) in recent years that has been attributed to habitat degradation and competition with the non-native Asiatic clam, *Corbicula fluminea* **(Georgia Museum undated; Wisniewski, Krakow and Albanese 2005)**. Unauthorized collection of specimens of *E. spinosa* is also thought to have contributed factor to the species' decline.

Table 2.4-1 Protected Species in Burke County or Counties Crossed by Existing Transmission Lines[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2] Georgia	South Carolina
Mammals				
Rafinesque’s big-eared bat	*Corynorhinus rafinesquii*	-	R	E
Northern right whale[3]	*Eubalaena glacialis*	E	E	-
Southeastern pocket gopher	*Geomys pinetis*	-	T	-
Humpback whale[3]	*Megaptera novaeangliae*	E	E	-
Manatee[3]	*Trichechus manatus*	E	E	E
Birds				
Bachman's sparrow	*Aimophila aestivalis*	-	R	-
Henslow’s sparrow	*Ammodramus henslowii*	-	R	-
Bald eagle[4]	*Haliaeetus leucocephalus*	T	T	E
Piping plover	*Charadrius melodus*	T	T	-
Wilson's plover	*Charadrius wilsonia*	-	T	T
Kirtland’s warbler	*Dendroica kirtlandii*	E	E	-
Southeastern American kestrel	*Falco sparverius paulus*	-	R	-
American oystercatcher	*Haematopus palliatus*	-	R	-
Wood stork[4,5]	*Mycteria americana*	E	E	E
Red-cockaded woodpecker[4]	*Picoides borealis*	E	E	E
Swallow-tailed kite	*Elanoides forficatus*	-	R	E
Black skimmer	*Rynchops niger*	-	R	-
Least tern	*Sterna antillarum*	-	R	T
Gull-billed tern	*Sterna nilotica*	-	T	-
Bachman's warbler	*Vermivora bachmanii*	E	-	-
Reptiles				
Loggerhead sea turtle	*Caretta caretta*	T	T	T
Green sea turtle	*Chelonia mydas*	T	T	-
Spotted turtle[4,5]	*Clemmys guttata*	-	U	T
Leatherback sea turtle	*Dermochelys coriacea*	E	E	-
Hawksbill sea turtle	*Eretmochelys imbricata*	E	E	-
American alligator[6,7]	*Alligator mississippiensis*	T(S/A)	-	-
Eastern indigo snake	*Drymarchon corais couperi*	T	T	-
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	E	-
Gopher tortoise[4,5]	*Gopherus polyphemus*	-	T	E
Southern hognose snake[4]	*Heterodon simus*	-	T	-
Mimic glass lizard	*Ophisaurus mimicus*	-	R	-
Amphibians				
Gopher frog[4]	*Rana capito*	-	R	E
Striped newt	*Notophthalmus perstriatus*	-	T	-
Flatwoods salamander[4]	*Ambystoma cingulatum*	T	T	E
Fish				
Shortnose sturgeon[4]	*Acipenser brevirostrum*	E	E	E
Altamaha shiner	*Cyprinella xaenura*	-	T	-
Bluebared pygmy sunfish	*Elassoma okatie*	-	E	-
Goldstripe darter	*Etheostoma parvipinne*	-	R	-
Bluefin killifish	*Lucania goodei*	-	R	-
Robust redhorse	*Moxostoma robustum*	-	E	-
Invertebrates				

Table 2.4-1 (cont.) Protected Species in Burke County or Counties Crossed by Existing Transmission Lines[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2] Georgia	State Status[2] South Carolina
Oconee burrowing crayfish	*Cambarus truncatus*	-	T	-
Say's spiketail	*Cordulegaster sayi*	-	T	-
Altamaha arcmussel	*Alasmidonta arcula*	-	T	-
Altamaha spinymussel	*Elliptio spinosa*	C	E	-
Atlantic pigtoe mussel[4]	*Fusconaia masoni*	-	E	-
Plants				
Pool sprite	*Amphianthus pusillus*	T	T	T
Georgia aster	*Aster georgianus* (=*Symphyotrichum georgianum*)	C	T	-
Sandhill vetch	*Astragulus michauxii*	-	T	-
Purple honeycomb head	*Balduina atropurpurea*	-	R	-
Velvet sedge	*Carex dasycarpa*	-	R	-
Sandhill rosemary[4]	*Ceratiola ericoides*	-	T	-
Atlantic white-cedar	*Chamaecyparis thyoides*	-	R	-
Floodplain tickseed	*Coreopsis integrifolia*	-	T	-
Harper's dodder	*Cuscuta harperi*	-	E	-
Pink ladyslipper	*Cypripedium acaule*	-	U	-
Radford's mint	*Dicerandra radfordiana*	-	E	-
Smooth coneflower	*Echinacea laevigata*	E	E	E
Georgia plume[4]	*Elliottia racemosa*	-	T	-
Green fly orchid	*Epidendrum conopseum*	-	U	-
Dwarf hatpins	*Eriocaulon koernickianum*	-	E	-
Florida wild privet	*Forestiera segregata*	-	R	-
Dwarf witch-alder	*Fothergilla gardenii*	-	T	-
Shoals spiderlily	*Hymenocallis coronaria*	-	T	-
Mat-forming quillwort	*Isoetes tegetiformans*	E	E	-
Corkwood	*Leitneria floridana*	-	T	-
Pondberry	*Lindera melissifolia*	E	E	E
Pondspice[5]	*Litsea aestivalis*	-	R	-
Pineland Barbara buttons	*Marshallia ramosa*	-	R	-
Trailing milkvine	*Matelea pubiflora*	-	R	-
Indian olive[4]	*Nestronia umbellula*	-	R	-
Canby's dropwort[4]	*Oxypolis canbyi*	E	E	E
Grit beardtongue	*Penstemon dissectus*	-	R	-
Crestless plume orchid	*Pteroglossaspis ecristata*	-	T	-
Harperella	*Ptilimnium nodosum*	E	E	E
Tiny-leaf (climbing) buckthorn	*Sageretia minutiflora*	-	T	-
Soapberry	*Sapindus marginatus*	-	R	-
Yellow flytrap	*Sarracenia flava*	-	U	-
Hooded pitcherplant[4,5]	*Sarracenia minor*	-	U	-
Parrot pitcherplant	*Sarracenia psittacina*	-	T	-
Sweet pitcherplant[4]	*Sarracenia rubra*	-	E	-
Bay star-vine[6]	*Schisandra glabra*	-	T	-
Chaffseed	*Schwalbea americana*	E	E	E
Ocmulgee skullcap[4]	*Scutellaria ocmulgee*	-	T	-
Swamp buckthorn	*Sideroxylon thornei*	-	R	-
Silky camellia[4]	*Stewartia malacodendron*	-	R	-

Table 2.4-1 (cont.) Protected Species in Burke County or Counties Crossed by Existing Transmission Lines[1]

			State Status[2]	
Common Name	**Scientific Name**	**Federal Status[2]**	**Georgia**	**South Carolina**
Pickering's morning-glory	*Stylisma pickeringii pickeringii*	-	T	-
Relict trillium	*Trillium reliquum*	E	E	E

1 Species has been recorded by **USFWS 2004** or **GDNR 2007** to occur in Georgia counties crossed by the transmission lines, or by **SCDNR 2006** to occur in Barnwell County, South Carolina. Shaded species were observed during 2005 survey.

2 E = Endangered, T = Threatened, C = Candidate for federal listing, T(S/A) = Threatened due to similarity of appearance, R = Rare (Georgia only), U = Unusual (Georgia only), - = not listed.

3 Included for completeness. Some VEGP transmission lines cross Georgia coastal counties that list these marine mammals as protected species.

4 Species has been recorded by **USFWS 2004** or **GDNR 2007** in Burke County, Georgia.

5 Species was observed along VEGP-associated transmission corridors during field surveys conducted in 2005.

6 Species was observed at VEGP site during field surveys conducted in 2005.

7 County occurrences for the American alligator are not maintained by **USFWS 2004**, **GDNR 2007**, or **SCDNR 2006**; this species is included in this table because it is known to occur at the VEGP site.

Table 2.4-2 Protected Species in Counties Likely to be Crossed by the New VEGP Transmission Corridor[1]

Common name	Scientific name	Federal status[2]	Georgia status[2]
Birds			
Bald eagle	*Haliaeetus leucocephalus*	T	T
Wood stork	*Mycteria americana*	E	E
Red-cockaded woodpecker	*Picoides borealis*	E	E
Reptiles			
Spotted turtle	*Clemmys guttata*	-	U
Gopher tortoise	*Gopherus polyphemus*	-	T
Southern hognose snake	*Heterodon simus*	-	T
Amphibians			
Flatwoods salamander	*Ambystoma cingulatum*	T	T
Gopher frog	*Rana capito*	-	R
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	E	E
Sandbar shiner	*Notropis scepticus*	-	R
Invertebrates			
Atlantic pigtoe mussel	*Fusconaia masoni*	-	E
Plants			
Georgia aster	*Aster georgianus* (=*Symphyotrichum georgianum)*	C	-
Sandhill rosemary	*Ceratiola ericoides*	-	T
Pink ladyslipper	*Cypripedium acaule*	-	U
Georgia plume	*Elliottia racemosa*	-	T
Carolina bogmint	*Macbridea caroliniana*	-	R
Indian olive	*Nestronia umbellula*	-	R
Canby's dropwort	*Oxypolis canbyi*	E	E
Grit beardtongue	*Penstemon dissectus*	-	R
Oglethorpe oak	*Quercus oglethorpensis*	-	T
Hooded pitcherplant	*Sarracenia minor*	-	U
Sweet pitcherplant	*Sarracenia rubra*	-	T
Ocmulgee skullcap	*Scutellaria ocmulgee*	-	T
Granite stonecrop	*Sedum pusillum*	-	T
Silky camellia	*Stewartia malacodendron*	-	R
Georgia aster	*Symphyotrichum georgianum*	C	T

1 Source of County Occurrence: **USFWS 2004**, **GDNR 2007**.
2 E = Endangered, T = Threatened, C = Candidate for federal listing, R = Rare, U = Unusual, - = not listed.

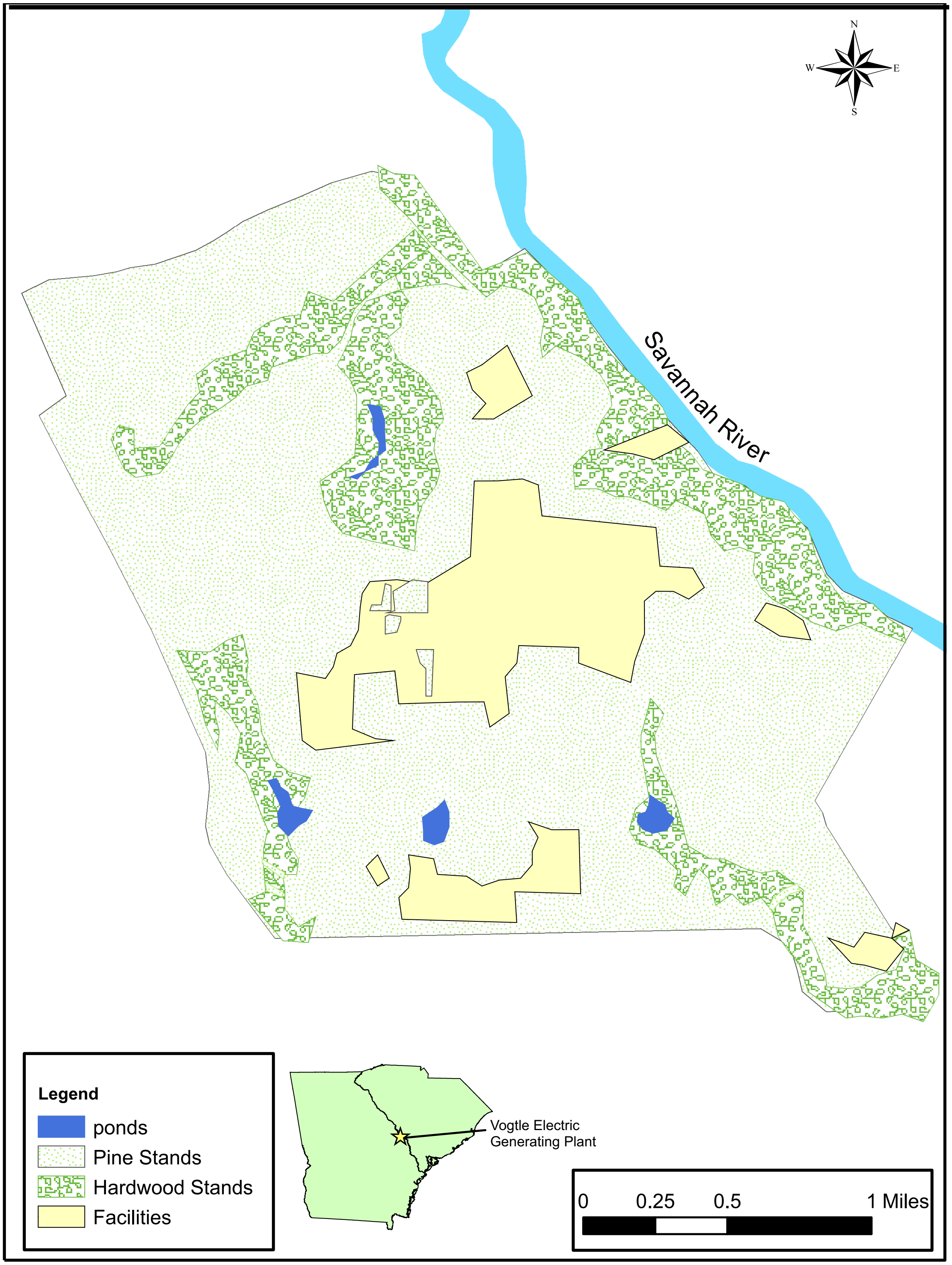

Figure 2.4-1 Vegetation Communities on the VEGP Site

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